COGNITIVE CORRELATES OF SLEEPINESS AND SLEEP DISRUPTION

IN EVERYDAY DOMESTIC SETTINGS

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CANDIDATE'S DECLARATION

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Alison Wadeley

20 September 2014

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...and for all those other mums out there:

'*People who say they sleep like a baby usually don't have one*.' (Leo J. Burke)

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ABSTRACT

Sleepiness and sleep disruption caused by cohabitees could have deleterious cognitive consequences in everyday life. Research in this area is scarce, thus cognitive correlates of varying degrees of sub-optimal sleep patterns in five groups of healthy adults in domestic settings were studied.

In the first study, healthy adults, living solely with healthy partners, self-reported sleep patterns, mood and cognitive failures. It was found that anxiety, but not sleepiness, predicted cognitive failures in sleepy people alone. In a spatial attention test of pseudoneglect (manual line bisection: LB), responses indicated sleepiness-induced changes in lateralisation of spatial attention and these were commensurate with sustained vigilance in the right hemisphere. A test of pseudoneglect in extra-personal space showed sleepiness-related improved accuracy, with no evidence of lateralisation changes, and a test of emotion perception in chimeric faces showed sleepiness-related lateralisation effects that interacted with emotional valence. Inherent sleepiness with no obvious cause was the most likely explanation for these findings.

In the second study, healthy partners of people with a chronic, and potentially sleep-disrupting, illness (Parkinson’s disease: PD) provided self-assessments of sleep patterns, mood and cognitive failures and completed a LB test. Cognitive failures were predicted by anxiety and sleepiness and LB showed similar sleepiness-related changes to those found in the first study. There was little evidence to link these effects with sleep disruption due to partners’ PD or to suggest that they were due to anything other than inherent sleepiness. Collateral findings in people with PD showed that depression predicted cognitive failures and LB performance changed according to side of symptom onset, with right onset appearing to preserve a waking pattern of spatial attention even with sleepiness present. It was proposed that this could be explained by a sleep-related, hemispheric disconnection that occurs in healthy and left-onset PD but not in right-onset PD.

In the third study, thematic analysis was used to explore mothers’ online discussions on *Mumsnet* about the perceived effects of sleep disruption due to their children. Superordinate themes concerning living with sleep disruption and its cognitive consequences were extracted and examined in the light of existing research. This analysis informed the design of the final study which focused on mothers of children under five years of age and comprised a survey assessing self-reported aspects of sleep and cognitive functioning and a neuropsychological test battery. In the survey, fatigue and sleepiness predicted attention and memory failures and executive functioning was predicted by fatigue and mood. In the tests, greater fatigue was associated with poorer performance as executive demand increased. Greater sleepiness was associated with poorer performance in the most demanding test. Sleepiness was also associated with clumsiness and changes in pseudoneglect.

It was concluded that, in healthy adults, sleepiness with no clearly discernible cause was associated with self-reported negative effects on everyday cognitive functioning and objectively measured spatial attention and emotion perception. Poorer cognitive functioning was evident in sleep-disrupted mothers in both self-assessments and neuropsychological tests. Sub-optimal sleep patterns in healthy adults were thus associated with changes in spatial attention and with poorer executive functioning.

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LIST OF ABBREVIATIONS

AD	Alzheimer's disease
ADDI, -gd, -sa, -pa	Anxiety Depression Distress Inventory, -general distress, -somatic anxiety, -positive affect
ARCES	Attention Related Cognitive Errors Scale
ANOVA	Analysis of variance
BADS	Behavioural Assessment of the Dysexecutive Syndrome
BAC	Blood alcohol concentration
CFQ	Cognitive Failures Questionnaire
COWAT	Controlled Oral Word Association Test
CPAP	Continuous positive airway pressure
CS	Contention scheduling
DEX	The Dysexecutive Questionnaire (Self-rating)
DEX-R	The Dysexecutive Questionnaire (Independent rater)
DLPFC	Dorso-lateral pre-frontal cortex
EDS	Excessive daytime sleepiness
EF	Executive functioning
EHI	Edinburgh Handedness Inventory
ESS	Epworth Sleepiness Scale
FAS	Fatigue Assessment Scale
fMRI	Functional magnetic resonance imaging
GABA	Gamma-amino butyric acid
HADS	Hospital Anxiety and Depression Scale
HAROLD	Hemispheric asymmetry reduction in older adults
HSNS	High sleepability with no other evidence of sleepiness
IMR	Internet-mediated research
LB	Line bisection
LMK	Landmark
LPD	Parkinson's disease - predominantly left symptoms
MFS	Memory Failures Scale
M	Mean
Mdn	Median
N or n	Number in sample or sub-sample
NA	Negative affect
NREM	Non rapid eye-movement
PA	Positive affect
PD	Parkinson's disease
PDSS	Parkinson's Disease Sleep Scale
PET	Positron emission tomography
PFC	Pre-frontal cortex
PH	Physiological hyper-arousal
PSD	Partial sleep deprivation
PND	Post-natal depression
PwPD	Person/people with Parkinson's disease
REM	Rapid eye movement
RPD	Parkinson's disease - predominantly right symptoms
SAS	Supervisory attention system
SD	Standard deviation
SLFII	Superior longitudinal fasciculus attention pathway II
SWS	Slow wave sleep
TA	Thematic analysis
TOH	Tower of Hanoi
TOL	Tower of London
TOT	Time on task
TSD	Total sleep deprivation
VLPO	Ventro-lateral preoptic nucleus
WAIS	Wechsler Adult Intelligence Scale
WCST	Wisconsin Card Sorting Test

Chapter 1

INTRODUCTION, RATIONALE AND OVERVIEW

1.1. Introduction

The vast and growing body of sleep research rarely addresses cognitive correlates of sub-optimal sleep in healthy people in everyday, domestic settings. More commonly, it focuses on the effects of systematic sleep deprivation (Walker, 2009), on atypical sleep patterns such as those involved in shift-work (Muecke, 2005), or on parasomnias (Pack and Pien, 2011). Inadequate sleep has been widely implicated in deficits in waking performance (Bonnet and Arand, 2003; Ferrara and De Gennaro, 2001), in road traffic accidents (Taylor and Dorn, 2006) and even in major disasters such as the nuclear accident at Chernobyl and the loss of the spaceship Challenger both in 1986 (Coren, 1997, 1998). Little, however, is known about the possible impact on cognition of sleepiness and sleep disruption that many people experience because of the people they live with rather than through any fault of their own.

The ultimate goal of this thesis is to focus on cognitive correlates of disturbed sleep in parents of young children. Sleep disruption in the post-partum period is extensive, especially for first-time mothers (Lee, 1998), and can affect parents for some considerable time thereafter (Crowe, Clark and Qualls, 1996; Kahn *et al.* 1989; Rona, Gulliford and Chinn, 1998; Sadler, 1994). In the longer term, fatigue may also present a challenge to parents (e.g. Gay, Lee and Lee, 2004; Giallo, Rose and Vittorino, 2011). Its impact is not well understood (Troy, 2003) but it does appear to be related to sleep disruption (Giallo, Rose, Cooklin and McCormack, 2013) and sleep quality (Wade, Giallo and Cooklin, 2012). Given the ubiquitous nature of sleep disruption in parents of babies and young children it is surprising that so little research has been conducted into its potential to affect cognition. Only two qualitative studies (Long and Johnson, 2001; Kurth, Kennedy, Spichiger, Hosli and Zemp Stutz, 2011) and one experimental study (Plessow, Kiesel, Petzold and Kirschbaum, 2011) have touched on this but most have concentrated on fatigue (e.g. Taylor and Johnson, 2012), on mental health (e.g. Giallo et al., 2013) or on the impact of parenthood on the quality of couples' relationships (e.g. Mannering et al., 2011).

The motivation to explore cognitive correlates of sleep disruption in parents arose from my personal experience of four years of sleep disruption due to my second-born child. Poor sleep, combined with responsibility for two young daughters and a busy working life, placed considerable demands on myself and my husband. We were both chronically sleep disrupted and fatigued and believed that our physical and mental health suffered as a result. We also noticed increased difficulties with memory, concentration, problem-solving, decision making, efficient functioning at work, motor co-ordination and driving.

Unlike parents in some of the research literature (e.g. Van Dongen, Maislin, Mullington and Dinges, 2003; Pilcher and Walters, 1997; Plessow et al., 2011) we did not believe we adapted to poor sleep, instead we adopted a number of coping mechanisms to help us survive a situation with no known duration. Indeed on many occasions at work we did not admit to feeling sleep-deprived and actively tried to conceal its effects. When our daughter started school, her sleep problems disappeared overnight and the consequent, dramatic improvement in our sleep quality quickly restored us to normal.

During our period of sleep disruption, we sought advice from our health visitor whose response was to direct us to a self-help book for parents about improving babies' sleep. Applying the advice therein led to some improvement in our daughter's sleep but not enough to allow us sufficient sleep. A few years later, I took the opportunity to discuss parental sleep disruption in a research meeting attended by 15 GPs and other health professionals. They said that parents frequently consulted them about coping with sleep-disruption but they were unsure about how to help them because the precise nature of its effects was unclear. Their responses tended to be aimed at the baby or child's sleep because they did not know how to support parents directly, unless they recognised a clinical condition such as post-natal depression. It appeared that, while health professionals do what they can to support parents, this is indirect and does not focus on parents themselves who may still struggle with the effects of sleep disruption even when their offspring are sleeping as well as could be expected for their age.

These experiences aroused my curiosity as a psychologist about the relationship between sleep disruption and the effects that we had perceived on our everyday functioning, and so I turned to the research literature for some explanations but found none. A number of researchers (e.g. Bonnet and Arand, 1995; Dement, 2000; Ferrara and De Gennaro, 2001; Horne, 2012; Rosekind, 2005) have concluded that current life-styles in the developed world lead us to voluntarily, or otherwise, curtail sleep but none of them lists parenting responsibilities amongst the causes. Sleep disruption in parents seems to be popularly regarded as an occupational hazard and its effects are assumed rather than empirically supported or are generally poorly understood (Middlemiss, 2004). It tends not to be taken seriously unless it is implicated in a parent becoming ill (Bayer, Hiscock, Hampton and Wake, 2007), yet sleepiness without illness has potentially serious, practical consequences, for example when driving (Stradling, Crosby and Payne, 1991; Shmuel, Shlomo, Natali, Ayala and Eliezer, 2003; Rogé, Pébayle, Kiehn and Muzet, 2002; Rogé, Pébayle, El Hannachi and Muzet (2003). My aim in this thesis, therefore, is to make a contribution to understanding some of the psychological correlates of sleepiness and sleep disruption in everyday domestic settings in which children are present compared to when they are not. My focus is on cognitive correlates of sleep disruption in particular as these are almost entirely absent from the research literature. In doing this, I aim to provide clarity for health professionals about the nature and extent of these cognitive correlates and thus help them to better understand the experiences of sleep disrupted parents and enable them to provide targeted support.

1.2. Defining measurable cognitive correlates of sleep disruption

When designing the studies reported in this thesis, I had to make decisions about which aspects of cognitive functioning would give meaningful indications of the effects of sleep disruption in everyday settings and how to measure them. I aimed to gather evidence about both subjectively reported on objectively measured cognitive functioning. While subjective measures are valuable, I believe that objective measures are less likely to be influenced by social desirability bias or participants' expectations. The use of both types of measure would also increase the validity of my findings through 'data triangulation' (Willig, 2008: 32). My decisions were also shaped by the practicalities of my proposed mixed methods research which included remote and face-to-face testing, postal and online surveys and laboratory-based testing. Testing equipment had to be portable and many of the scales and cognitive tests needed to be self-administered. Access to participants and responsible use of their time were further important considerations which influenced my choice of measures.

Research literature reported in the remainder of this introduction indicated that changes in lateralisation of spatial attention might be associated with sleepiness. Pseudoneglect and emotion perception were amongst the lateralised functions that had been used in others' research so I chose to test them as indicators of aspects of basic, attention-related cognitive functioning. The potential for sleep disruption also to affect executive functioning emerged from the qualitative study reported in chapter 4 so a battery of neuropsychological tests was compiled to broaden the scope of the objective measures for the studies reported in chapter 5. In the quantitative studies in this thesis, reported in chapters 2, 3 and 5, good-quality, self-report scales of aspects of everyday cognitive functioning were also used. Pseudoneglect and emotion perception are the main focus of this chapter, however, so research into these is discussed next. Research into the effects of sleep disruption on executive functioning is discussed in chapter 5.

1.3. Pseudoneglect: manifestations and explanations

In visual tasks, 'pseudoneglect' describes an attentional asymmetry in which the right hemisphere dominates, leading to enhanced perception of the left visual field (Bowers and Heilman, 1980; Jewell and McCourt, 2000). The research into leftward-biased asymmetries of visual spatial attention demonstrates its existence in a variety of ways. Leftward bias in manual line bisection (LB), a task presented in peri-personal space, is well-established (e.g. Jewell and McCourt, 2000; Sosa, Teder-Sälejärvi and McCourt, 2010). It is also demonstrable in perception of horizontal vertical line illusions (Josev, Forte and Nicholls, 2011), perception of faces (Borod, Koff, Lorch and Nicholas, 1988; Reuter-Lorenz and Davidson, 1981; Workman, Peters and Taylor, 2000), judgement of distance (Brian, Robinson and Elias, 2010) and judgement of brightness, numerosity and stimulus size (Nicholls, Bradshaw and Mattingley, 1999). Nicholls *et al.* (1999) however, suggested that, even though the tasks they themselves had used showed leftward preference, low correlations between them indicated different attentional processes for each one. This is echoed when different modalities are used, for example, Brodie and Dunn (2005) compared auditory and visual attentional asymmetries and found a leftward bias for visual stimuli and a rightward bias for auditory stimuli. The positive correlation between these however led them to suggest that lateralisation of attention can be modality specific yet share supra-modal mechanisms. Finally, some studies have correlated movement through space with pseudoneglect, for example, Nicholls, Loftus, Orr and Barre (2008) and Nicholls, Loftus, Meyer and Mattingley (2007) found that pseudoneglect, shown through greater leftward bias in manual line bisection (LB), correlated positively with the number of right-side collisions when walking through a doorway.

With regard to clinical hemianopsia (visual neglect) Corbetta and Shulman (2011: 583) say that 'Perhaps the most widely accepted, standard theory of neglect postulates that the right hemisphere controls shifts of attention to both sides of space while the left hemisphere only controls attention to the right side (Mesulam 1981).' If the right hemisphere is damaged, therefore, there is inattention to the left whereas left hemisphere damage can be more readily compensated for. Another explanation of pseudoneglect in healthy people is the activation/orientation model (Kinsbourne, 1970, 1987) that proposes that attentional asymmetry results from the most activated of the two cerebral hemispheres directing attention to contralateral space and temporarily inhibiting the other hemisphere. The model also proposes that contralateral orientation is strongest in the right hemisphere and it is this that tends to dominate in attentional tasks such as line bisection (LB) and the landmark (LMK) test. In LB tasks, participants typically have to indicate the centre of a line while in the LMK test, lines are pre-bisected and judgements are made about the position of the bisection. In manual LB this leads to bisections to the left of centre and, in the LMK test, to judgements that the left segment of equally pre-bisected lines is longer and to more accurate judgement of right bisected lines (Milner, Brechmann and Pagliarini, 1992). This leftward perceptual bias can be modified, but not eradicated, by such things as line length, left visual field presentation, position in the peri- or extra-personal visual field, scanning direction and time and hand used to make responses. A review of factors affecting LB by Jewell and McCourt (2000) reported that scanning from left to right was the most consistent source of bias in LB, tending to produce more leftward errors and vice versa. Brodie and Dunn (2005) generally concurred with this and further concluded that both sinistrals and dextrals show pseudoneglect if they initiate scanning from the left and use their preferred hand. One might also expect that habits such as reading from left to right would influence pseudoneglect magnitude but Nicholls and Roberts (2002) showed that right to left readers also bisect leftwards. Whether these examples of pseudoneglect occur because the left is 'over perceived' or the right is 'under-perceived' is yet to be established (Schmitz, Deliens, Urbain, Mary and Peigneux, 2011).

The activation/orientation model has been supported in brain imaging studies showing relatively greater activation of the right hemisphere during attentional tasks such as LB and the LMK test (e.g. Çiçek, Deouell and Knight, 2009; Fink et al., 2000; Fink, Marshall, Weiss and Zilles, 2001; Foxe, McCourt and Javitt, 2003) and Thiebaut de Schotten *et al.* (2011) used the recently developed technique of spherical deconvolution tractography to try to identify anatomical mechanisms underpinning the resulting pseudoneglect. They discovered that the superior longitudinal fasciculus attention pathway II (SLF II) was lateralised to the right hemisphere in 65% of their 20 right-handed participants assessed using the Edinburgh Handedness Inventory (EHI: Oldfield, 1971) so around two thirds had right hemisphere dominance for visuo-spatial attention with the rest having either symmetrical or left dominance. Thiebaut de Schotten *et al.* suggested that lateralisation of this pathway results from an unbalanced distribution of SLF II fibres, which possibly also affects speed of processing, both of which favour activity in the right hemisphere and thus left visual hemi-field preference. In accord with this, they found that greater right lateralisation correlated with a greater degree of leftward responses in the manual LB test. Furthermore, the fact that three of the right-handed participants who deviated rightwards in LBs were also found to have left lateralised SLF II underlines the importance of individual differences in the degree of SLF II lateralisation even amongst participants selected for being right-handed. For this reason it is not only important to establish research participants' handedness but also to measure its extent, even with a relatively crude, self-report measure of lateralisation, and to acknowledge that amongst right-handed people there will be a proportion whose attentional pathways are left lateralised and who may therefore behave atypically relative to other dextrals.

Finally, although LB and LMK tests are frequently used in pseudoneglect research, they involve different kinds of judgement and so are not necessarily directly comparable. This is specifically because LB involves finding the centre point of a stimulus, whereas the LMK test requires participants to make a judgement about the position of a pre-bisection, and generally because the way participants are instructed and required to respond in various research studies differs. Cavézian, Valadao, Hurwitz, Saoud and Danckert (2012) successfully used brain imaging techniques to demonstrate that differences in ocular responding to LB and LMK may lie at both behavioural and neurophysiological levels. They showed that, in the LB task, participants typically scan a more limited portion of the line than they do in the LMK test and the former activates neural networks bilaterally while the latter predominantly activates the right hemisphere. This led them to conclude that their data: '...*strongly suggest that the bisection and LMK tasks represent very different cognitive demands such that the LMK task should not merely be considered a perceptual version of the bisection task, despite its current conceptualization in the literature*.' (Cavézian et al., 2012: 102.)

1.3.1. Pseudoneglect in upper and lower, left and right visual fields and in peri- and extra-personal space.

Over 20 years ago, Previc (1990) argued that different mechanisms may operate in visual attention depending on the distance of stimuli from the viewer, and on their position in the vertical plane, such that near stimuli tended to be processed more efficiently in the lower visual field and far stimuli in the upper visual field. Key findings of a review of research into left-right and upper-lower visual asymmetries by Christman and Niebauer (1997) were summarised thus by Hagenbeek and Van Strien, (2002: 35):

> '*Christman and Niebauer concluded that upper-lower VF asymmetries are at least as strong and prevalent as left-right VF asymmetries. Furthermore, they suggested a systematic link between lower and left VF processing and between upper and right VF processing. For instance, Christman (1993) reported upper and right VF advantages for local processing, and lower and left VF advantages for global processing. Likewise, Niebauer and Christman (1998) found upper and right VF advantages for categorical (above/below) judgements, and lower and left VF advantages for coordinate (near/far) judgements*'

In two of very few papers, which examine simple attentional bias in upper and lower visual field effects, it was later claimed that, while left attentional bias is common, it is stronger in the upper visual field if presentation time is brief and stronger in the lower visual field (which is also fixated on for longer) when stimulus viewing time is unrestricted (Thomas and Elias, 2011, 2010). Furthermore, this visual field effect did not appear to change in peri-personal compared to extra-personal space (Thomas and Elias, 2010). These studies, which used the greyscale test of luminance perception, and the tasks reviewed by Christman and Niebauer (1997) however, did not involve LB and the LMK tests, both of which are to be considered next, so the effects of upper and lower visual field presentation on them are not well understood.

Manual (LB), by physically marking the centre of a line, can take place in both peri- and extra-personal space, typically defined as within vs. beyond arm's reach. Participants can be asked to mark the centre of a line displayed on paper or a screen using a pencil, pointer or laser pen or by positioning a slider using a computer keyboard. All of these methods have both perceptual and motor components, the latter being an important variable according to the activation-orientation model (Kinsbourne, 1987, 1970). The LMK test also allows for examination of attentional bias in both peri- and extra-personal space but requires participants to make judgements about pre-bisected lines. They may be asked to indicate whether lines are equally bisected (a symmetry judgement) or unequally bisected (an asymmetry judgement), in the latter case by stating which end looks longer or shorter. Lines may all be equally bisected or comprise a mixture of equally and unequally bisected lines. In order to test lateralisation effects on judgements, presentation of both LB and LMK tests can be varied by positioning them centrally as well as laterally and in the upper and lower visual fields. Viewing time may be brief (about 150ms), in order to prevent scanning, or longer to allow a considered decision to be made. Line lengths may also be varied and direction of scanning controlled. All of these methodological variations, as well as age, gender, the use or non-use of chin-rests or head-restraints and the alertness of participants, appear to influence responses and make it challenging to compare findings, nevertheless, an attempt to summarise key points from recent pseudoneglect literature follows. In nearly all of the following studies, participants were exclusively right-handed with the occasional, exceptional case of left-handedness being checked and found not to be influential. The age range of participants across all studies was 18 to 41 years.

In a study of lateralisation of attention in peri-personal space using a modified LMK test, central presentation, presentation times ranging from brief (170ms) to longer (2600ms) and counterbalanced responding with either hand, Wilkinson and Halligan (2002) found that participants were better at detecting exactly bisected lines (symmetry) on the left (favouring the right hemisphere) than on the right but there was no lateralisation effect for detecting asymmetry. Other studies (Gamberini, Seraglia and Priftis, 2008; Heber, Siebertz, Wolter, Kuhlen and Fimm, 2010; Varnava, McCarthy and Beaumont, 2002) have examined lateral asymmetries in the perception of centrally presented stimuli in peri- and extra-personal space and all agree that a left bias in peri-personal space becomes less pronounced or even shifts to the right in extra-personal space. Varnarva *et al.* presented lines centrally at distances ranging from 30 to 120 cm and participants bisected these using a cursor. They found a rightward shift with increasing distance and line length but only when scanning was initiated on the left rather than the right. Gamberini *et al.* used the same viewing distances as Varnava *et al.* but required participants to indicate the lines' centre using either a laser pointer or a stick and found an attentional shift from left to right that they claimed changed abruptly between 60cm (peri-personal) and 90cm (extra-personal) distances. They explain the detection of this abrupt change, which they took to indicate a switch from one attentional system to another, as the result of using a chin rest to control participants' head and body position, which other researchers, such as Longo and Lourenco (2006) who found more gradual change, did not do. This effect only occurred with the laser pointer however and not with the stick which seemed to serve to extend peri-personal space. Finally, Heber *et al.* used both the greyscale and LMK tests, to which participants responded with their left hand to indicate left bias judgements and their right hand to indicate right bias judgements. Heber *et al.* concurred that, in horizontal stimuli in both tests, there was a stronger left than right bias in longer rather than shorter lines and in peri-personal compared to extra-personal space which, at 270cm, was the longest reported distance to show the effect.

All of these studies also suggest that different attentional mechanisms operate for the left and right hemispheres as stimulus distance increases. In addition, Heber *et al.* (2010)

controlled for fatigue and alertness, both of which will be shown to be important contributory factors in attentional asymmetries next and which might affect how people respond when they are ordinarily sleepy as opposed to alert.

1.3.2. Pseudoneglect and sleepiness

While it may be the case that sleepiness leads to inattention and thus a reduction in leftward bias in pseudoneglect, there may also be individual differences in the ability to sustain attention that operate independently of sleepiness. A study of university students, which went some way towards testing this, demonstrated that lower sustained attention ability was associated with a reduction in leftward attentional bias in the greyscale test (Bellgrove, et al., 2004). It was not clear, however, whether the students, although generally healthy, were also fatigued or sleepy, both of which could have accounted for the results.

Further studies in this area have used naturally occurring sleep deprivation or deliberately induced it in order to test for links between this and pseudoneglect. In a two-part study, Manly, Dobler, Dodds and George (2005) first tested hospital staff when they were relatively sleep deprived due to a shift working pattern and again when rested. They used a LMK test in which participants were shown a series of centrally-presented horizontal lines on a screen. Lines had been pre-bisected with a vertical marker and participants had to say which end of the line they thought was shorter. In the alert condition, they typically judged the right-hand end to be shorter and the left as longer but, as testing time increased, the number of 'left longer' errors decreased. In the sleepy condition there was a general tendency throughout to make 'left longer' errors. In the second part of the study, in which alert participants were presented with lines for just 1000ms, the effect of time on task (TOT) was replicated. Manly *et al.* concluded that this indicated a rightward drift in spatial awareness as both subjective sleepiness and TOT increased. Dufour, Touzalin and Candas (2007) also reported a reduction in leftward bias on the LMK test when participants were less alert due to continuous testing for an hour, but not enough to constitute a rightward shift, and Kendall, Kautz, Russo and Killgore (2006) found a similar but marginally significant effect in a vigilance test over 40 hours of sustained wakefulness. Schmitz *et al.* (2011) however, presented evidence to question such studies when they failed to find an effect on left bias in the LMK test after one night of sleep deprivation. They suggest, however, that the effect may be most noticeable when there is both fatigue and high circadian sleep pressure and, in further analysis, showed this to be the case. This was further supported by Fimm, Willmes and Spijkers (2006) whose participants underwent 28 hours of sustained wakefulness and showed slower response times to left visual field stimuli but only at 5am.

A possible explanation for the decreased leftward bias claimed by most of these studies is offered by Manly *et al.* (2005), Dufour *et al.* (2007) and Casagrande and Bertini (2008a, 2008b) who think that the lateral shift in spatial attention occurs because the right hemisphere remains more vigilant than the left when sleepy with the result that the attentional asymmetry seen in normally alert individuals is changed. However it should be borne in mind that Kendall *et al.* (2006) and Casagrande and Bertini used vigilance and finger-tapping tasks rather than the LMK test and, even though Dufour et al., Manly *et al.* and Schmitz *et al.* (2011) all used the LMK test in peri-personal space, there were procedural differences in such things as stimulus exposure time, line lengths and 'sleepiness' (boredom with monotonous tasks, tiredness after work, prolonged sleep deprivation) that make direct comparisons difficult. However, if Manly *et al.* are correct in suggesting that the right hemisphere remains vigilant when sleepy, pseudoneglect should be affected.

1.3.3. Pseudoneglect, age and gender

Age is a potentially important variable affecting pseudoneglect as leftward bias in abilities such as emotion perception (Failla, Sheppard and Bradshaw, 2003) and identification of gender in chimeric faces decreases in older participants (Collins and Mohr, 2013). Using the LMK test, Schmitz and Peigneux (2011) tested adults aged between 19-39 years compared with 60-81 year olds using centrally presented, 200mm lines in peri-personal space. Older participants showed a reduced leftward bias, the reasons for which are debatable. Schmitz and Peigneux argue that it could indicate right hemisphere impairment or reduced asymmetry, possibly involving left hemisphere compensation as was also suggested by the Hemispheric Asymmetry Reduction in Older Adults (HAROLD) model (Cabeza, 2002). Schmitz and Peigneux also speculate that reduced leftward bias could result from a decline in callosal function, age-related inhibition of return failure or even a decrease in dopamine, a neurochemical that has been shown to affect spatial bias (Greene, Robertson, Gill and Bellgrove, 2010; Newmann, O'Connell, Nathan and Bellgrove, 2012). Whatever the explanation, research has shown that these changes may begin as early as in the 30s (Mill, Allik, Realo and Valk, 2009; Suzuki, Hoshino, Shigemasu and Kawamura, 2007).

Two studies have also shown a gender effect in attentional bias in LB (not LMK) tests. Hausmann, Ergun, Yazgan and Güntürkün (2002) tested manual LB (using a pencil) in peri-personal space and found an interaction of hand and gender such that females showed a left bias with both hands but males, while also left biased in general, matched the extent of this with their left hand only. The overall gender difference in left bias however, was non-significant ($p = .10$). Stancey and Turner's (2010) participants, who were mostly 19-year olds, made LB judgements in both (near) peri- and (far) extra-personal space using a laser or stick. In both near and far stick conditions females were consistently more accurate than males and, within groups, neither showed a near vs. far difference. For both males and females, using a stick appeared simply to function to extend peri-personal space. In the far laser condition there was a cross-over effect in that females' accuracy decreased to match males' stick performance while males' accuracy improved to match females' stick performance. With regard to pseudoneglect, for all participants, a left bias was found in all but the extra-personal stick condition and this pattern remained when males and females were considered separately. Crucially, the left bias itself did not differ between gender groups in all conditions. The authors concluded that, unlike Heber *et al.* (2010) Gamberini *et al.* (2008), Longo and Lourenco (2006) and Varnarva *et al.* (2002), they had found evidence for pseudoneglect but no convincing support for reduction of leftward bias with increasing distance. Collectively, these studies suggest that accuracy and attentional bias are both influenced by a complex mix of gender, tool, task and space.

To date just one study has examined a possible age and gender interaction. Chen, Goedert, Murray, Kelly, Ahmeti and Barrett (2011) tested men and women aged 22 to 93 years old who made on-screen LBs using a computer mouse. It was concluded that women generally bisected leftwards at all ages while men showed a leftward to rightward drift with increasing age. Chen *et al.* suggest that there is a greater degree of right lateralisation in young men to start with, which highlights the decline with age whereas, in women, lateralisation is less marked and less changeable. The authors conclude that both age and gender should thus be taken into account in studies of visuo-spatial tasks.

1.4. Hemispherisation in perception of emotional stimuli

The role of sleep in regulating emotions and in perception of emotional stimuli is receiving increased attention in the research literature (Killgore, 2010). Pallesen *et al.* (2004) showed that after 72-100 hours of sleep deprivation in 36 right-handed men, efficiency and speed of emotional recognition decreased. In addition, they detected a shift in hemispherisation such that the dominance of the right hemisphere in alert participants shifted to the left after sustained wakefulness suggesting particular vulnerability of the right hemisphere to sleep deprivation. In a group of studies, which all used young adults and just one night of sleep deprivation, Tempesta *et al.* (2010) found increases in self-rated negative mood and more negative judgement of neutral stimuli but no change in perception of pleasant and unpleasant stimuli, some of which were faces. Chuah, Dolcos, Chen, Zheng, Parimal and Chee (2010), Marín and Lopera (2009) and Yoo, Gujar, Hu, Jolesz and Walker (2007) found heightened sensitivity to emotional stimuli and Franzen, Buysse, Dahl, Thompson and Siegle (2009) found greater pupil dilation to negative compared to neutral or positive stimuli. Phillips, Yanagi, Carr and Drummond (2004) also found that prolonged sleep deprivation affects the time taken to identify emotions, increasing the most for fear and anger and the least for happiness and surprise. It could be argued that implicitly recognising an emotion should be faster than explicitly being able to name it, but the difference was observed in both of the two tasks used by Phillips et al., which required implicit or explicit identification of emotion. In addition, Van der Helm, Gujar and Walker (2010) found that sleep deprivation led to a blunting of subjective ratings of angry and happy faces, especially when the expression was less intense and only when participants were female. Ratings of sadness, an emotion not associated with such strong autonomic arousal, were not affected by sleepiness. Hoffmann, Kessler, Eppel, Rukavina and Traue (2010) however, found that, in alert participants, there were no gender differences in recognition of intense emotional expressions but women were more accurate in detecting subtly expressed emotions suggesting that Van der Helm *et al.* had discovered a gender difference in vulnerability to sleepiness with regard to emotion processing.

1.4.1. Hemispherisation and perception of emotional valence

The right hemisphere is particularly implicated in emotion processing and labelling both of which are more impaired by right hemisphere damage than by left hemisphere damage (Kucharska-Pietura, Phillips, Gernand and David, 2003). More recently, the influence of emotional valence has also been studied. Kucharska-Pietura et al., for example, compared people with right and left hemisphere damage on facial and vocal emotion recognition and found that right lesions were associated with impaired recognition of all emotions except happiness. Jessimer and Markham (1997) implicated right hemisphere dysfunction in alexithymia (reduced ability to recognise and describe one's feelings) in that high alexithymics showed less leftward bias in perception in general and this was associated with poorer recognition of facial expressions. In healthy people also, Darby and Walsh (2005) claim that there is accumulating evidence that the right hemisphere plays a greater, but not exclusive, part in various aspects of emotional processing, particularly in the evaluation of emotional expression. Teow-Chong and Martinez (2005) for example, found that emotion words are remembered better if presented in the left ear, indicating a right hemisphere advantage for processing emotional meaning and McFarland and Kennison (1989) found a cerebral asymmetry in perception of emotional valence in music that interacted with handedness.

With specific reference to facial expression, Workman *et al.* (2000) investigated emotion perception in chimeric faces in a bid to test the right hemisphere hypothesis (e.g. Borod, et al., 1988) against the valence hypothesis (e.g. Reuter-Lorenz and Davidson, 1981). The former states that there is a right hemisphere advantage in processing emotions and, while the latter does too, it also states that the right hemisphere is dominant in processing negative emotions while the left plays a special part in processing positive emotions. Workman *et al.* used six facial expressions thought to be universal amongst humans (Ekman and Friesen, 1971; Ekman 1972): anger, fear, disgust, happiness, pleasant surprise and sadness and found that preference for left hemi-faces in chimeric face stimuli increased in the order happiness, sadness, pleasant surprise, disgust, fear, anger.

This led them to suggest that, rather than a positive or negative distinction, a pro- or anti-social division might be a more fitting evolutionary explanation of their findings in the sense that fear and anger are clear signals to others of danger while the remainder are not. More recently, Tamietto, Adenzato, Geminiani and de Gelder (2007) showed that the type of social emotion may also be relevant in that perception of less commonly researched ones, such as arrogance and flirtatiousness, does not appear to be lateralised.

Not all research supports the valence hypothesis however. According to a study of 19-35 year old students (Alpers, 2008), emotional pictures of either positive or negative valence captured attention more rapidly than neutral ones when presented in the left visual field implicating the initial superiority of the right hemisphere. Thereafter, however, emotional pictures of positive or negative valence were found to hold attention equally in both visual fields. This apparent lack of hemispherisation of processing emotional valence is not borne out by the majority of research findings however and may even change with age. Using adults aged 18-25 and 62-81 years old, Suzuki *et al.* (2007) found that the older group recognised facial expressions of disgust more readily and sadness less readily than the younger group. A slight decline in recognition of surprise and anger was also noted ($p = .09$). Mill *et al.* (2009) presented evidence to show that this decline began at about 30 years of age and was particularly noteworthy in perception of negative emotions. Failla *et al.* (2003) confirmed that leftward preference for happiness in chimeric faces declined with age and was less evident in 60-70 year olds compared to 5-30 year olds and Collins and Mohr (2013) found a similar decline in participants aged 60 and over in the identification of gender. The latter was taken as support for the Hemispheric Asymmetry Reduction in Older Adults (HAROLD) model (Cabeza, 2002).

1.5. Rationale for studies

The range of domestic settings in which sleepiness and sleep disruption may occur is vast, so the decision was made to restrict the scope of this thesis to healthy adults with the potential to sleep well but who were or were not disturbed by other family members. Five groups were chosen with the intention of showing cognitive effects associated with increasing sleepiness and sleep disruption and the studies conducted with them are reported in chapters 2-5. In chapter 2, healthy adults with healthy partners and 'empty nests', were selected as a 'baseline' group as they were the least likely to have disrupted sleep. They could, however, be expected to show inherent individual differences in daytime sleepiness (Ferrara and De Gennaro, 2001) because some adults feel more sleepy than others during the day even though they consider their sleep to be adequate or of good quality. Such sleepiness is distinct from inherent individual differences in the ability to sustain attention (Bellgrove, Dockree, Aimola and Robertson, 2004) and napability, which Harrison and Horne (1996: 16) called "…high sleepability with no other evidence of sleepiness (HSNS)", and the effects of deliberate sleep deprivation (Rauchs, Desgranges, Foret and Eustache, 2005; Walker and Stickgold, 2006). It also differs from sleepiness for endogenous reasons, such as insomnia (Espie, 2002) and sleep apnoea (Pack and Pien, 2011; Vgontzas and Kales, 1999), and exogenous reasons such as a bed partner's snoring (National Sleep Foundation, 2005) or disturbance by young children. A general or occasional feeling of being a little sleepy is common (National Sleep Foundation, 2005; The Great British Sleep Survey, 2012), normal and usually no cause for concern but, just as with sleepiness induced by sleep-disruption, it may have both subjectively and objectively measurable effects that could have practical consequences and is thus the starting point for this thesis.

In the chapter 3, healthy adults with 'empty nests' and a partner with a sleep-disrupting illness were chosen in order to assess the potentially deleterious effects on cognition of being disturbed by someone else's sleep problems. Early stage Parkinson's disease (PD) was chosen in this instance due to the known association between PD and sleep disturbance (e.g. Abdelgabar and Sharma, 2003; Chaudhuri, 2002; Larsen and Tandberg, 2001). Other chronic, progressive conditions could also have been suitable but, since one intention of this research was to investigate possible associations between changes in lateralisation of visual attention and sleepiness, the inclusion of PD, which is often lateralised in onset, afforded a good opportunity to assess this in people with PD in comparison with healthy partners. In the early stages of the disease, complicating factors such as dementia or care-giver burden were unlikely to be present and this was a further factor behind the decision to choose PD.

Chapters 4 and 5 of this thesis focused on three groups of healthy adults with 'full nests', and for whom parental care-giving responsibilities were clearly present. Various degrees of sleep disruption due to their children were also apparent amongst these adults, so their inclusion provided a natural progression from the first two groups.

1.6. Overview of key research questions and methods

In chapters 2 through to 5, different but related research questions were asked of healthy adults about the impact on them of everyday sleep disruption in domestic settings and some of them were tested directly. In each study, mixtures of methods were employed as appropriate. An overview is given here:

- Chapter 2: Do healthy, mature adults, whose partners do not disrupt their sleep, show sleepiness-related differences in self-reported cognitive failures and lateralisation of visual spatial attention (specifically pseudoneglect)? Are lateralisation effects also measurable in the perception of emotion? A questionnaire was constructed to gather demographic data. It also included sleepiness, mood and cognitive failures scales. Manual line bisection in peri-personal space and a landmark test in extra-personal space were used to test changes in visual-spatial attention with sleepiness. A chimeric faces test of was used to test lateralisation of emotion perception changes with sleepiness.

- Chapter 3: How is the sleep of healthy, mature adults affected by living with a partner with sleep-disrupting illness (Parkinson's disease: PD)? Does sleepiness in partners predict self-reported cognitive failures? Do partners show sleepiness-associated lateralisation changes in pseudoneglect? Demographic data and responses to scales measuring sleepiness, mood and cognitive failures were collected by means of a postal questionnaire. A self-administered, manual, line bisection (LB) test of pseudoneglect was included in the questionnaire.

- Chapter 4: What do mothers, whose sleep is disrupted by their children, perceive the effects of this to be on their everyday functioning? Thematic Analysis (Braun and Clarke, 2006) was applied to discussions conducted online between sleep-disrupted mothers in order to explore these effects. Analysis included an examination of their experiences of living with sleep-disruption and perceived effects on cognitive functioning were singled out for further testing in chapter 5.

- Chapter 5: Are the effects of sleep disruption and fatigue identified in online discussions of mothers of babies and young children subjectively and objectively measurable? Does severity of sleep disruption predict executive functioning and is this effect greater as executive demand increases? Is pseudoneglect also affected? Study 1 in this chapter comprised an online questionnaire survey of mothers and included scales measuring sleep disturbance, everyday sleepiness, fatigue, attention, memory, mood, executive functioning as well as questions about clumsiness. Study 2 comprised the same questionnaire survey and a field study using a battery of neurological tests that increased in executive demand.

As this research was essentially exploratory, measures of cognitive function were both refined as it progressed and restrained by the data collection method and access to participants. At all stages it was thought to be important to ask participants to self-report on a number of sleep-related variables and scales and, where possible, to augment these with objective measures. At first, the scales and measures were chosen on the basis of published research, thus using a ‘top-down’ approach. However, in chapters 2 and 3, as sleep disruption was unlikely to have been an underlying cause of the sleepiness-related effects that had been found, it was necessary to turn to participants in chapter 4 and take a ‘bottom up’ approach to find out what they believed to be the consequences of disrupted sleep. The combination of this with findings from chapters 2 and 3 eventually led to the finely-tuned choice of scales and neuropsychological tests reported in the chapter 5.

Chapter 2

COGNITIVE CORRELATES OF SLEEPINESS IN HEALTHY ADULTS

2.1. Introduction.

To begin the process of investigating cognitive correlates of sleepiness and sleep disruption in healthy adults in this chapter, it was decided that subjective effects could be measured using self-assessed cognitive failures and objective effects could be measured using indicators of pseudoneglect and perception of emotion. These objective effects are known to involve lateralised visual attention, (e.g. Manly, Dobler, Dodds and George, 2005; Pallesen et al., 2004) which has itself been shown to alter with sleepiness, and so they presented a simple way to test for a possible relationship between the two. A consideration of research into these two effects was presented in chapter 1 and, based on this, the following predictions have been derived.

2.1.1. Predictions about potential changes in pseudoneglect with sleepiness

Studies into pseudoneglect described in chapter 1 have used normally alert participants or tested them with different degrees of sleepiness, sleep deprivation or time on task (TOT), for example one study (Manly et al., 2005) used sleepiness brought about by shift-work and another (Bellgrove et al., 2004) concerned individual differences in ability to sustain attention. None of them, however, have considered the common experience of naturally occurring, everyday sleepiness in healthy participants and it is the possible effect of this on pseudoneglect that is addressed here. Based on the literature so far considered three predictions can be made:

- Peri-personal LB. Many studies show that leftward bias in central, peri-personal space is common (Gamberini et al., 2008; Heber *et al.* 2010; Longo and Lourenco, 2006; Varnava et al., 2002). If this is the case, it should occur in a manual LB task in peri-personal space and the effect should be exaggerated when the right hemisphere, relative to the left hemisphere, is differentially activated by moving the stimulus from the left, through centre to the right visual field (Kinsbourne, 1987, 1970). In LB, leftward drift becomes exaggerated if the line to be bisected is on the right and is less if the line is presented on the left. Furthermore, sleepiness and decreased alertness, due to TOT, have been shown to attenuate leftward bias in peri-personal vigilance, reaction time and the LMK test (Dufour et al., 2007; Fimm et al., 2006; Kendall et al., 2006; Manly et al., 2005), usually in centrally presented stimuli, but none of these are directly comparable to LB (Cavézian et al., 2012). If the right hemisphere remains more vigilant than the left when sleepy (Casagrande and Bertini, 2008a, 2008b; Dufour et al., 2007; Manly et al., 2005), and Cavézian *et al.* are correct in their conclusion that bilateral hemisphere activation occurs in peri-personal LB, the combination of a vigilant right hemisphere with increased asymmetry in cerebral activation should lead to an exaggerated tendency to bisect leftwards in LB, especially when the stimulus is shifted rightwards.

- Extra-personal LMK. The majority of studies show that, in alert people, leftward bias in central, peri-personal space reduces or shifts to the right in central, extra-personal space (Gamberini et al., 2008; Heber *et al.* 2010; Longo and Lourenco, 2006; Varnava et al., 2002) possibly because different attention mechanisms are involved, although not all would agree (e.g. Stancey and Turner, 2010). Studies also suggest that LMK judgements in peri-personal space become more accurate (less leftward biased) with sleep deprivation and decreased alertness (Dufour et al., 2007; Manly et al., 2005). The influence of everyday sleepiness on the apparent reduced bias effect of placing stimuli in extra-personal space is unknown, but a combination of the aforementioned studies suggests that, not only should LMK judgements show little or no leftward bias in extra-personal space, they should also become more accurate with sleepiness.

- Upper and lower visual field. Left attentional bias is stronger in the lower visual field in peri-personal space if presentation time is unrestricted (Thomas and Elias, 2011, 2010). In an extra-personal LMK test with unlimited viewing time, the attenuation of leftward bias in general may occur unevenly in upper and lower visual fields for alert people. The addition of sleepiness to this may further attenuate any bias.

Findings about gender and age in LB or LMK performance are mixed or non-existent. In a manual LB task, which is the most similar to the pencil LB task to be used here, Stancey and Turner (2010) found that males were less accurate than females in a peri-personal stick condition but both groups showed similar degrees of leftward bias. Conversely, however, Hausmann *et al.* (2002) suggested that females show leftward bias more than males when they use their right hand for manual pencil LB. If, in addition, there is a reduction in leftward bias with age, (Cabeza 2002, Chen et al., 2011; Collins and Mohr, 2013; Failla et al., 2003; Schmitz and Peignuex, 2011) and this potentially begins in one's 30s (Mill *et al.* 2009; Suzuki *et al.* 2007), age as a covariate should attenuate pseudoneglect in both LB and the LMK test. Chen *et al.* (2011), however, found that leftward bias decreased only in older males. Taken together, these findings suggest that leftward bias is to be expected but that it may or may not be generally greater in females and may be less marked in older males. In extra-personal space, gender and age effects are less clear. Stancey and Turner claimed that the weight of evidence suggests that males' perception is superior to that of females in a number of different tasks, and themselves showed males to be more accurate than females in extra-personal laser LB, but most of their participants were 19 years old. None of the aforementioned pseudoneglect research used an extra-personal LMK test similar to that which will be used here so possible age and gender effects on this should be investigated.

2.1.2. Predictions about lateralisation of emotion perception, valence and sleepiness

The research described in chapter 1 concerns testing lateralisation of emotional stimulus perception in peri-personal space and the effects of valence in alert individuals as well as sensitivity and reaction times to emotional stimuli of different valence and intensity in sleep deprived individuals of different ages and genders. The methods and measures, however, are varied, the findings are mixed, and sometimes contradictory or counter-intuitive, and none of them tests the effects of everyday sleepiness. As a consequence, it is intended to test the effect of this on lateralisation of facial emotion perception taking into account emotional intensity, valence, reaction time, age and gender with the following expectations:

Preference for the left visual field should increase with sleepiness. Pallesen *et al.* (2004) found an attentional shift away from the right hemisphere. Studies such as this, however, tend to use extended periods of sleep deprivation, which Pallesen *et al.* suggest is particularly deleterious to right hemisphere functioning which is, itself, strongly linked to aspects of emotion processing (Casagrande and Bertini, 2008a, 2008b; Darby and Walsh, 2005). Manly *et al.* (2005) and Dufour *et al.* (2007) however, suggested that the right hemisphere remains more vigilant than the left when ordinarily sleepy and at sleep onset, as opposed to sleep-deprived. This should be reflected in judgement of emotions in chimeric faces such that preference for the left visual field becomes more pronounced.

Visual field preference should interact with emotional valence. Workman *et al.* (2000) and Tamietto (2007) found that lateralisation of emotion perception varied according to emotional valence and Marín *et al.* (2009) and Chuah *et al.* (2010) found heightened sensitivity to emotional stimuli in general following sleep deprivation. Combining these two effects, Chuah *et al.* (2010), Franzen *et al.* (2009), Marín and Lopera (2009) and Yoo *et al.* (2007) found that sensitivity to emotions of different valencies varied with sleep deprivation. From an evolutionary point of view, it would be adaptive if a slightly sleepy right hemisphere remained vigilant for emotions that signal threat (fear and anger) so it is expected that left preference will be more exaggerated for these when sleepy. The least change with sleepiness should be observed for non-threatening emotions (happiness and pleasant surprise) and an intermediate change for emotions that are ambiguous (sadness and disgust).

Reaction times for emotions that signal danger should be faster than reaction times to non-threatening emotions. Findings by Phillips *et al.* (2004) and Van der Helm *et al.* (2010) which show a slowing of reaction times and a blunting of responses to negative emotions seem to run counter to evolutionary explanations of adaptive responses to danger as it could be argued that potentially threatening situations need to be perceived and responded to rapidly. These studies, however, used debilitating, long periods of sleep deprivation rather than testing everyday sleepiness so it is argued that a slightly sleepy but vigilant right hemisphere should be quick to notice threatening emotions and reaction times to them should be shorter compared to non-threatening emotions.

Age and gender may interact with lateralisation of face perception and emotional valence (Collins and Mohr, 2013 and Failla et al., 2003). Mill *et al.* (2009) and Suzuki *et al.* (2007) reported a trend for older adults, especially after 30 years of age, to become less sensitive to recognizing negative emotions in particular suggesting there may be a gender difference in the effect of sleepiness in emotion processing possibly depending, as Van Der Helm *et al.* (2010) also suggested, on the subtlety of the emotional stimulus. For this reason, emotional intensity in stimuli will be maintained at a consistently high level. It is important to bear in mind however that, in an extensive review of the literature on sex differences in processing emotional signals, Kret and Gelder (2012) concluded that research findings concerning lateralisation of emotion perception, valence and gender are inconsistent and suggestive of complex patterns of neural activity. Findings differ according to the nature of such variables as the emotional stimulus (not all studies used faces), emotional valence, the age of participants and their ethnic group. In addition, Kret and Gelder argue that an interaction may exist between the gender of the viewer and that of the face being judged such that threat valence in a male face is reacted to more strongly by males compared to females. While there is no immediate reason to assume that gender will exert a systematic influence on chimeric face perception, its possible contribution, along with age, will be assessed as a precautionary measure in tests of the possible interaction between visual field preference and emotional valence.

2.1.3. Study overview

In summary, the literature reviewed in chapter 1 and in this introduction has linked lateralisation with both pseudoneglect and emotion perception and some of it has shown how these may be affected by such factors as sleep deprivation, decreasing alertness with TOT, age and gender. None of it, however, has examined the effects of different degrees of naturally occurring everyday sleepiness in healthy people who are unaffected by endogenous or exogenous sleep disturbances. For this reason a questionnaire will first be used in order to understand the nature and context of sleep and subjective judgements of mood and cognition in healthy adults who are both normally alert and sleepy. Differences in simple attention-based LB and LMK tests of pseudoneglect and emotion perception, which are both sensitive to lateralisation, will then be assessed in order to see whether subjectively rated differences in sleepiness and its effects can be corroborated objectively and are in line with the aforementioned predictions.

2.2. Method

2.2.1. Design

Participants completed a questionnaire concerning demographic information, sleep patterns, cognitive failures and mood. They were also asked to complete the manual LB test and a series of pencil and paper tests chosen to assess handedness. In addition, they completed two experiments consisting of a LMK test presented on a projection screen and a chimeric faces tests presented on a computer screen. All participants completed the questionnaire first, followed in randomised order by the paper and pencil tests and the two experiments. Where there were sub-tests within tests, e.g. LMK stimuli in different screen positions or different chimeric faces, the order of presentation of these was also randomised. Administration of tests by the researcher allowed for a good degree of control over the presentation of stimuli, for example in positioning them relative to the participants and over how and in what order they were done. Finally, time on task (TOT) in the LMK experiment could also be measured, since Dufour, Touzalin and Candas (2007) and Manly *et al.* (2005) had both presented evidence that this could be influential in visual attention tasks, and reaction time in the chimeric faces experiment could be recorded to assess the relationship with sleepiness and age (Pallesen *et al.,* 2004; Phillips *et al.,* 2004; Suzuki *et al.*, 2007). All procedures were approved by the *Bath Royal United Hospital NHS Research Ethics Committee*. (See Appendix A.)

2.2.2. Participants

A volunteer sample of 38 (male n = 12) White, British, adult, professionals was recruited by means of an e-mail advertisement (Appendix B) and purposive sampling thereafter. Criteria for participation were that participants should consider themselves to be right-handed, with no diagnosed sleep disorders, in good health, living with a partner in good health and with no diagnosed sleep disorders, not taking medication that affects sleep and with normal, or corrected to normal, vision. In order to recruit sufficient numbers of both normally alert and sleepy people, some purposive sampling of volunteers, who scored in the sleepy range of the Epworth Sleepiness Scale (ESS; Johns, 1991), was carried out in the later stages of data collection such that 16 (male n = 6) out of 38 participants were sleepy. Participants were asked to abstain from drinking caffeinated drinks on the day of testing and all were tested at a time convenient to themselves.

In the following analyses, participants with a strong degree of right-handedness (≥ 80 on the EHI) were selected. A further participant was excluded because of extreme rightward LB errors that differed by > 3 SD from the remaining group mean for central line position and by > 4 SD for the left line position, thus 16 normal and 12 sleepy participants remained. An a priori sample size calculation for the intended 2 x (3) mixed factorial ANOVA design was carried out using the online power analysis programme *G*Power 3* (Buchner, Erdfelder and Faul, 1997) assuming a medium effect size of f = 0.25 (Cohen, 1992, 1988), an alpha p level = .05 and power = .80, which confirmed that N = 28 was the minimum requirement. The proportion out of the original 38 participants excluded was 26% which is a little lower than the 33% mixed or left cerebral lateralisation figure suggested for right-handed participants by Thiebaut de Schotten *et al.* (2011). As age had been identified as a potentially influential variable, and now ranged from 31 to 68 years, it was checked and found not to differ between the sleepy and normal group (age: $t_{(26)} = 0.19$, $p = .85$, two-tailed) and between the remaining 8 males and 20 females ($t_{(26)} = 0.39$, $p = .72$, two-tailed). Sleepiness did not differ between males and females ($t_{(26)} = 0.34$, $p = .74$, two-tailed) and it was confirmed as being significantly different between the sleepy and normal groups ($t_{(22.56)} = 12.68$, $p < .001$, one-tailed).

2.2.3. Materials

A self-administered questionnaire was devised (Appendix D), incorporating the following elements:

2.2.3.1. Demographic questions

General demographic information was requested about age and gender. Individual somnotypology questions were asked including preferred length of sleep, sleepability and morning/eveningness (Ferrara and De Gennaro, 2001). Questions were also asked about the character of participants' normal (preferred) and actual sleep pattern, sleeping arrangements (Billman and Ware, 2002), sleep continuity and fragmentation (Haba-Rubio, Ibanez and Sforza, 2004) and phase of greatest disturbance (Murray and Dodds, 2003).

2.2.3.2. Epworth Sleepiness Scale and Parkinson's Disease Sleep Scale

Questions about sleepiness were asked using the Epworth Sleepiness Scale (ESS; Johns, 1991) and selected items from the Parkinson's Disease Sleep Scale (PDSS: Chaudhuri *et al.*, 2002). The ESS addresses particular kinds of sleep propensity in everyday activities and is a simple, subjective measure asking people to rate their chances of dozing or sleeping in eight common situations such as sitting and reading or watching TV. Each item is scored on a four point scale ranging from 0 to 3 so total scores on this scale range from 0 to 24 with ≥ 11 being the criterion for sleepiness.

The full PDSS comprises 15 items and was developed specifically to enable the assessment of sleep problems in people with PD. PD-specific questions were omitted from the questionnaires for this study, leaving items relating to sleep quality, sleep onset and maintenance insomnia, sleep refreshment and incidences of falling asleep in the day. Participants respond to these items on bipolar scales (e.g. always – never) and these are scored from 1 to 10. These questions were used in this study to facilitate comparison with data analysis in chapter 3 in which partners of people with PD were surveyed.

2.2.3.3. Cognitive Failures Questionnaire

The Cognitive Failures Questionnaire (CFQ: Broadbent, Cooper, FitzGerald and Parkes, 1982; Cheyne, Carriere and Smilek, 2006; Wallace, Kass and Stanny, 2002) was used to test everyday cognitive failures. The CFQ is a broad measure of everyday cognitive failures incorporating everyday lapses and slips of memory, concentration and attention. It was '...designed to be non-specific with regard to underlying cognitive processes.' (Cheyne, Carriere and Smilek, 2006: 579). It contains 25 items describing errors that everyone makes from time to time e.g. 'Do you forget if you turned off a light / or a fire / or locked the door?'; 'Do you have trouble making up your mind?; 'Do you drop things?'.) Participants respond to each item on a five-point scale ranging from 0 (never) to 4 (very often). The original test asks respondents to consider the last 6 months but, as the whole questionnaire in this study relates to the past week, the time scale was altered accordingly. Permission to use the CFQ was obtained from the British Psychological Society. Research has linked higher CFQ scores with accidents (Larson, Alderton, Neideffer and Underhill, 1997; Shmuel, Shlomo, Natali, Ayala and Eliezer, 2003).and to different 'bump' rates when navigating through doorways (Nicholls et al., 2007, 2008), therefore a question about accident proneness was added.

2.2.3.4. Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale - HADS (Zigmond and Snaith, 1983) is a short test for anxiety and depression. It was provided by the National Foundation for Educational Research (nferNelson) following approval and registration of the user. The HADS is a non-clinical screening instrument used prior to formal psychiatric assessment. It comprises seven depression and seven anxiety items in alternating order, for example, 'I feel tense or wound up'; 'I still enjoy the things I used to enjoy'. Respondents indicate the extent to which these apply to themselves on a four-point scale. Two scale scores are generated allowing such that individuals can be sorted into normal, mild, moderate and severe depression and anxiety categories (Snaith, 2003).

2.2.3.5. Edinburgh Handedness Inventory

The Edinburgh Handedness Inventory (EHI: Oldfield, 1971) was included to measure degree of handedness and thus give an indication of cerebral lateralisation. The test asks participants to say which hand they prefer to use for 10 common actions, such as throwing or using a spoon, and to indicate whether they ever use the other hand for each action. Degrees of handedness can be calculated and scores of 70% or more commonly classifies individuals as right-handed as opposed to left-handed or ambidextrous, although 80% was used in this study.

2.2.3.6. Torque Test

The Torque Test (Blau, 1974) is a simple test of cerebral hemisphere dominance in which participants are required to draw freehand circles, usually around letter Xs. 'Torque' refers to the tendency to circle clockwise and is most common in sinistrals and mixed-handed individuals. Anti-clockwise circling indicates left hemispheric dominance and is most common in dextrals. It was used here as a comparison with, and cross-check of, handedness measured by the EHI (Oldfield, 1971) to give a further indication of cerebral lateralisation of attention pathways (Thiebaut de Schotten *et al.* 2011).

2.2.3.7. Line bisection test

The line bisection test (LB) from the Behavioural Inattention Test Battery (Halligan, Cockburn and Wilson, 1991) was used as a test of pseudoneglect in peri-personal space. It consisted of landscape-oriented, A4 sheets of white paper on which there were three, staggered, black, 0.75 point horizontal lines each 206mm long, one being centrally placed and the other two in the top right or bottom left of the page beginning 15mm from side edge and positioned at 40mm from the top or bottom edge. Since left bisection errors tend to increase with the length of the line to be bisected and may even 'cross over' to a right bias with very short lines, (Heber *et al.*, 2010; Jewell and McCourt, 2000; McCourt and Jewell, 1999), 206mm was chosen as middle of the range of typically tested lengths. Lines placed to the left and right of centre modify the leftward bias effect and any differences between sleepy and rested individuals should become apparent. Participants are asked to make a vertical pencil-mark on each line to indicate where they think its centre point is. Normal judgement of the midpoint of the centrally placed line is slightly to the left of centre and is indicative of pseudo-neglect (Bowers and Heilman, 1980). A mirror image version of this test was also made so that five page positions were covered. Starting position (top/bottom, left/right) was randomised on both tests which gave some control over which cerebral hemisphere was favoured at the outset of the task but not where scanning is initiated or how it progressed across line positions (Jewell and McCourt, 2000; Brodie and Dunn, 2005), it does. Participants found their own strategies for completing this task. Use of the right hand was required in order to control it as a possible source of bias.

2.3.3.8. Landmark test

In addition to the manual LB test, a LMK test (Milner *et al.*, 1992) was used to test visual attention for stimuli presented in extra-personal space. Stimuli were projected onto a screen using a Sony LCD VPL-CX3 Data Projector such that the illuminated area in which stimuli appeared measured 84 wide x 76cm high. A block of 20 LMK stimuli was prepared for presentation in each of seven projection screen positions: centrally, to the centre left or right of the screen and in the four upper and lower corners. Each stimulus consisted of a pair of horizontal lines that initially appeared on screen un-bisected and on both of which vertical bisection lines appeared after 500ms, remaining there until a judgement was made (Figure 2.1.). A programme for this test was written in *E-Prime* (© Psychology Software Tools) setting horizontal lines at 5 pixels wide and 200 pixels long with vertical end bars 5 pixels wide and 4 pixels long. The vertical bisection bar was 3 pixels wide by 4 pixels long. Each pixel was seen as 1.2mm at a viewing distance of 200cm, which was chosen as an intermediate between the longest extra-personal distance reported in pseudoneglect research (270cm: Heber *et al*., 2010) and the more typical one (120cm: e.g. Varnava *et al*., 2002; Gamberini *et al.,* 2008), so that on-screen horizontal lines appeared to be 240mm long (a length similar to the 206mm lines used in the LB task). In each pair of lines, one line was bisected at the exact centre and the other was set in the *E-Prime* (© Psychology Software Tools) programme to be mis-bisected at 0.5, 1.0, 1.5, 2.0 or 2.5mm to the left or right of centre. These ten mis-bisections were presented once each, on the top or bottom of each pair of lines, making 20 trials per block in total and these were repeated in randomised order at each of the seven screen positions. Upper and lower, right and left visual field stimuli appeared at an angle of approximately 10° above or below and to the left or right of participants' central line of vision. Responses were recorded by the experimenter to eliminate the motor component of responding in participants and its influence on hemispheric activation.

2.3.3.9. Chimeric faces test

The chimeric faces test consisted of manipulated, grayscale photographs of two White, British adults' faces, one man and one woman. Faces had a neutral expression on one side and an emotional expression on the other. An *E-Prime* (© Psychology Software Tools), programme was written in order to present images. Each trial consisted of mirror images of the same face presented centrally in a pair, one at the top and the other at the bottom of a computer monitor. There were thus 2 (gender) x 2 (emotion on left or right of face) x 2 (top or bottom screen position) x 6 (emotion) combinations, making 48 trials in all, that were counterbalanced for screen position and side of emotion and randomised in order of presentation. Each emotion was thus presented eight times. The six emotions were fear, anger, disgust, pleasant surprise, sadness and happiness, which are thought to be universal (Ekman, 1972; Ekman and Friesen, 1971). The faces used were of White British people and participants were also drawn from this group.

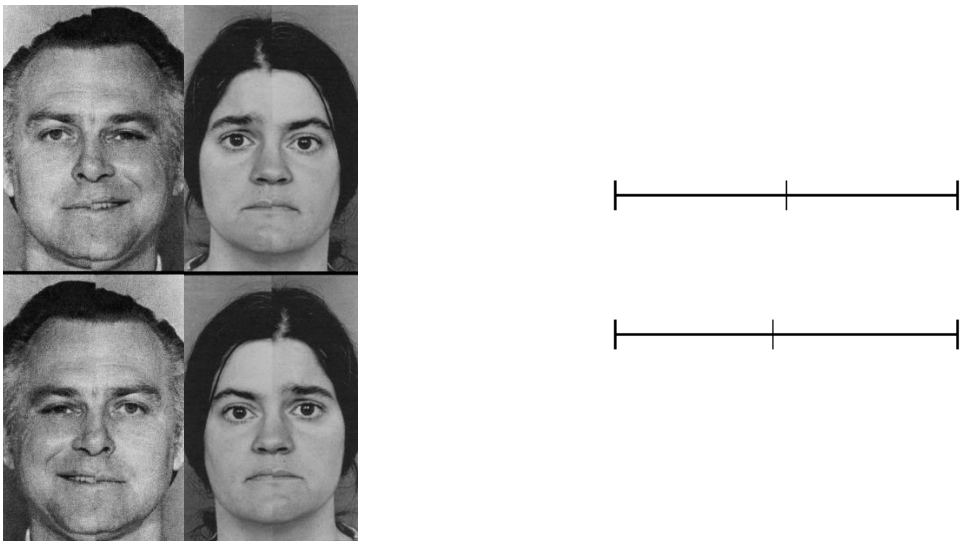


Figure 2.1. Examples of Chimeric Face Pairs (Male: Happy; Female: Sad) and a LMK Trial with Bisections Shown (Top Line Equally Bisected)

The 48 face-pairs were presented centrally on a 55cm, flat-screen, perpendicular, *Iiyama* ProLite B2409HDS computer monitor set to maximum resolution with a 60Hz screen refresh rate. They measured approximately 250 by 775 pixels and on-screen appeared to be approximately 9.25 by 29cm. In each trial, participants were asked to say whether the top or bottom face appeared to express the emotion most strongly (Figure 2.1). Scores from 5 to 8 indicate right hemisphere advantage and a preference for judging the left side of a face as showing the strongest emotion. A score of 4 shows no advantage and scores from 0 to 3 indicate left hemisphere advantage and a preference for judging the right side of a face as showing the strongest emotion.

2.2.4. Procedure

Participants first completed the questionnaire asking for demographic information, sleep patterns, cognitive failures and mood. To assess lateralisation, they completed the EHI and responses to the Torque Test (Blau, 1974) were collected by presenting participants with a sheet of A4 paper in portrait orientation with printed instructions at the top and centre. They were asked to provide a sample of hand-writing by writing ABC with their preferred hand and then immediately drawing a circle round it and to repeat this with their other hand on the lower half of the sheet. Direction of circling was noted as anti-clockwise, which indicated dextrality, as opposed to clock-wise (torque) or both directions which indicated sinistrality or mixed handedness. The relative quality of the handwriting provided a further check of handedness.

Participants completed manual LB tasks beginning from one of four randomised corner starting positions. Test papers were presented to seated participants at desk-top height and placed mid-sagitally by the experimenter. Verbal instructions were given indicating which starting position to use and asking participants to use their preferred writing hand to place a short vertical stroke where the perceived exact mid-point of each line was. All paper and pencil tests were completed in glare-free, daylight conditions using daylight simulating lighting when necessary.

Prior to beginning the LMK experiment, participants were seated comfortably in an adjustable, office armchair, positioned centrally and directly in front of a projection screen. The projector lens was positioned so that participants were at a viewing distance of 2m from the screen and their line of vision was directed at its centre. Chin rests or head-restraints were not used because of the potential discomfort these might cause over long testing times. Instead, participants wore a supportive, inflatable neck pillow to discourage head turning and were asked, and periodically reminded, to remain facing forward and to move their eyes to view laterally presented stimuli rather than their heads. Participants were shown a sample trial of a pair of lines on which bisections appeared while on screen so that it looked like Figure 2.1. Participants were informed that one line had been bisected exactly in half and the other a little off-centre. They were given standardised instructions to explain that they would see a number of similar images and that they should decide, as soon as possible, which of the two lines appeared to them to be exactly bisected, to indicate this by saying ‘top’ or ‘bottom’ and to make a best guess if they could not tell. Before each block of 20 trials participants were told where on the screen to expect the stimuli to appear. In each trial, a pair of horizontal lines appeared on screen as a prime, then the vertical bisection lines appeared on them after 500ms and the image remained until a response was made. The next trial followed automatically until all 20 had been presented. Responses were recorded immediately by the experimenter, who was unable to see the screen, and collated automatically by the *E-Prime* (© Psychology Software Tools) programme.

To prepare for the chimeric faces test, participants were shown a list of names of the six emotions that were to be used and sample male and female face pairs as in Figure 2.1. They were seated squarely in front of an *Iiyama* ProLite B2409HDS computer monitor set to maximum resolution with a 60Hz screen refresh rate that was adjusted so that their line of vision was directed at its centre and the screen was approximately 50cm from their faces. On screen instructions stated:

> ‘*You are about to view a series of photographs, one above the other. The faces are a little odd as one side of the face shows an emotion and the other does not. Your task is to decide which of the two faces on each screen is the best example of the emotion displayed (i.e. the more intense example of the emotion).*’

In each of the 48 trials, participants were primed with a centrally-placed, on-screen, emotion label for 5 seconds and this was followed by a corresponding face-pair that remained on screen for a further 5 seconds. They were asked to decide as quickly as possible which image appeared to be the most intense by saying ‘top’ or ‘bottom’ and to make a best guess if they could not tell. Responses were recorded immediately by the experimenter, who was unable to see the screen, and collated automatically by the *E-Prime* (© Psychology Software Tools) programme.

2.3. Results

2.3.1. Demographic data

Twenty-eight (male = 8) participants remained after selection from the original sample of 38. M (SD) age = 51.11 (9.21) and males and females did not differ in age ($t_{(26)} = 0.39$, $p = .72$, two-tailed).

2.3.2. Current sleep patterns compared to normal patterns.

Table 2.1.

Normal (Preferred) and Current Sleep Patterns: M (SD) and Reported Range

	M (SD)		Range	
	Normal	*Current*	*Normal*	*Current*
Sleep duration per night (hrs.)	7.58 (0.85)	7.85 (0.83)	6.00-9.25	6.00-9.50
Awakenings per night	1.30 (1.04)	3.00 (2.27)	0-5	0-5
Quality of sleep (1 awful - 10 excellent)	7.34 (1.94)	6.70 (2.05)	3-10	3-10
Nap time during the day (hrs.)	0.47 (0.55)	0.32 (0.50)	0-2	0-2

Note: N = 28, male n = 8, female n = 20.

Statistical tests comparing participants' normal (preferred) sleeping pattern with their current pattern (Table 2.1.) showed that differences were significant at $p \leq .02$ (two-tailed) for all except preferred sleep hours ($p = .10$, two-tailed). On average, although participants thought that their current sleep duration was adequate, they currently woke more often at night, had poorer quality sleep and napped less in the day than they considered normal for themselves. This pattern remained when participants were considered separately in sleepy and normal groups as defined by their Epworth Sleepiness Scale (ESS) scores. Participants also responded to additional sleep-related questions. Mid-range scores were noted for 'waking earlier than preferred, low, positively skewed scores for insomnia, oversleeping and lateness and high, negatively skewed scores for the importance of good sleep.

Selection criteria asked for participants who did not have diagnosed sleep problems and who did not take medication that affected sleep, but further questions were asked about the incidence and frequency of sleep problems as an additional check. Low frequencies amongst the 28 participants were found for occasional insomnia (n = 4), snoring (n = 4), nightmares (n = 4), restless legs (n = 3), sleep-talking (n = 1) and sleep walking (n = 0). No-one reported more than one problem. In some of these cases participants were only aware of a problem because they had been told about it by their sleeping partner, and since all of those who answered questions about sleep location slept with a partner, the overall impression is that good sleep patterns were the norm in this sample since it is unlikely that participants and their sleeping partners would both be unaware of a problem.

Twenty six out of 28 participants answered questions about where they habitually slept and whether they were disturbed by their partner. All of them said that they slept in the same room as their partners. Twelve (46%) participants said that their partner disturbed their sleep compared with 14 (54%) who said they were not disturbed. This is considerably more than the Great British Sleep Survey (2012) finding that 34% out of their 20,814 respondents across the UK claimed to be disturbed by their partner. Sleepiness scores did not differ between people disturbed by their partner or not ($t_{(25)} = 0.70$, $p = .49$, two-tailed).

A sleep fragmentation index (SFI) was calculated as a measure of sleep continuity during the night by dividing current total number of awakenings, which included getting out of bed, by sleep hours. It is thought to mark shifts from deeper NREM or REM sleep to Stage 1 sleep (Haba-Rubio *et al.,* 2004). Lower values indicate better sleep continuity and zero indicates no awakening at all. As a whole group participants' SFI was low (M = 0.37, SD = 0.26, n = 28) and the sleepy and normal ESS sub-groups' SFI scores did not differ ($t_{(38)} = 0.26$, $p = .71$, two-tailed).

Correlations between SFI and other sleep-related variables were explored for participants classified on the ESS as normal or sleepy. No relationships were found between SFI and ESS score, distress due to sleep disturbance and daytime naps. For normal participants, higher SFI was related to disturbance by partner (rho $_{(15)}$ = .80, $p < .001$, two-tailed), anxiety (rho $_{(16)}$ = .52, p = .03, two-tailed) and disturbance in the final third of the night (rho $_{(16)}$ = .51, p = .02, two-tailed). In the sleepy group higher SFI was, counter-intuitively, negatively correlated with CFQ (rho $_{(12)}$ = -.64, two-tailed) and with anxiety (rho $_{(12)}$ = -.63, p = .03, two-tailed).

2.3.3. Predictors of Cognitive Failures Questionnaire scores.

While multiple regression analysis would have been ideal for testing predictors of CFQ, participant numbers were relatively low so correlations were calculated instead separating normal and sleepy participants. In accordance with Ferrara and De Gennaro's (2001) recommendations about the importance of individual somnotypology in sleep disruption studies, age, gender, preferred length of sleep, sleepability (napability) and morning/eveningness (circadian preference) were considered as predictors of CFQ scores. No significant results were found ($p \geq .18$, two-tailed) suggesting that, for this sample at least, individual somnotypology variables are not clear predictors of CFQ scores. Next, relationships between CFQ, ESS and the two HADS mood scales measuring anxiety and depression were tested. The only significant relationship found was between CFQ and anxiety in the sleepy group (rho $_{(12)}$ = .61, p = .04, two-tailed). All other tests were non-significant ($p \geq .12$, two-tailed). Total ESS score and any one of its questions did not correlate with CFQ for all participants together and for normal or sleepy participants alone ($p \geq .10$, two-tailed). Table 2.2. summarises descriptive statistics for CFQ and other variables considered in this section. CFQ scores compare well with those provided by Knight, McMahon, Green and Skeaff (2004) from 270 mentally and physically healthy men and women aged 65 and over as well as younger adult groups: CFQ M(SD) = 32.10 (10.66). Normal and sleepy groups differed as expected in total ESS score ($t_{(26)}$ = 11.54, p = .001, one tailed). There were no differences in the two groups' preferred sleep hours that had earlier been shown not to differ from actual sleep hours. Napability and morning-eveningness scores were generally mid-range and did not differ between groups ($p \geq .14$, two-tailed). On the two HADS mood scales, scores of 8 to 21 indicate mild to severe anxiety, so the mean scores for these participants fell within the normal range and did not differ between normal and sleepy groups ($p \geq .87$, two-tailed).

Table 2.2.

M (SD) and Scale Ranges for CFQ, ESS, Somnotypology Variables and HADS Anxiety and Depression Mood Scales

Scale	Normal	Sleepy	All	Scale range
CFQ	35.56 (10.10)	38.42 (10.22)	36.79 (10.06)	0-100
ESS	4.81 (2.11)	12.42 (1.00)	8.07 (4.19)	0-24
Preferred sleep hours	7.77 (0.86)	7.33 (0.81)	7.58 (0.85)	0-24
Napability	5.13 (3.07)	6.75 (2.26)	5.82 (2.83)	1-10
Morning-eveningness	4.87 (2.60)	4.17 (2.37)	4.57 (2.49)	1-10
HADSANX	6.44 (2.83)	6.25 (2.93)	6.36 (2.82)	0-21
HADSDEP	3.44 (2.28)	3.50 (2.65)	3.46 (2.40)	0-21

Note: N = 28, normal n = 16, sleepy n = 12; male n = 8, female n = 20; age range = 31-68 years. In HADSANX and HADSDEP 0-7 is considered low/normal.

2.3.4. Line bisection

In order to randomise start position, participants had bisected lines in two conditions (top right, centre, bottom left and top left, centre, bottom right). No significant differences were found in the bisection errors for left top vs. bottom, right top vs. bottom or the two central positions in these conditions ($p \geq .23$, two-tailed, in all tests) so bisection errors for left, central and right positions were combined (Table 2.3. and Figure 2.2). Single sample t-tests showed that, for normal people, LBs did not differ from zero in any of the conditions but for sleepy people they were all leftwards and differed from zero in the right condition ($p = .04$, one-tailed), marginally so in the centre condition ($p = .08$, one tailed) and not at all in the left condition ($p = .39$, one tailed). A factorial 2 x (3) sleepiness group x line position ANOVA revealed no main effect for line position ($F_{(2, 52)} = 1.13$, $p = .33$) and no interaction between line position and sleepiness ($F_{(2, 52)} = 0.65$, $p = .53$) but there was a marginal, overall main effect for sleepiness group ($F_{(1, 26)} = 3.42$, $p = .08$) such that all bisections tended to drift more to the left of centre for sleepy participants (M normal = 0.09mm; M sleepy = -1.26mm). The effect size bordered on medium; $r = .26$ (compared to the benchmark value of $r = .30$, Field, 2009) and appeared to result mainly from the difference between the two groups' right position bisection means ($t_{(26)} = 2.10$, p = .05, two-tailed, r = .27) since means at the central and left positions did not differ (≥ p .33, two–tailed).

To check for the possible influence of gender, a 2 x (3) ANOVA was computed for gender x line position with no significant main effects or interaction found ($p \geq .21$). An average measure of all bisection errors showed no tendency for all males and females to differ in leftward drift (male M (SD) = -1.24 (1.25); female M (SD) = -0.19 (2.17); $t_{(26)} = 1.28$, p = .21, two-tailed). Exclusions made before carrying out the sleepiness analyses had left an imbalance of males and females in the two ESS groups such that there were 42% males in the sleepy group compared to 19% in the normal group. While male N was too small in the normal group to allow for meaningful comparisons, male and female LB scores at all line positions and overall for sleepy participants were compared and there were no significant differences ($p \geq .60$, two-tailed). It had already been determined that age did not differ between the normal and sleepy groups and that males and females did not differ in sleepiness (see ‘Participants’). These analyses suggest that the sleepiness effect on leftward drift in these data is not affected by age or gender. The addition of anxiety and depression separately as covariates showed that neither attenuated the sleepiness main effect in the sleepiness x line position ANOVA.

Table 2.3

Mean (SD) Deviations from Centre in mm on the Line Bisection Task in Normal and Sleepy ESS groups

	Line position		
ESS group	Left	Centre	Right
Normal	0.36 (3.26)	-0.42 (2.67)	0.33 (2.13)
Sleepy	-0.23 (2.59)	-1.58 (3.57)	-1.96 (3.63)
Total	0.11 (2.95)	-0.92 (3.10)	-0.65 (3.03)

Note: N = 28; normal n = 16, sleepy n = 12. Negative values indicate left of centre deviations.

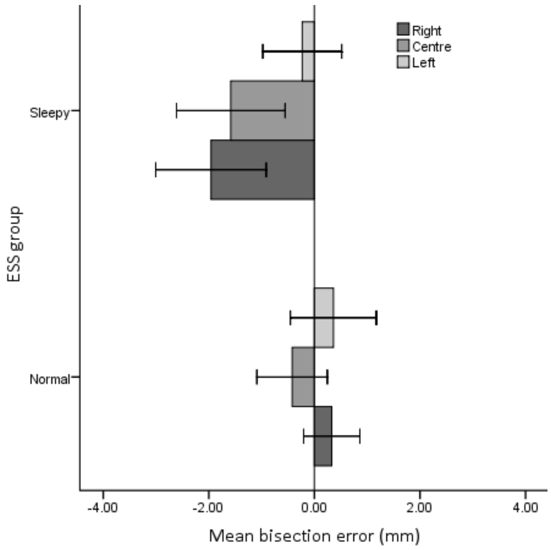


Figure 2.2. Line Bisection Error Means (mm) ± 1 SE by Position and ESS Group. (Normal n = 16, Sleepy n = 12; negative values indicate left errors, positive values indicate right errors)

2.3.5. Landmark test

A four-way, 2 x (2 x 2 x 3) factorial ANOVA was used to examine error rates in six screen positions excluding the central condition (see Table 2.4. for all sample statistics). The between groups factor was ESS score on two levels (normal and sleepy) and the within groups factors were visual field (upper, central and lower), screen side (left and right) and type of error (left and right). Firstly, it was confirmed that LMK error detection rates differed from zero in all 24 samples used in the analysis ($p \leq .01$, one tailed) with the marginal exception of sleepy, top right, left errors ($p = .06$, one tailed). The ANOVA revealed just one significant interaction between the side of the screen on which the LMK stimulus appeared and the side of the bisection error ($F_{(1, 26)} = 73.47$, $p < .001$, $r = .86$: a very large effect size) suggesting that more right than left errors were made on the right screen position and more left than right errors were made on the left screen position (see total means in Table 2.4). Post hoc analyses using t-tests with Bonferroni corrections for multiple comparisons (such that alpha = .01) confirmed that the interaction was due to more left errors on the left than the right side ($t_{(27)} = 5.64$, $p < .001$, two-tailed, $r = .73$) and more right errors on the right than the left side ($t_{(27)} = 5.22$, $p < .001$, two-tailed, $r = .71$). There were also more left than right errors on the left ($t_{(27)} = 2.93$, $p = .007$, two-tailed, $r = .49$) and more right than left errors on the right ($t_{(27)} = 3.73$, $p = .001$, two-tailed, $r = .58$). All effect sizes (r) were large or very large. The tendency to make right errors on the right did not differ from the tendency to make left errors on the left ($t_{(27)}$ = 0.88 p = .39, two-tailed, r = .17) neither did the tendency to make left errors on the right and right errors on the left ($t_{(27)}$ = 0.80, p = .43, two-tailed, r = .13).

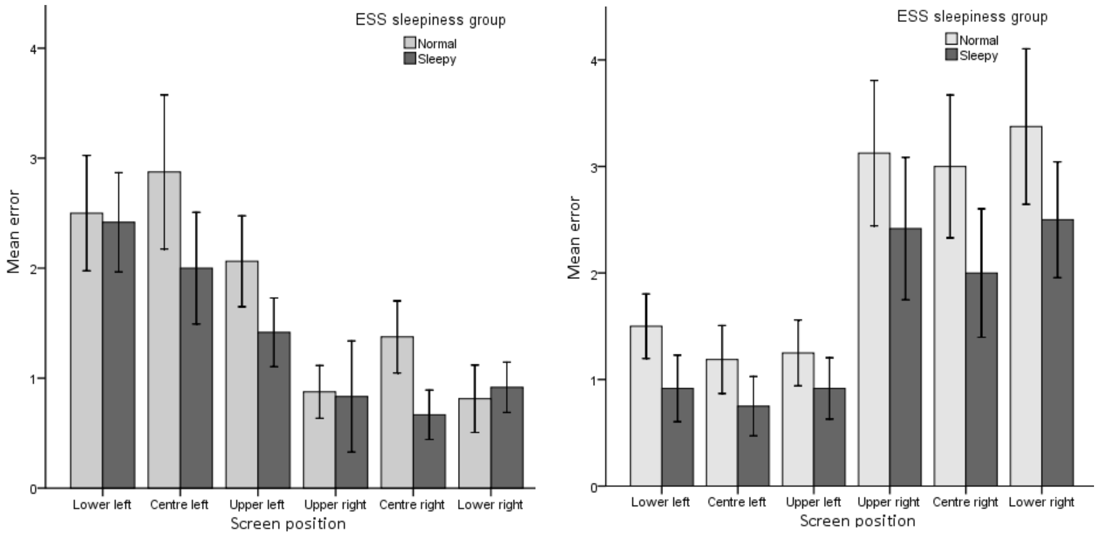
These results suggest that there is no asymmetry in the tendency to make left errors on the left compared with right errors on the right or to make left errors on the right and right errors on the left. It thus appears that attentional biases are greatest and equal in the contralateral visual fields and least and equal in the ipsilateral visual fields for both hemispheres. Failure to detect a left mis-bisection, and see it as equally bisected, indicates a leftward attentional bias in that the left of a line is seen as longer. In these results, this tendency is greatest for the left visual field, implicating dominance of the right hemisphere, but the bias shifts to the right in the right visual field suggesting an equally potent attentional shift to the left hemisphere. There were no main effects for the three within groups factors and no interactions between them and visual field ($p \geq .27$), the latter indicating that upper, central or lower presentation bore no relation to perception of bisection position.

Table 2.4

Mean (SD) Undetected Left and Right Errors out of 10 on All Line Positions on the LMK Test in Normal and Sleepy ESS Groups.

	Left errors				Right errors			
	Left screen		Right screen		Left screen		Right screen	
Visual field	Normal	Sleepy	Normal	Sleepy	Normal	Sleepy	Normal	Sleepy
Upper	2.06 (1.65)	1.42 (1.08)	0.87 (0.96)	0.83 (1.75)	1.25 (1.24)	0.92 (1.00)	3.13 (2.73)	2.42 (2.31)
Central	2.88 (2.80)	2.00 (1.76)	1.38 (1.31)	0.67 (0.78)	1.19 (1.28)	0.75 (0.96)	3.00 (2.68)	2.00 (2.09)
Lower	2.50 (2.10)	2.42 (1.56)	0.81 (1.22)	0.92 (0.79)	1.50 (1.21)	0.92 (1.08)	3.38 (2.92)	2.50 (1.88)
Total	2.25 (1.56)		1.12 (0.92)		0.93 (0.95)		2.80 (2.14)	

Note: Normal n = 16; Sleepy n = 12. Centre screen condition: Normal left errors = 1.06 (1.34), Sleepy left errors = 0.75 (0.97), Normal right errors = 2.19 (1.64), Sleepy right errors = 1.33 (1.50).



Left errors Right errors

Figure 2.3. Mean ± 1 SE Undetected Left and Right Errors out of 10 on All Line Positions on the LMK Test in Normal and Sleepy ESS Groups. (N = 28. Normal n = 16, Sleepy n = 12)

To check for the possible influence of gender, the four-way ANOVA was repeated replacing ESS group with gender as the between groups factor. The significant interaction between screen side and error side remained and the gender main effect was non-significant ($p = .21$). These analyses suggest that gender was not influential in responses to the LMK test. Adding anxiety and depression separately as covariates to the original four-way ANOVA had no effect on the screen side x error side interaction.

Sleepiness did not interact with any of the other factors but there was a significant main effect for normal compared with sleepy ESS groups ($F_{(1, 26)} = 4.78$, $p = .04$, $r = .39$). This was due to sleepy people making fewer detection errors ($M = 1.48$, $SD = 0.42$) than normal people ($M = 1.99$, $SD = 0.73$) across the 120 judgements they each made in all screen positions combined. The effect size ($r = .39$) falls between the medium and large benchmark values of .30 and .50 suggested by Field (2009). Furthermore, when right and left errors were broken down by the six screen positions and by sleepiness group, Table 2.4. and Figure 2.3 show that sleepy group means tended to be lower than normal group means in all conditions except for lower-right screen left errors. In the seventh, centre screen condition this pattern was repeated with normal left errors exceeding sleepy ones and normal right errors exceeding sleepy ones although not significantly so ($p \geq .17$, see footnote for Table 2.4). There were, however, marginally more right than left errors for normal people in the central position ($t_{(15)} = 1.95$, $p = .07$, two-tailed, $r = .34$) but not for sleepy people ($t_{(11)}$ = 0.96, p = .36, two-tailed, r = .28). To check for the possible influence of gender, the four-way ANOVA was repeated replacing sleepiness group with gender but no significant main effects or interactions were found (p ≥ .17). A comparison of mean errors across all positions also showed no difference (male M (SD) = 1.52 (0.40); female M (SD) = 1.88 (0.72); $t_{(26)}$ = 1.30, p = .21, two-tailed) and this was also true for the sleepy group alone (p = .73, two-tailed). As with LB, it had already been determined that age did not differ between the normal and sleepy groups and that males and females did not differ in sleepiness (see section 2.2.2.). Adding anxiety and depression separately as covariates to the original four-way ANOVA had no effect on what consequently appears to be a robust sleepiness main effect.

TOT may also play a part in mediating error rates although it was not excessively long; for normal participants M (SD) = 18.26 (4.48) minutes and for sleepy participants M (SD) = 16.98 (4.15) minutes. No-one took longer than 30 minutes to complete the LMK test and participants completed all testing in under an hour. When tested as a covariate in the four-way ANOVA, TOT was non-significant (p = .82). Time of testing in the day, which ranged from 10am to 8pm, similarly had no effect (p = .63).

2.3.6. Chimeric faces test

In the chimeric faces test a score greater than 4 on the 0-8 scale for each of the six universal emotions indicates left hemi-face preference. Mean scores for sleepy and normal participants' left choices are shown in Table 2.5. and they were found to be significantly greater than 4 (p ≤ .05, one-tailed) in all cases except for sleepy surprise (p = .14, one-tailed). Following suggestions by Workman *et al.* (2000) three levels of emotional valence were computed by averaging scores for pro-social emotions indicating potentially non-threatening situations (happiness + surprise), ambiguous emotions indicating potentially approach/avoid situations, (sadness + disgust) and anti-social emotions indicating potentially threatening situations (fear + anger). The means of these new variables were also significantly greater than 4 (p ≤ .05, one tailed).

Table 2.5.

Mean (SD) Left Choices Out of Eight for Six Universal Emotions and Combined Non-threat/Ambiguous/Threat Valence Categories

	Emotion					
ESS group	Happiness	Surprise	Sadness	Disgust	Fear	Anger
Normal	5.81 (1.42)	5.19 (1.80)	5.00 (2.22)	4.94 (1.48)	4.94 (2.08)	4.88 (1.75)
Sleepy	5.33 (2.10)	4.67 (2.06)	5.42 (1.44)	5.17 (2.16)	5.92 (1.38)	5.92 (1.24)
Total	5.61 (1.72)	4.96 (1.90)	5.18 (1.91)	5.04 (1.77)	5.36 (1.85)	5.32 (1.61)

	Non-threat valence	Ambiguous valence	Threat valence
Normal	5.50 (1.44)	4.97 (1.66)	4.91 (1.74)
Sleepy	5.00 (1.87)	5.30 (1.14)	5.92 (1.06)
Total	5.29 (1.62)	5.11 (1.44)	5.34 (1.55)

Note: N = 28. Normal n = 16; Sleepy n = 12. Non-threat valence= (Happiness + Surprise)/2, Ambiguous valence = Sadness + Disgust/2, Threat valence = (Fear + Anger)/2.

When mean left choices for all emotions were considered together there was no overall tendency for sleepy people to make more left choices than normal people ($t_{(26)} = 0.57$, $p = .57$, two-tailed) although both groups means were greater than 4 ($p \leq .003$, one tailed) and the effect size for sleepy people was greater than for normal people ($r = .80$ and $r = .64$ respectively). A two-way, 2 x (3) factorial ANOVA was carried out to test for an interaction between sleepiness and emotional valence with the between groups factor on two levels (sleepy and normal) and the within groups factor on three levels (non-threat, ambiguous and threat valence) with respect to left hemi-face choices. The interaction was significant ($F_{(2, 52)} = 3.65$, $p = .03$) and post hoc analysis indicated that this was due to the sleepy participants making more left choices than normal participants in the threat valence condition ($t_{(26)} = 1.77$, $p = .04$, $r = .33$, one-tailed), the effect size being medium. Non-significant differences between groups were observed for non-threat and ambiguous valence conditions ($p \geq .22$). See also Figure 2.4., which is suggestive of lateralisation trends in opposite directions for sleepy and normal participants with respect to magnitude of threat. The addition of age as a covariate made a minor difference to the interaction ($F_{(2, 52)} = 3.52$, $p = .04$). Gender, however, appeared to play a part in that repeating the ANOVA, replacing sleepiness with gender as the between groups factor, resulted in a main effect for gender ($F_{(1, 26)}$ = 4.11, p = .05). Females made more left choices out of 48 than males (female M (SD) = 33.20 (7.56); male M (SD) = 27.12 (5.69)). There was no interaction between valence and gender (p = .16). Within the sleepy group, no gender differences were found in frequency of left choices for threat and ambiguous valence but there was a marginal difference in the non-threat condition in which females made slightly more left choices (p = . 08, two-tailed).

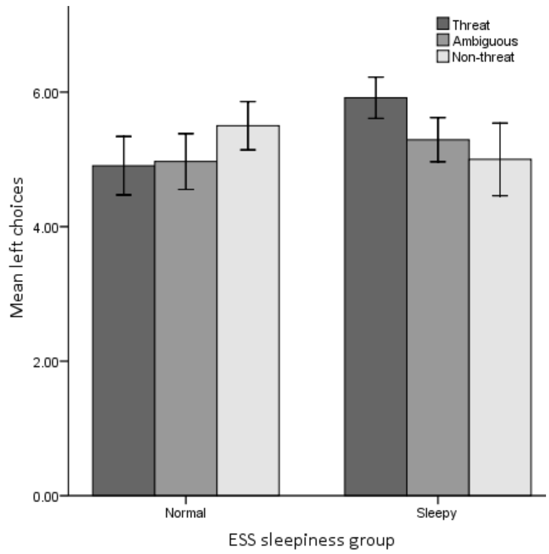


Figure 2.4. Mean ± 1 SE Left Hemi-face Choices out of 8 in Threat, Ambiguous and Non-threat Valence Conditions in the Chimeric Faces Test in Normal and Sleepy ESS Groups. (Normal n = 16, Sleepy n = 12)

A second two-way, 2 x (3) factorial ANOVA was carried out to test for an interaction between sleepiness and emotional valence with the between groups factor on two levels (sleepy and normal) and the within groups factor on three levels (non-threat, ambiguous and threat valence) with respect to reaction times (RT) for left hemi-face choices. Descriptive statistics for all conditions are shown in Table 2.6. along with values for the three emotional valence variables. There was a significant main effect for valence alone ($F_{(2, 52)}$ = 2.63, p = .003) such that mean RT in the ambiguous emotion valence condition was slower than in both the non-threat (p = .004) and threat valence (p = .05) conditions. Sleepiness appeared not to contribute to the variance in RT in any way except in a non-significant trend to be faster in all conditions and there was no interaction between sleepiness and valence. Repeating the 2 x (3) ANOVA with gender instead of sleepiness group as the independent factor resulted in attenuation of the valence effect alone (p =

.01) but there was no gender main effect or interaction ($p \geq .69$). Sleepy male and female RT did not differ in any of the three valence conditions ($p \geq .22$).

Table 2.6.

Mean (SD) Reaction Time (ms) for Six Universal Emotions and Combined Non-threat/Ambiguous/Threat Valence Categories.

	Emotion					
ESS group	Happiness	Surprise	Sadness	Disgust	Fear	Anger
Normal	3516.45 (1115.34)	3561.41 (1295.87)	4254.04 (1808.29)	3907.59 (1248.85)	4274.98 (2109.89)	3438.59 (1109.26)
Sleepy	3470.79 (1225.25)	3370.35 (1435.16)	3454.93 (1229.47)	4112.00 (2381.29)	3383.96 (1162.55)	3460.11 (1573.04)
Total	3496.88 (1141.60)	3479.53 (1334.66)	3911.57 (1610.79)	3995.19 (1785.30)	3893.12 (1795.93)	3447.81 (1300.70)

	Non-threat valence	Ambiguous valence	Threat valence
Normal	3538.93 (1152.00)	4080.81 (1418.79)	3856.79 (1519.39)
Sleepy	3420.57 (1243.75)	3783.47 (1757.18)	3422.03 (1293.80)
Total	3488.21 (1170.93)	3953.38 (1548.78)	3670.47 (1418.62)

Note: Normal n = 16; Sleepy n = 12. Non-threat valence= (Happiness + Surprise)/2, Ambiguous valence = Sadness + Disgust/2, Threat valence = (Fear + Anger)/2.

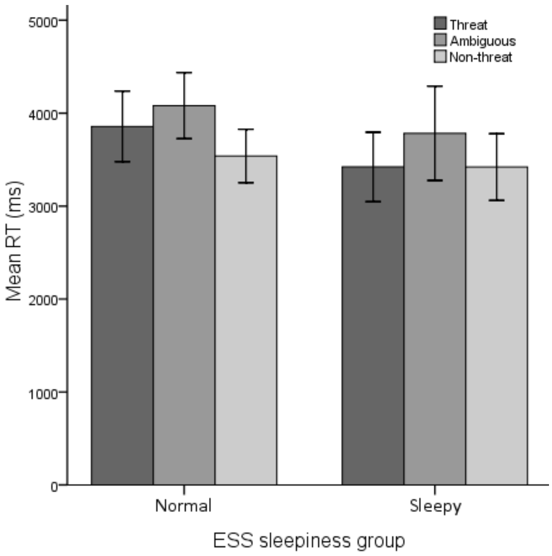


Figure 2.5. Mean ± 1 SE Reaction Time (ms) to Left Hemi-faces in Threat, Ambiguous and Non-threat Valence Conditions in the Chimeric Faces Test in Normal and Sleepy ESS Groups. (Normal n = 16, Sleepy n = 12)

2.4. Discussion

2.4.1. Sample characteristics

The 28 participants selected for this study ranged in age from 31 to 68 years and 71% were female. They were in good health, were not taking medication that affected sleep and had no suspected or formally diagnosed sleep problems. On average they slept for M (SD) = 7.85 (0.83) hours per night, which they thought was normal and sufficient for themselves, but both sleepy and normal participants perceived they napped less and had slightly worse quality sleep than they would have preferred. They rarely overslept or were late for work or appointments and all considered good sleep to be personally very important. The incidence of sleep problems such as occasional insomnia or nightmares, which had been pre-screened but was double-checked, was extremely low. Just under half of participants in both normal and sleepy groups reported that their sleep was disturbed by their sleeping partner but these participants were no more sleepy than those who said they were undisturbed. Sleep fragmentation was low for all participants. CFQ scores were close to the norms reported by Knight *et al.* (2004) for people aged 65+ years and in younger adult groups and did not correlate with sleepiness measured using the ESS. In the sleepy group alone CFQ correlated positively with anxiety and negatively with sleep fragmentation and anxiety and sleep fragmentation correlated negatively. Both anxiety and sleep fragmentation scores, however, were low and positively skewed. Anxiety and depression measured on the HADS were both within normal ranges. The overwhelming impression is, therefore, that these participants were in good physical and mental health with healthy sleep patterns and no sleep problems or subjectively assessed cognitive deficits. The only systematic difference between them was that some were significantly more sleepy than others and this had measurable effects in three tests of lateralised attention.

2.4.2. Line bisection

Manual LB in peri-personal space was expected to show the widely corroborated, leftward bias characteristic of pseudoneglect (Gamberini *et al.,* 2008; Heber *et al.* 2010; Longo and Lourenco, 2006; Varnava *et al.,* 2002). According to the hemispheric activation/orientation hypothesis (Kinsbourne, 1987, 1970), this effect should become more pronounced as a line moves from the right visual field to the left, and in LB lead to greater leftward drift on lines in the right visual field and vice versa. It was further argued that, if the right hemisphere remains more vigilant than the left when sleepy (Casagrande and Bertini, 2008a, 2008b; Dufour *et al.,* 2007; Manly *et al.,* 2005), and Cavézian *et al.* (2102) are correct in their conclusion that bilateral hemisphere activation occurs in peri-personal LB, the combination of a vigilant right hemisphere with increased asymmetry in cerebral activation should lead to an exaggerated tendency to drift leftward in LB, especially when the stimulus is shifted rightwards. Contrary to the general prediction that leftward bias would occur centrally and shift predictably to left or right, it was not evident in the normal group but did occur in the sleepy group, although the effect was marginal and was due to the relatively greater, and expected, leftward drift on the right-hand line. There were relatively more males in the sleepy group (42%) compared to the normal group (19%) so the possibility that gender played a part was investigated, as Stancey and Turner (2010) had suggested that adult females manually bisect more accurately than males in peri-personal space. Nevertheless no gender differences were found.

There are several further considerations that strengthen the argument that sleepiness was responsible for the observed effects. Firstly, in both sleepy and normal groups participants were matched closely in all measured variables such as sleep fragmentation, sleep preferences, sleep adequacy and mood, which afforded a good degree of control. Secondly, various features of the design worked against encouraging overly leftward bias. At 206mm the lines used were in the middle of the range of typically used lengths and less likely to elicit the exaggerated left bias that has been shown to occur with longer lines (Heber *et al*., 2010; Jewell and McCourt, 2000; McCourt and Jewell, 1999). In addition, scanning from the left has been shown to exaggerate left bias (Jewell and McCourt, 2000) and, although scanning direction could not be strictly controlled, some attempt was made to discourage consistency by randomised starting positions and the requirement to move from both right to left and left to right on LB tests. Thirdly, Hausmann *et al.,* (2002) showed that, although there was no overall difference between males and females in left bias, it was significantly reduced in men, relative to women, if they used their right hand. In the current study, all participants were strongly right-handed and bisected lines with that hand. While this should have activated the left hemisphere in everyone and work against left bias, leftward drift in men, who were relatively more numerous in the sleepy group compared to the normal group, should have been even less and further depressed the overall group mean. Finally, the statistical analysis suggests that age cannot account for the differences since it did not differ between groups and was non-significant as a covariate. In any case, if it is true that leftward bias declines with age after 30 (Cabeza, 2002; Mill *et al.* 2009; Schmitz and Peigneux, 2011; Suzuki *et al.* 2007) particularly in men (Chen *et al.* 2011) both of these should have reduced leftward bias in a sample aged between 31 and 68 years and in which 42% of the sleepy group were male. In short, the design of the LB task was such that it mitigated in several ways against leftward bias. It is likely, therefore, that this is the reason for the lack of leftward bias in normal participants and the only marginally significant effect in sleepy participants. The fact that there was still a bias in sleepy people, even though the design worked against exaggerating it however, might be simply explained as a relatively more vigilant right hemisphere increasing a tendency to scan from the left.

2.4.3. Landmark test

A LMK test in extra-personal space is likely to produce very different results from the peri-personal, manual LB task just described. Typically, extra-personal tasks do not show the leftward bias common in peri-personal space and predicted by the hemispheric activation/orientation model (Kinsbourne, 1987, 1970) possibly because different attentional mechanisms are involved (Gamberini *et al.,* 2008; Heber *et al.* 2010; Longo and Lourenco, 2006; Varnava *et al.,* 2002). In addition Cavézian *et al.* (2012) showed that LB and LMK tests in peri-personal space, requiring ocular responses, tend to produce bilateral or right hemispheric activation respectively so there may also be differences in extra-personal space. In this study, participants made extra-personal, visual judgements without a proprioceptive element so the effect of left hemispheric activation due to using the right hand was removed and, due to the distance involved, it would not necessarily be expected that there would be right hemispheric activation. It was argued that sleepiness (Dufour *et al.*, 2007; Manly *et al.,* 2005) combined with extra-personal space, both of which appear to reduce left bias, would enhance accuracy of LMK judgements.

In accord with the symmetry prediction, the tendency to make right errors on the right and left errors on the left were equal and large (a contralateral field effect) and the tendency to make left errors on the right and right errors on the left were equal and small (an ipsilateral field effect). 'Left as longer' errors of judgement bias in the left visual field were equalled by the opposite judgement in the right visual field indicating no hemispheric asymmetry. In the central condition some evidence was found for classic pseudoneglect in that the normal group made more right than left errors but no difference for the sleepy group was found, as though the effect in this position was attenuated. The most robust effect found was that sleepy people made more accurate judgements overall. There was no evidence that TOT, which is thought to be associated with rightward drift (Dufour *et al.*, 2007; Fimm *et al.*, 2006; Kendall *et al.*, 2006; Manly *et al.,* 2005), mood or time of day when tested had any influence on these results.

Finally, with regard to visual field, Thomas and Elias (2011, 2010) found that attentional bias was stronger in the lower visual field but no effects were found in the current data. This may have been due to methodological differences as Thomas and Elias presented stimuli in peri-personal space and required a luminosity (greyscale) judgement rather than using extra-personal LMK. Furthermore, there was no evidence that gender, raised as a possible concern in LB, had any effect on patterns of responding. Finally, age had no effect on LMK judgements in these 31 to 68 year olds so there is no evidence to suggest that attention shifts rightwards with increasing age (Cabeza 2002, Chen *et al.*, 2011; Collins and Mohr, 2013; Failla *et al.,* 2003; Schmitz and Peignuex, 2011) but there is little extra-personal space literature with which to make comparisons. The superior accuracy of males over females in laser line bisection in extra-personal space shown by Stancey and Turner (2010) was a different task to the LMK test and was based on testing mainly 19 year olds who are not comparable to the current sample and whose visuo-spatial performance may simply be explained by males' greater experience with on-screen computer games played in extra-personal space with remote controls (Feng, Spence and Pratt, 2007).

2.4.4. Chimeric faces

When considered as a whole group, across all six emotions, the expected general tendency to choose left hemi-faces as being more intense in emotional expression was observed (Darby and Walsh, 2005; Jessimer and Markham, 1997; Kucharska-Pietura *et al.*, 2003) and, although sleepy people did not differ significantly from normal people in this, the effect size was larger for them (r = .80) than it was for normal people (r = .64). This provides only partial support for Manly *et al.* (2005) and Dufour *et al.* (2007) who suggested that the right hemisphere remains more vigilant than the left when ordinarily sleepy and at sleep onset and, as a consequence, left preference would become more pronounced.

With regard to emotional valence it was expected that a slightly sleepy right hemisphere would nevertheless remain relatively more vigilant for emotional threat signals (Chuah *et al.* 2010; Franzen *et al.*, 2009; Marín and Lopera, 2009; Yoo *et al.*, 2007) and less so for ambiguous or non-threat emotions. It was found that sleepiness did interact with emotional valence such that more left choices were made in the threat valence condition by sleepy compared to normal people and, in both the ambiguous or non-threat conditions, left choices were lower than in the threat condition and did not differ from each other.

Contrary to the findings of Phillips *et al.* (2004) and Van der Helm *et al.* (2010) who showed a slowing of reaction times and a blunting of responses to negative emotions after sleep deprivation, the prediction that, in contrast, slight sleepiness could be expected to lead to faster responding to threat was partially upheld. RT to threat and non-threat emotional stimuli did not differ but both were faster than to ambiguous stimuli suggesting that lack of clarity, as opposed to level of threat, was responsible.

With regard to gender, the most marked effect was that females tended to make more left choices in general than males and marginally more so in the non-threat valence condition but no other effects were found for left choices and valence or for RT and valence that might indicate a blunting of responses (Van Der Helm *et al.*, 2010). Furthermore, a tendency for females to make more left choices should have inflated means in the normal group, in which they were in the majority but this did not occur. Kret and Gelder (2012) were of the opinion that lateralisation of emotion perception research is inconsistent and this accords with the somewhat ambiguous findings reported here. However there may, as they suggested, have been a three-way interaction between gender of face, gender of participant and valence. While this is potentially of interest and could have been extracted from the data, it was not the main focus of the research prediction. There was no suggestion that lateralisation or sensitivity to valence changed with age (Collins and Mohr, 2013; Failla *et al.*, 2003; Mill *et al.*, 2009; Suzuki *et al.*, 2007) since further checks revealed correlations between age and left choices in the chimeric faces test were, contrary to expectation, generally positive although non-significant.

2.4.5. Comments on methodology

In this study, the CFQ was used as a subjective measure of general cognitive functioning and showed that participants' scores did not differ from norms established by Knight *et al.* (2004) suggesting that this sample of working adults was functioning well. No links with sleepiness were found. If these subjective assessments are accurate, this further strengthens the argument that the effects found in this study are due to attention shifts rather than global cognitive functioning, which the CFQ is intended to measure (Broadbent *et al.,* 1982). The majority of the variance in scores in the CFQ can be accounted for by memory lapses (Wallace, Kass and Stanny, 2002) while attention lapses account for very little of the variance (Cheyne, Carriere and Smilek, 2006) so, as expected, CFQ scores did not correlate with average overall drift in LB or average LMK errors in sleepy or normal groups ($p \geq .15$, two-tailed).

The ESS (Johns, 1991) was considered to be a suitable measure of everyday sleepiness that takes account of individual sleep propensity, situation specific sleep propensity, the situation x individual interaction and situational factors such as time of day and circadian preference. It is a reliable measure of relatively enduring sleep propensity as opposed to transient sleepiness or fatigue (Johns, 1998). Furthermore, ESS scores correlate negatively with night-time sleep duration and positively with relative sleep deprivation such as might occur in daily life (Johns, 1991) but neither of these was reported by participants in this study. This allows for the separation of sleepiness due to sleep disruption from general sleepiness, which some of them did report, and made it possible for the effects of this alone to be assessed.

One possible source of extraneous variation in this study is differing degrees of lateralisation amongst participants. The EHI (Oldfield, 1971), which was used to assess this, is widely used (by October 2013, *Google Scholar* located over 21,500 citations of it), but certain of its items have lately been questioned. Dragovic (2004) suggested that writing and drawing should be replaced with drawing alone and items about broom use and opening a box, which are less reliable, should be replaced with more contemporary items such as using a computer mouse. In this study however, the original EHI was retained, reasoning that it was still suitable for 31-68-year olds, but the criterion for right-handedness was raised to 80% on the basis of findings by Thiebaut de Schotten *et al.* (2011) that about two-thirds of adults identified as being right-handed on the EHI show right, as opposed to left or mixed hemisphere dominance, for visuo-spatial attention. It was hoped that this more stringent requirement would increase the likelihood that participants were right hemisphere dominant although it could not be guaranteed.

The literature on pseudoneglect uses a variety of research designs, participants, attention tasks and outcome measures. The closest to the LB part of this study methodologically is Stancey and Turner's (2010) test of stick LB in peri-personal space, although they used much younger participants. The use of a stick for the extra-personal condition would most likely have extended peri-personal space (Stancey and Turner, 2010) and found nothing new and so it was not considered suitable here. Instead a completely different LMK test for extra-personal space had to be chosen and an equivalent to this, using lateralised stimuli, has not yet been reported. Wilkinson and Halligan (2002) showed that in a lateralised, peri-personal landmark test, participants were better at detecting symmetry on the left but there were no hemispheric differences for detecting mis-bisections. In this study participants detected symmetry most easily when they were comparing it to left mis-bisections on the right and right mis-bisections on the left, and least easily when comparing it to right bisections on the right and left bisections on the left. This suggests that, in extra-personal LMK there is a symmetrical lateralisation effect alone that does not interact with accuracy and this shows general improved accuracy with sleepiness.

2.5. Conclusion

In the foregoing analysis, everyday sleepiness has been linked with differences in peri-personal, manual LB, extra-personal LMK test performance and an emotional valence effect in judging chimeric faces. In LB, sleepy participants tend to err leftwards more than normal participants, in the LMK test judgements showed no lateralisation and became more accurate with sleepiness, and in the chimeric faces test sleepy people showed a tendency to perceive threat valence more readily and ambiguous valence more slowly. Results from both the LB and emotion perception tests support the suggestion that responses to tasks already open to pseudoneglect and left bias respectively become more exaggerated due to the influence of a relatively more vigilant right hemisphere (Casagrande and Bertini, 2008a, 2008b; Dufour *et al.,* 2007; Manly *et al.,* 2005) even though the attentional mechanisms for these might differ (Heber *et al.* 2010). The lack of lateralisation in the LMK test was to be expected, again because attentional mechanisms may differ between peri- and extra-personal space (Gamberini *et al.,* 2008; Heber *et al.* 2010; Longo and Lourenco, 2006; Varnava *et al.,* 2002). Indeed in this study there was no correlation between LB and LMK average overall scores in sleepy or normal participants ($p \geq .44$, two-tailed) which suggests that there may not be a supra-modal mechanism common to both (Brodie and Dunn, 2005). The increased accuracy, however, remains unexplained. LMK performance tends to improve with increased sleepiness in peri-personal space and this can be explained by lateralisation changes (Manly *et al.*, 2005) but the effect of extra-personal space on accuracy has not been well-researched and possible causes are yet to be identified. The answer may lie in the discovery by Cavézian *et al.* (2012) that in peri-personal space, LB tends to produce bilateral, hemispheric activation and localised scanning and the LMK test tends to produce right hemispheric activation and broader scanning. It is conceivable that processing LMK stimuli in extra-personal space involves its own combination of scanning and hemispheric activation and these may correlate with performance of everyday actions in a similar vein to the study by Nicholls *et al.* (2007), which showed that manual LB performance correlated with the peri-personal task of navigating through doorways. The addition of sleepiness may also be shown to have an effect on navigation such as this, but also on similar attentional tasks in extra-personal space.

In conclusion, in this sample of healthy adults with 'empty nests', sleepiness did not appear to be related to sleep disruption by partners or with any other discernible cause. Some of the participants appeared to be inherently sleepy and this was linked to measurable self-reported and objectively measured effects, particularly on spatial attention. In the next chapter, the investigation extends to another group of healthy adults who may face a potential challenge to their sleep in that they live with a partner with an early stage, chronic, progressive, sleep-disrupting disease (PD). Aspects of these healthy adults' self-reported sleep and subjectively and objectively measured cognitive functioning can be compared with those of participants investigated in chapter 2, thus affording an opportunity to explore whether the presence of early stage PD in one's partner has measurable effects on cognitive functioning that might be mediated by sleep disruption.

Chapter 3

COGNITIVE CORRELATES OF SLEEPINESS IN PARTNERS OF PEOPLE WITH PARKINSON'S DISEASE

3.1. Introduction

In the 60 years since the pioneering work of Aserinsky and Kleitman (1953) and Dement and Kleitman (1957), research into sleep has proliferated. Much of it has been in tightly controlled laboratory conditions in which sleep has been curtailed, systematically disrupted or even prevented altogether in order to discover the nature of normal sleep and the functions its fulfils. It has thus been established that sleep is not merely the absence of wakefulness. It is an active process that appears to be intrinsic to our physiological and psychological health and well-being (Horne, 2001), to the expression of genes involved in many functions, including stress responses and immunity (Möller-Levet *et al.*, 2013), and indeed even to our survival (Rechtshaffen, Bergmann, Everson, Kushida and Gilliland, 1989).

More recently, attention has turned to the nature of sleep in everyday settings and the impact of this on cognition, emotion and behaviour (Horne, 2012). In the developed world, human sleep patterns are much influenced by such things as the availability of artificial lighting, time zone travel, work patterns and a 24-hour society, resulting in a reduction in sleep (Dement, 2000; Ferrara and De Gennaro, 2001; Rosekind, 2005). This has led researchers to debate what constitutes adequate sleep and there is considerable disagreement over this. At one extreme, Horne (1988) suggested that adult humans need between 4.5 and 6 hours of core sleep and could adapt to just five to six hours per night, the extra sleep being optional. At the other extreme, following an investigation in which participants were allowed to sleep as much as they wished and, accordingly, increased their sleep time by an average of two hours, Webb and Agnew (1975) concluded that nine to ten hours per night was necessary. This opinion was supported by Bonnet and Arand (1995) in a study of sleep extension. They presented evidence to suggest that young adults, in particular, were likely to be sleep-deficient since they needed about 8.5 hours of sleep per night but were typically only sleeping for 7.2 – 7.4 hours. These authors believe that we are '…*chronically sleep deprived*… and that sleep lengths of equal to or less than 6.5 hours '…*can be disastrous*' (Bonnet and Arand, 1995: 908).

In an attempt to clarify the issue, Ferrara and De Gennaro (2001) reviewed 110 research papers reporting various aspects of sleep and sleep deprivation. First they examined the commonly held view that modern lifestyles in the developed world work against normal, healthy sleep. They cited evidence from several studies of sleep patterns in children, adolescents and adults living in Japan, America and Sweden in the twentieth and current century. Some of these studies lasted for decades and others for a few days. Some were epidemiological, some used sleep diaries or other forms of self-report and others used actigraphy. In spite of some methodological reservations and difficulties in comparing studies, Ferrara and De Gennaro concluded that the weight of the evidence was in favour of the existence of chronic sleep deprivation, especially amongst 17-65 year olds. In the UK, this is the most usual age-range of working adults and, if the findings of these predominantly American studies could be extrapolated to UK adults, suggests the presence of a substantial public health risk (Dement, 2000).

While researchers strive to understand sleep disruption and its effects in laboratory settings, research into its impact on people experiencing sleep disruption in naturalistic settings as a feature of everyday life is relatively new (Horne, 2012). In laboratory settings, people may be obliged to go to bed at a prescribed hour, wake earlier than they would like to, deprive themselves of particular sleep stages or shorten their total sleep duration. As Ferrara and De Gennaro (2001) have shown, sleep disruption such as this might also be a feature of people's lifestyle but its 'real world', rather more erratic, nature is probably best described as naturalistic, rather than systematic. For some people, naturalistic sleep disruption may be a choice but for others it may be outside their control and, possibly, unpredictable. Of particular interest here are people who would sleep well if they could but are prevented from doing so by others such as snoring bed-partners, babies, young children or other family members needing attention at night. Such disruption may be largely out of an individual's control and result in sleep that is too short, lacking in continuity and of poor quality.

Two features of Ferrara and De Gennaro's (2001) review are relevant to the study of sleep disruption in naturalistic settings. Firstly, they describe a meta-analysis of sleep studies carried out by Pilcher and Huffcutt (1996). This study concluded that partial sleep deprivation (PSD), which is, incidentally, more likely to occur in naturalistic situations, was more disruptive to functioning than total long or short-term sleep deprivation in that it had larger detrimental effects on motor performance, particularly on tasks lasting 10 minutes or more. The effect on cognitive performance was worse still with simple tasks apparently being more affected than complex ones. There was also a larger effect on mood and all of these changes were noticeable after only one or two hours of PSD. In a review of the effects of both sleep fragmentation and deprivation on people specifically selected for having no sleep problems, Bonnet and Arand (2003) concluded that both are associated with subjective and objective measures of impairment in daytime alertness, short term memory, reaction time, vigilance and mood. More seriously, Dew *et al.* (2003) carried out a polysomnographic study of 185 adults in their 60s to 80s. These adults had no mental illness, sleep complaints or cognitive impairment and yet those who had sleep latencies over 30 minutes and whose sleep efficiency was less than 80% were approximately twice as likely as other adults to have died at follow up. Studies such as these have relevance to sleep disruption in natural settings where it may be on-going, often unpredictable and partial rather than total. It is also noteworthy that two-thirds of the studies analysed by Pilcher and Huffcutt (1996) used medical residents as participants and half of them measured performance on medical tasks. People experiencing naturalistic sleep disruption may also need to be able to carry out everyday tasks efficiently and, in domestic situations in particular, any associated impairment to their functioning may impact not only on themselves but also on those around them, such as family members for whom they have responsibility.

Secondly, Ferrara and De Gennaro (2001) emphasise the importance of taking individual differences into account when trying to understand the impact of sleep disruption, a sentiment echoed by Van Dongen, Vitellaro and Dinges (2005). They argue that everyone has an individual sleep pattern that may interact with how they respond when it is disrupted. Ferrara and De Gennaro list five characteristics of particular interest: gender, age, morningness-eveningness, longer/shorter sleep need and general sleepiness/alertness. These could be an important source of 'noise' in both laboratory and naturalistic settings and are typically not taken into account in sleep disruption studies.

In the next sections, research into the impact of sleep disruption in domestic settings on people who could sleep well if allowed to, but are prevented from doing so by others, will be considered. Parents of babies and young children are well-represented in this category and will be reserved for special consideration later. Two groups of people in particular will be considered here: partners of snorers and people affected by sleep disrupting illness (Parkinson's disease) in a partner or dependent. Special emphasis will be given to findings about the psychological consequences of sleep disruption, particularly mood and cognitive function.

3.1.1. Sleep disruption in naturalistic settings

In *Sleep Survey* (1999), a report prepared by the Gallup Organisation for the British Sleep Foundation, 30% of respondents claimed that daytime sleepiness affected their routine daily activities because it resulted in poor concentration, impaired alertness and changed mood. This occurred even though they had spent a normal amount of time in bed during the preceding night. Seventeen per-cent of these people also reported that this was a daily occurrence for them. This equated to about 5% of the general population whose sleep quality was less than ideal. In the most recent *Great British Sleep Survey* (2012) 20,124 people were surveyed between and March 2010 and June 2012 and, while it was acknowledged that there was a possible bias towards people who do not sleep well taking a particular interest in the survey, an average sleep score of just 5.1 out of ten was recorded. Seventy-three percent of respondents were female, 93% were 21 or over, 66% had a partner and 34% said that they were kept awake by their partner. Poor sleepers were more likely than good sleepers to say they had difficulty concentrating in the day (62% vs. 17%), suffered from fatigue (88% vs. 29%) and had low mood (77% vs. 27%). Partners were second to bodily discomfort only as a reason for keeping adults over 25 awake at night.

3.1.1.1. Partners of snorers

A recent survey of over 1500 American adults by the *National Sleep Foundation* (2005: 27) found that 77% reported being affected by a sleep problem in their partner in the last year with the majority (65%) complaining of the partner's snoring. Compared to unaffected individuals they reported getting '...*a good night's sleep a few nights a month or less (26% vs. 19%)', experiencing '...daytime sleepiness at least three days a week (30% vs. 19%)*' and as having '*problems in their relationship due to their or their partner's sleep disorders (35% vs. 9%)'*.

Much of the research into snoring concerns people with sleep disorders (notably sleep apnoea) but there are a few studies of non-apnoeic people and their partners. One such study by Stradling, Crosby and Payne (1991) surveyed 850 men aged 35-65 years old, asking them a number of questions about their sleep habits, work, health and health-related behaviour such as smoking and drug use. After ensuring that confounds such as sleep apnoea really were controlled, sleepiness was found to be independently and positively related to snoring and was also associated with the extent to which participants admitted to having two or more 'near-miss' car accidents when driving while sleepy. With regard to snorers' health, sleep fragmentation alone (Morrell, Finn, Kim, Peppard, Badr and Young, 2000) and a combination of snoring with sleep fragmentation were found to be associated with hypertension (Lofaso, Coste, Gilain, Harf, Guilleminault and Goldenberg, 1996). Lofaso *et al.* (1996) suggest that their findings might not only have implications for people with other kinds of sleep disruption not related to breathing but also for those who are disturbed by others' snoring throughout the night. This underlines the importance of treating sleep disrupted couples as a unit.

Some studies have assessed the effects on couples of interventions to reduce snoring. Ulfberg, Carter, Talback and Edling (2000) surveyed 1,032 Swedish women and found that, compared to the partners of non-snorers, women whose partners' snoring was untreated complained more often of disturbed sleep, morning headache and daytime sleepiness, regardless of whether they snored themselves. In contrast, Loth, Petruson, Wiren and Wilhelmsen (1999) treated 42 heavily snoring men for a month with a nostril dilator in an attempt to improve their breathing while asleep. Before and after measures of daytime sleepiness and quality of life were taken for the men and measures of their partners' snoring, quality of sleep and sense of well-being on waking were taken from the women. Comparison groups were obtained and it was found that, in men, the treatment led to improved quality of life and alertness during the day. Their female partners also experienced less disturbed sleep and better quality sleep and feelings of well-being in the morning. In an American study of ten couples by Beninati, Harris, Herold and Shepard (1999) men who snored and had suspected sleep apnoea were monitored for one night along with their spouses. Halfway through the night, continuous positive airway pressure (CPAP) was applied to eliminate the snoring. A corresponding improvement in the sleep of the wives was observed amounting to an estimated extra hour of sleep per night. This was, however, a small-scale, one-night study that took no account of the quality of sleep during different phases of the night. Disruption to sleep during the first part of the night, when slow wave sleep predominates, has the worst effect, according to Murray and Dodds (2003), so the intervention could have had greater impact if it had been early instead of later, and the extra hour of sleep in wives may have resulted from the opportunity to catch up on sleep lost earlier in that one night. In a study of both male and female partners, McArdle, Kingshott, Engleman, Mackay and Douglas (2001) used polysomnography to compare sleep in people whose partners tried CPAP over one month to alleviate sleep apnoea but found that this was associated with improvements in subjective sleep quality alone. Finally, another short-term study by Blumen *et al.* (2009) used polysomnography on 16 women during one night when they slept with their snoring husbands compared to one when they slept in the same room but alone. Sleep time, efficiency and deep sleep (stages 3 and 4) were found not to differ but there was less light (NREM stage 2) sleep and better sleep continuity during the night apart and poorer sleep quality and greater fragmentation during the night together. These findings add credibility to self-report studies that indicate detrimental effects of sleeping with a snorer. A further point raised in a study by Hatfield *et al.* (2002: 341) might also be relevant to snoring research, or indeed any other sleep disrupted individuals. They found that perceived control over sleep disruption, which in this case was aircraft noise, was negatively related to *'learned helplessness'* hence, people whose sleep is disturbed by cohabitees and who feel that they cannot improve the situation may be especially vulnerable to negative effects.

One concern raised by breathing-related sleep problems in married or co-habiting partners is that chronic sleep disruption could, eventually, contribute to undermining their relationship. A study by Billman and Ware (2002) of marital satisfaction in women with untreated apnoeic male partners, however, found that satisfaction was not influenced by the presence or absence of sleep apnoea. The major finding was that 60% of partners of apnoeic men sometimes slept in another room compared to only 20% of partners of non-apnoeic men. Also, having a separate bed in the same room increased the chances that the woman would remain in the same room throughout the night. The authors suggested that any dissatisfaction with a partner's sleeping behaviour was more likely to be underpinned by concern for the partner's health rather than problems within the relationship itself, especially if the woman was sometimes able to sleep satisfactorily herself. A more recent study by Strawbridge, Shema and Roberts (2004) was less optimistic. They carried out a cross-sectional survey of 405 couples aged between 51 and 94 and asked them a variety of questions about their sleep patterns and those of their partners. They found that, regardless of the person's gender, an individual's health, mood, mental health, optimism, satisfaction with the relationship, feelings of inclusion and happiness in the marriage were all negatively associated with sleep problems in the partner. Venn (2007), however, found that, in couples in which one or both partners snored, their response was not only gendered but also negotiated in that women were more forgiving of their partner's snoring and put more effort into managing it at the expense of their own sleep. As a result, the women's sleep was sub-optimal and, therefore, likely to have negative consequences for them.

In summary, research into the 'fallout' affecting people whose sleep is disrupted by others' snoring has identified a range of physical and psychological consequences, especially if snoring is persistent. Psychological consequences have only been subjectively measured but they do indicate negative effects, particularly on well-being and mood (Loth *et al.*, 1999; Strawbridge *et al.*, 2004). None of the studies, however, appear to have measured cognitive consequences of this kind of sleep disruption.

3.1.1.2. People with Parkinson's disease and their partners

Partners of people with Parkinson's disease (PD) are potentially at risk of sleep disruption because PD is strongly associated with sleep problems due to the fluctuating but ultimately deteriorating nature of the disease (Goetz *et al.*, 2004; Hoehn and Yahr, 1967). James Parkinson himself had noted this when he wrote, in *An Essay on the Shaking Palsy*, that "*…the sleep becomes much disturbed. The tremulous motion of the limbs occur during sleep, and augment until they awaken the patient, and frequently with much agitation and alarm*" (Parkinson, 1817: 3-4). Abdelgabar and Sharma (2003) claim that sleep problems in people with PD (PwPD) are more prevalent than could be expected from ageing alone and have multiple causes. It is generally agreed that they fall into three major groups (Larsen and Tandberg, 2001; Chaudhuri, 2002; Abdelgabar and Sharma, 2003): nocturnal sleep disorders such as insomnia and parasomnias, sleep disturbances associated with dopaminergic medication and daytime sleep disorders. Fatigue, which may or may not be related to their sleep, is also a common complaint in people with PD (Abe, Takanashi and Yanagihara, 2000; Ferreira and Rascol, 2000; Herlofson and Larsen, 2003; Lou, Kearns, Oken, Sexton and Nutt, 2001). It has also been debated which side of PD symptoms is most associated with sleep problems e.g. in a sample of 232 Mexican PwPD, Rodríguez-Violante, Cervantes-Arriaga, Villar-Velarde and Corona (2011) found that, compared to predominantly left symptoms, people with right symptoms (RPD) report less daytime sleepiness and insomnia and more vivid dreams, sleep behaviour disorders and restless legs. Stavitsky, McNamara, Durso, Harris, Auerbach and Cronin-Golomb, (2008), however, presented evidence to show that in PD with predominantly left symptoms (LPD), in which right hemisphere functioning is compromised, there is a greater incidence of vivid dreams, hallucinations and daytime dozing. Their sample of 20 LPD and 18 RPD, however, was considerably smaller than the one studied by Rodriguez-Violante *et al*.

Disturbances, such as light or fragmented sleep, or difficulty in getting to sleep, occur early on and frequently in PD. Insomnia, parasomnias and excessive daytime sleepiness (EDS) tend to occur in the more advanced stages. The exact prevalence of sleep problems in PD can be difficult to measure and studies vary in their estimates. Kumar, Bhatia and Behari (2002) quote a figure of 42% in a sample of 149 Indian PD patients. Stocchi *et al.* (2000) suggest that it is 72% and Abdelgabar and Sharma (2003: 781) estimated that “*Up to 98% of PD patients may experience at least one symptom causing a nocturnal sleep problem*”. The estimate from Stocchi *et al.* (2000) is based on their own survey of 100 Italian men and women with PD. Twenty-eight per cent of these reported no sleep problems. Of the remaining 72% that did have problems, 20% had insomnia only, 25% EDS only and 27% had both insomnia and EDS. Surprisingly, there were no significant effects with regard to age, gender, disease duration or therapy duration. Conversely, in a prospective study of 106 German PD patients, Happe, Ludemann and Berger (2002) provided evidence that associated sleep-related events, such as sleep-walking, with disease severity and insomnia with depressive symptoms and increasing levodopa dose. Abdelgabar and Sharma (2003), however, believe that it is controversial whether sleep disorders correlate neatly with the severity of PD symptoms, or the amount of associated disability, probably due to the diverse nature of the PD.

Some research directly concerning the potential impact of sleep problems in the PwPD on their partners does exist but tends to be subsumed into other findings, for example Lloyd (1998) found that partners involved especially in night-time and nursing care of the PwPD were more likely to feel stressed and depressed and Thommessen, Aarsland, Braekhus, Oksengaard, Engedal and Laake (2002) cited sleep disturbances as a major self-reported challenge to spouses of PwPD. Happe *et al.* (2002) found associations between self-assessed poor sleep in partners with disturbed sleep in the PwPD, having a male PwPD, disease severity and night-time caregiving. Agrawal, Goyal, Shukla and Behari (2012) found highly significant negative correlations between sleep disturbance in the PWPD and all measures of partners’ quality of life, caregiver burden and mental and physical health. However, Fernandez, Tabamo, David and Friedman (2001) initially found significantly higher depression scores in sleep disturbed spouses of PwPD compared to those with no sleep disturbances but, when these variables were treated using multiple regression analysis, only duration of PD remained significant, leading the authors to conclude that it was the best predictor of depression in their sample of spouse carers.

There is on-going research into the psychosocial and physical correlates of caregiving, chiefly in older people, but very little research has included a consideration of cognitive functioning in carers and, in particular, how this might relate to their sleep patterns. An exception is research by Caswell *et al.* (2003) who recruited 44 caregivers with a partner with Alzheimer's Disease (AD), rather than PD, and compared them with 66 demographically similar non caregiving spouses. They used the WAIS digit symbol test (Wechsler, 1981) as a measure of '...*speed of information processing, complex attention, and concentration*.' (Caswell *et al.*, 2003: 306). It was found that, compared to controls, caregivers had lower scores on this test as well as having more sleep problems but these did not correlate with the test scores. Controlling for '*distress'* however, a measure which incorporated sleep problems, burdens and uplifts, removed the effect of caregiver status on test scores and was, on its own, significantly predictive of them. This suggested that the relationship between caregiver status and test performance was in some way mediated by '*distress'* (in which sleep problems were included but not distinguished). Depression, however, appeared to play no part in predicting test scores. Some clarity might be gained by using different measures of mood. Clark and Watson (1991: 316), for example, have suggested a '*tripartite model'* which includes anxiety and depression and a third dimension called '*negative affect'* and other researchers, such as Babson *et al.* (2010), have linked all of these with sleep deprivation. Their relative contributions to, and possible interactions with, cognitive functioning, however, remain unclear in the study by Caswell *et al.* whose composite '*distress'* and separate depression measures seem to have incorporated all three dimensions.

An informative finding in the paper by Caswell *et al.* was that AD caregivers' average sleep problem scores were significantly higher (M = 25.30, SD = 6.76, scale range 0-39) than non-caregivers (M = 22.48 , SD = 5.02). This raises a question about how many of these carers could be classified as having problem sleep. In a survey of 500 AD caregivers in the USA, by the nationwide *Alzheimer's Association* (1996), 45% of respondents complained that they felt they had insufficient sleep as a result of having to provide care. This is a slightly lower rate than that reported in surveys of PD carers, but it should be noted that each of the surveys cited here used different measures.

Yarrow (1999) and Giunta, Parrish and Adams (2002) have shown that 50% of PD caregivers report problems with sleep. In Yarrow's UK study, 50% of caregivers had rated getting a good night's sleep as important but were unable to get it and, in the study by Giunta *et al*., 50% of carers were moderately or extremely upset by the PD person waking them or other family members up at night. In the study by Caswell *et al.* there were 44 carers so, if the findings of other studies can be extrapolated, about 22 of them would have been entirely responsible for increasing the mean.

3.1.2. Summary and study rationale

The nature of normal, healthy sleep architecture and the impact of systematically disrupting it have been well-documented (e.g. Dement, 1999; Horne, 1988, 2001, 2012). More recently, the question of how much sleep we need in order to feel refreshed and function efficiently in the day has received attention due to concerns that modern living in itself commonly leaves us sleep deprived (Dement, 2000; Bonnet and Arand, 1995; Ferrara and De Gennaro, 2001; Kripke and Marler, 2000; Rosekind, 2005). Naturalistic sleep disruption in domestic and work settings has been less well-researched, yet many people's sleep is disrupted for reasons beyond their control and they routinely make compromises between their personal sleep needs and the demands of daily living. One such group, reviewed earlier, consisted of bed-partners of snorers and a second group consisted of people who live with a PwPD.

In the case of snorers, researchers looked for measurable effects of this disturbance in both snorers and partners. Snoring made partners more sleepy (Ulfberg *et al.,* 2000) and had the potential to undermine relationship quality and reduce positive affect (e.g. Billman and Ware, 2002; Strawbridge *et al.*, 2004). The effect of place of sleep was uncertain (Billman and Ware, 2002). In some cases, subjective and polysomnographic measures were taken with a view to assessing the effectiveness of interventions using such devices as CPAP (e.g. Loth *et al.,* 1999; Beninati. *et al.,* 1999; McArdle *et al.* 2001; Blumen *et al.,* 2009) and some improvements were found. In summary, there was evidence for increased daytime sleepiness and depressed mood in bed-partners of snorers and a suggestion that uncontrollability of the source of disturbance adds to their distress (Hatfield *et al.*, 2002), but there is no research that links this directly to their cognitive functioning in the day or their individual sleep preferences.

In PD research, sleep problems in PwPD have long been acknowledged (Stocchi *et al.*, 2000; Kumar *et al.*, 2002; Happe *et al.*, 2002; Abdelgabar and Sharma, 2003) but the effects of this on partners are not often researched. Links have been made between later stages of PD, when partners might expect to become carers, and caregiver stress, burden and depressed mood and between mood states in couples (Lloyd, 1998; Giunta *et al.*, 2002; Aarsland *et al.*, 1999) or not (Hooker *et al.*, 2000) but the possible role of sleepiness in this is barely addressed. A rare exception is the previously described study of AD carers by Caswell *et al.* (2003). Evidence that sleep problems may affect cognition was present, but it was indirect, and sleep problems themselves were conflated into a measure that also assessed aspects of mood.

The study that follows concentrates on just one of the groups of sleep disrupted people so far reviewed, specifically couples in which one person had PD. Early stage PD has been associated with sleep disturbances (e.g. Goetz *et al.,* 2004; Rodriguez-Violante *et al*., 2011; Stavitsky *et al*., 2008) but the PD in the current sample is unlikely to be advanced enough to mean that the complicating factor of caregiving burden for partners is also present. The first aim is to describe participants' self-reported sleep patterns, mood and everyday cognitive functioning, and the context in which these occur, in an attempt to understand possible associations between them. Participants' responses will be analysed both individually and in relation to those of their partners in order to discover whether their sleep patterns are affected by their joint situation, and whether this has measurable self-reported outcomes in cognitive functioning in both partners and PwPD. This will allow for comparison with the findings of Caswell *et al.* (2003) but with a clearer distinction between the possible association of sleep factors and mood with cognitive functioning.

The second aim is to take a basic measure of cognitive functioning to assess objectively whether this differs according to self-assessed, PD-related sleep disturbance and sleepiness. Spatial attention can be assessed simply by using a manual line bisection (LB) test in which participants mark the perceived mid-point of a centrally placed horizontal line. Approximately 91% of participants display mild asymmetry of spatial attention (McCourt, 2001) that leads them to bisect the line slightly to the left of centre; a tendency known as '*pseudoneglect'* (Bowers and Heilman, 1980: 491). The reason for this is obscure, but it has been proposed that it is because a spatial task such as LB activates the right hemisphere, directing attention to the left visual field and leading participants to over-estimate the left end of the line (Manly, Dobler, Dodds and George, 2005). Corbetta and Shulman (2011: 583) say '*Perhaps the most widely accepted, standard theory of* [clinical] *neglect* [Mesulam 1981] *postulates that the right hemisphere controls shifts of attention to both sides of space while the left hemisphere only controls attention to the right side. Damage to the right hemisphere impairs attention to the left hemifield, whereas damage to the left hemisphere can be compensated.'* Another explanation of pseudoneglect in healthy people is the activation/orientation model (Kinsbourne, 1970, 1987) which proposes that attentional asymmetry results from the most activated of the two cerebral hemispheres directing attention to contralateral space and temporarily inhibiting the other hemisphere. The model also proposes that contralateral orientation is strongest in the right hemisphere which tends to dominate in attentional tasks such as LB.

Pseudoneglect also seems to be affected by changes in alertness. Casagrande and Bertini (2008a, 2008b) propose that, in right-handed participants, the right hemisphere remains more vigilant and for longer than the left as alertness decreases '...*in other words, the right hemisphere, as compared to the left, seems to have greater levels of wakeability or vigilanceability when the vigilance state is very low and the brain is going to sleep'* (Casagrande and Bertini, 2008a: 79). If this is the case, this should be reflected in LB performance. Some evidence for attentional shift with sleepiness has been presented by Manly *et al.* and Dufour *et al.* (2007) but contested by Kendall *et al.* (2006). The latter do not, however, say whether handedness was controlled and, in spite of a trend in the data in the expected direction, reject an interaction between sleepiness/alertness and left/right visual field signal detection at $p = .06$. The weight of the evidence, therefore, is in favour of attentional shift. Many other factors affect LB performance and one which has particular relevance in this study is age (Jewell and McCourt, 2000). This could interact with lateralisation changes with sleepiness in an older participant group, possibly due to '*hemispheric asymmetry reduction in older adults* (the *'HAROLD'* model, Cabeza, 2002: 85), and hence will be explored.

Cronin-Golomb (2010) has proposed that PD is a syndrome arising from disconnections between cortical and sub-cortical structures involved in functions such as attention, sleep and mood. The lateralised nature of PD and the association of this with sleep disorders (Rodriguez-Violante *et al*., 2011; Stavitsky *et al.,* 2008) affords an opportunity to compare sleepy and alert healthy people, and people with RPD and LPD, with respect to potential changes in lateralisation of attention. Cronin-Golomb (2010) suggested that the lateralised nature of PD and the sensitivity to sleepiness of right hemisphere vigilance functions might be expected to interact and so this possibility will be explored as an adjunct to the focus on healthy partners.

3.2. Method

3.2.1. Design

This study was conducted by means of a self-administered, questionnaire survey designed to explore the domestic context of couples' sleep patterns and gather simple measures of everyday cognitive functioning and mood. Two questionnaires were developed, one for the PwPD and the other for the partner (see Appendix D). They were piloted by four couples known to the researcher, in each of which one person had PD. The two questionnaires asked for the same information, using mostly closed, fixed-response questions, but with some minor adjustments to make them appropriate for each respondent group. They were delivered in person to potential participants and returned to the researcher by post. Questionnaires comprised four sections asking for demographic and clinical information (the latter about the PwPD only) in section one and information about sleep patterns in section two. Section three contained a scale measuring everyday cognitive failures and a simple test of manual pseudoneglect and section four contained a mood scale. Questions yielded quantitative data except for one which asked about medication currently being taken and another which invited further comments. Ethical approval for this survey was granted by the *Bath Royal United Hospital NHS Research Ethics Committee* (Appendix A) and this was communicated to the research division of *Parkinson's UK* (formerly the *Parkinson's Disease Society*) to whom a research summary was also provided (Appendix J).

3.2.2. Participants

An opportunity sample of PwPD and their partners was initially approached at regional *Parkinson's UK* meetings attended by over 120 PwPD. The only inclusion criterion was that respondents should live together as spouses or partners. No stipulation was made that partners should regard themselves as carers. It was requested that both members of a couple completed questionnaires although it was made clear that either one could still usefully participate. In the event, all respondents were married or co-habiting (N = 61) and were self-selected on the basis of returned questionnaires. The sample size thus exceeded Aldridge and Levine's (2001: 77) rather crude rule of thumb that the N in any survey sample that will be the basis of any analysis, should not fall below 50. No formal clinical assessments of the PD were available, including predominant side of PD symptoms (RPD, LPD or both) or the severity of disease. Twenty-two partners were male and 39 were female and all were in heterosexual relationships.

3.2.3. Materials

The contents of the questionnaires for partners and PwPD were as follows:

3.2.3.1. Demographic, clinical and sleep questions.

All participants were asked to indicate their age, gender (Ferrara and De Gennaro, 2001) and preferred writing hand (Larson, Alderton, Neideffer and Underhill 1997). PwPD were asked to indicate how they occupied themselves during a typical week e.g. work hours, daily tasks, managing their PD. Clinical information was requested about the medical condition of the PwPD because several issues were regarded as potentially influential in sleep i.e. participants' PD history, medication and current severity of symptoms at their best. Partners were asked for their relationship to partner, length of relationship, medication (as an indication of their own health), constitution of the household, occupation during a typical week (including PD related activities) and any help they had in coping with the PD.

Both partners were asked questions about their normal adult sleep pattern, following the recommendation by Ferrara and De Gennaro (2001) who stressed the importance of establishing individual somnotypology as a context within which to understand the impact of sleep disruption. In particular, they suggested inclusion of age, gender, preferred length of sleep, sleepability and morningness/eveningness. Questions about the character of participants' normal (preferred) and actual sleep pattern, as well as any PD and non-PD sleep-related problems, were included. Both partners were asked about their sleeping arrangements (Billman and Ware, 2002) and about the existence and persistence of sleep problems, such as insomnia, prior to and since the diagnosis of PD.

In order to examine sleep continuity, a sleep fragmentation index (SFI) was devised using questions about typical bed times and rising times and the number and type of interruptions to sleep. The SFI was calculated from the total number of awakenings divided by the total sleep time in hours. This widely used measure is thought to mark shifts from deeper NREM or REM sleep to Stage 1 sleep (Haba-Rubio, Ibanez and Sforza, 2004). Both partners were also separately asked to indicate how much time in the night they spent dealing with PD and non PD related disturbances and whether they found disturbed sleep distressing. The distress measure was suggested by a study (Alapin *et al.,* 2000) that had compared the consequences of good and poor sleep in older and younger adults. Poor sleepers reported more daytime problems with fatigue and concentration and, to a lesser extent, with sleepiness. This effect was exacerbated by the amount of distress surrounding the sleep problem that was reported by participants.

Finally partners were asked a series of questions about their role as carer. These were suggested by Maslach and Jackson (1986) who devised a series of burnout inventories for people in various professions including health and social services workers. It was judged to be inappropriate to use the full inventory because of the negative connotations of the items it contains. Nevertheless, the major groups of questions suggested the importance of three factors: emotional exhaustion, depersonalisation, and personal accomplishment. Positively worded questions addressing these, as well as physical coping, were therefore included.

3.2.3.2. Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS: Johns, 1991) measures individual sleep propensity, situation specific sleep propensity, the situation x individual interaction and situational factors such as time of day and circadian preference. The ESS captures all of these sources of variation and gives a measure of individuals' relatively enduring sleep propensity as opposed to transient sleepiness or fatigue (Johns, 1998). Respondents rate their chances of dozing or sleeping in eight common situations such as sitting and reading or watching TV. Each item is scored on a four point scale ranging from 0 to 3 so total scores on this scale range from 0 to 24 with ≥ 11 being the criterion for sleepiness.

3.2.3.3. Parkinson's Disease Sleep Scale

The Parkinson's Disease Sleep Scale (PDSS: Chaudhuri et al., 2002) comprises 15 items to assess sleep problems in people with PD whose symptoms can lead to particular types of disturbance at night. Questions relate to sleep quality, insomnia, restlessness, psychosis, nocturia, nocturnal motor symptoms and daytime tendency to fall asleep. Paricipants respond to these items on bipolar scales (e.g. always – never) and these are scored from 1 to 10. PD-specific questions were omitted from the partners' questionnaires.

3.2.3.4. Cognitive Failures Questionnaire

The Cognitive Failures Questionnaire (CFQ: Broadbent, Cooper, FitzGerald and Parkes, 1982; Cheyne, Carriere and Smilek, 2006; Wallace, Kass and Stanny, 2002) is a broad measure of everyday cognitive failures incorporating everyday lapses and slips of memory, concentration and attention. It contains 25 items describing errors that everyone makes from time to time e.g. 'Do you forget if you turned off a light / or a fire / or locked the door?'; 'Do you have trouble making up your mind?; 'Do you drop things?'. Participants respond to each item on a five-point scale ranging from 0 (never) to 4 (very often). Research has linked higher CFQ scores with accidents (Larson, Alderton, Neideffer and Underhill, 1997; Shmuel, Shlomo, Natali, Ayala and Eliezer, 2003).and to different 'bump' rates when navigating through doorways (Nicholls et al., 2007, 2008), therefore a question about accident proneness was added. The original questionnaire instructs respondents to consider the last 6 months but, as the whole questionnaire in this study relates to the past week, the time scale was altered accordingly. Permission to use the CFQ was obtained from the British Psychological Society.

3.2.3.5. Hospital Anxiety and Depression Scale

The Hospital Anxiety and Depression Scale - HADS (Zigmond and Snaith, 1983) is a short test for anxiety and depression. It was provided by the *National Foundation for Educational Research (nferNelson)* following approval and registration of the user. The HADS is a non-clinical screening instrument used prior to formal psychiatric assessment. It comprises seven depression and seven anxiety items in alternating order, for example, 'I feel tense or wound up'; 'I still enjoy the things I used to enjoy'. Respondents indicate the extent to which each of these apply to themselves on a four-point scale. Two scale scores are generated allowing such that individuals can be sorted into normal, mild, moderate and severe depression and anxiety categories (Snaith, 2003).

3.2.3.6. Line bisection test

The manual line bisection (LB) test, which is part of the Behavioural Inattention Test (BIT: Halligan, Cockburn and Wilson, 1991), was used to test pseudoneglect. It consists of one, landscape-oriented, A4 sheet of white paper on which there are three, staggered, black, 0.75 point, horizontal lines each 206mm long. One line is centrally placed and the other two are in the top right or bottom left of the page beginning 15mm from side edge and positioned at 40mm from the top or bottom edge. Since bisection errors tend to increase with the length of the line to be bisected, (Jewell and

McCourt, 2000; Heber, Siebertz, Wolter, Kuhlen and Fimm, 2010), 206mm was chosen as middle of the range of typically tested lengths. Participants are instructed to place the paper mid-sagitally using a printed guide arrow and make a vertical pencil-mark on each line to indicate where they thought its centre point was. Normal judgement of the midpoint of the centrally placed line is slightly to the left of centre and is indicative of pseudoneglect (Bowers and Heilman, 1980). The two additional lines placed to the left and right exaggerate this effect and any differences between sleepy and rested individuals should become apparent.

3.2.4. Procedure

Between late July and early September 2006, contact was made with seven *Parkinson's UK* (formerly *Parkinson's Disease Society*) branches in the South West of England and permission was given by the branch officers to address the attendees at meetings of six of these in order to recruit participants. Strategies for maximising response rates, as recommended by Punch (2003), included pre-notification of the researchers' visit to the meetings, face-to-face presentations explaining the purpose of the research, invitation letters re-iterating this information including details of ethical clearance and researcher's contact details (Appendix C) and simple questionnaires returnable in post-paid envelopes. For the seventh group, a branch officer took questionnaires to give out on behalf of the researcher.

Following verbal presentations at the meetings, couples were invited to take away a pack containing a pair of questionnaires, along with a post-paid envelope for their return. If couples decided to complete them, they could do so at home at a time convenient to themselves and return them anonymously. Individuals were also asked to complete their questionnaires independently and not to debate their answers with each other, although it was stressed that PwPD could, if preferred, dictate their answers to their partners. PwPD were encouraged to complete the questionnaire when their symptoms were at their best. It was hoped that anonymity of responses would discourage socially favourable self-presentation (Sturgis, 2012; Aldridge and Levine, 2001).

In total, 120 pairs of questionnaires were distributed. Four couples returned them partially completed and 57 couples returned them fully completed. This represents a high return rate of about 50 per cent (N = 61). All responses were recorded and missing data were coded in order that the maximum information could be extracted, even from partially completed questionnaires. Variation in sample sizes in the following data analyses are, therefore, due to missing data.

3.3. Results

3.3.1. Demographic and clinical data.

Table 3.1. shows males' and females' ages. Couples' ages were correlated ($r = .83$, $p < .001$, two tailed, N = 56) and PwPD were significantly older than their partners ($t_{(55)} = 3.46$, $p = .001$, two-tailed). Couples reported that they had been together for M = 37.66 years (SD = 13.48; range = 5 – 60).

Table 3.1.

Partners' and PwPD'*s Ages in Years: M (SD), Range and N*

	M (SD)		Range		N	
Gender	Partner	PwPD	Partner	PwPD	Partner	PwPD
Male	67.41 (11.32)	70.33 (10.36)	46-82	52-89	22	36
Female	65.62 (9.73)	66.52 (10.62)	50-81	44-82	37	21
Total	66.29 (10.29)	68.93 (10.53)	46-82	44-89	59	57

PwPD were asked about the nature and severity of their symptoms. Of those who responded, 21 (34%) reported left side, 29 (48%) reported right side and 5 (8%) reported bilateral onset of symptoms. On average, PwPD had been aware of their symptoms for M, SD = 7.05 (4.61) years. In response to a 24-point scale, rating current symptoms from absent to severe when medication was working at its best, PwPD scores were M, SD = 3.44 (2.79). All samples showed a strong positive skew, indicating lower levels of symptoms. When asked to identify the main symptom, 54% of PwPD named freezing/slowness/loss of movement, 21% said symptoms were tremor dominant and 23% said their symptoms were mixed. Twenty-six per cent said they had fallen more than twice and 46% had experienced on-off fluctuations in the past year. Falls and on-off fluctuations were not statistically associated ($X^2_{(1)} = 0.37$, $p = .27$). A very few PwPD reported other troublesome symptoms such as speech problems and excess saliva.

The hours per week that partners spent helping the PwPD with aspects of Parkinson's disease were strongly positively skewed distribution, with 45% reporting that no help was needed. The remaining 55% reported a wide range of hours varying from 0.5 to 42 per week. A similar skew was evident for hours per week spent helping the PwPD with practical things, with 30% reporting that no help was needed. The remaining scores were spread widely over a range of 15 minutes to 60 hours per week. In accord with this, 63% received no help from others with their partner's care and the remaining 37% ranged widely from 15 minutes to 10.5 hours per week. PwPD reported spending very few hours per week managing their PD (Mean, SD = 1.22, 2.00) with 50% recording zero.

Partners were asked about their personal reactions to living with a PwPD and presented a generally positive impression. Their responses to questions about how well they felt they coped emotionally and physically and their competence as carers were strongly negatively skewed towards the maximum of 10 (M = 7.31, SD = 2.62; M = 7.40, SD = 2.45; M = 8.18, SD = 2.18 respectively) and their feelings of detachment were very low and positively skewed towards the minimum score of 1 (M = 3.31, SD = 2.92).

Ninety-one per cent of PwPD were taking medication to treat PD, 16% were taking anti-depressants and 18% took analgesics. Seven per cent of PwPD and 32% of their partners took medication for hypertension. No-one reported taking medication to help them sleep.

3.3.2. Current sleep patterns compared to normal patterns.

Partners and PwPD were asked to describe what constituted a normal (preferred), healthy sleep pattern for themselves if they were able to sleep undisturbed. They were also asked to indicate what their sleep patterns were currently like. Table 3.2. shows their normal (preferred) sleep patterns compared with current sleep patterns.

Table 3.2.

Partners' and PwPD's M (SD) Normal (Preferred) and Current Sleep Patterns

	Partners M (SD)		PwPD M (SD)	
	Normal	Current	Normal	Current
Sleep duration per night (hrs.)	7.19 (1.02)	8.10 (0.89)	7.34 (1.02)	8.35 (1.73)
Awakenings per night	1.80 (1.55)	3.94 (3.04)	1.13 (1.27)	3.31 (2.45)
Quality of sleep (1 awful - 10 excellent)	7.54 (1.48)	6.17 (1.90)	8.05 (1.61)	5.45 (2.51)
Nap time during the day (hrs.)	0.63 (0.61)	0.56 (0.58)	0.57 (0.75)	0.91 (0.80)

Note: Partners: N = 58: 36% male. PwPD: N = 60. 62% male.

Statistical comparisons were then made between these sleep preferences and recent sleep experiences for all partners and then separately for undisturbed and disturbed partners. Results indicated consistent differences between all partners' preferred sleep patterns and their current sleep pattern in all cases except for preferred and actual nap times. All differences were significant at $p \leq .001$ (two tailed). When disturbed ($n = 27\text{-}29$) and undisturbed ($n = 25$) partners were considered separately the same pattern remained ($p \leq .007$, two tailed). Partners reported currently sleeping for longer at night, waking more and experiencing poorer sleep quality than what they considered to be normal for themselves irrespective of disturbance. Comparison of means for PwPD's preferred and actual sleep patterns revealed that they differed on all measures ($p \leq .002$, two tailed). They perceived departures from normal such that they currently slept for longer at night, woke more often, experienced poorer sleep quality and napped for longer in the day.

PwPD completed all items on the PDSS and some additional questions. Partners also responded to insomnia items from the PDSS and the additional sleep-related questions. Scores for these and the PDSS sub-scales are summarised in Table 2.3. For PwPD, psychosis and nocturia items showed pronounced positive skews as did lateness for appointments and tendency to oversleep. The importance of good sleep scored highly and was negatively skewed. For partners, mid-range scores were noted for 'waking earlier than preferred, low, positively skewed scores for oversleeping and lateness and high, negatively skewed scores for the importance of good sleep. The five items in Table 2.3., that were common to partners and PwPD, were compared for couples and it was found that they differed in the PDSS insomnia scores alone ($t_{(55)} = 2.14$, $p = .04$, two-tailed) with PwPD scoring more highly.

Table 3.3.

PwPD's and Partners' Responses to the PDSS and its Subscales and Additional Sleep Questions: M (SD) and Reported Range

PwPD	M (SD)	Reported range
PDSS restlessness items (range 2-20)	9.88 (5.96)	2-20
PDSS psychosis items (range 2-20)	6.33 (5.05)	2-20
PDSS nocturia items (range 2-20)	6.16 (4.67)	2-18
PDSS motor items (range 4-40)	14.72 (10.11)	4-40
PDSS insomnia items (range 2-20)	9.09 (5.12)	2-20
PDSS items total (range = 15-150)	60.97 (23.10)	20-116
Waking earlier than preferred (1-10)	5.67 (3.42)	1-10
Tendency to oversleep (1-10)	2.34 (2.07)	1-10
Lateness for appointments or work (1-10)	1.76 (1.73)	1-8
Importance of getting good sleep (1-10)	8.57 (1.78)	3-10
Partners		
PDSS insomnia items (range 2-20)	6.92 (3.49)	2-14
Waking earlier than preferred (1-10)	4.20 (2.83)	1-10
Tendency to oversleep	2.40 (2.03)	1-10
Lateness for appointments or work	1.46 (1.15)	1-6
Importance of getting good sleep	8.70 (1.81)	3-10

Note. Partners N = 57. PwPD N = 58-60. Lower scores indicate 'poor', low incidence or irrelevance.

3.3.3. Parasomnias

Participants were asked questions about the occurrence of parasomnias such as sleep apnoea, snoring and restless legs syndrome (RLS). These were reported by 18 out of 58 (31%) of partners and 35 out of 61 (57%) of PwPD. The coincidence of parasomnias within couples was negligible, with only one couple reporting that they were both long-term snorers and two other couples both reporting sleep maintenance insomnia. For partners, snoring was overwhelmingly the most common problem (N = 10/18). In PwPD, 35 individuals accounted for 70 reported incidences of parasomnia. Sixteen PwPD reported just one problem and for 7 of these it was snoring. Nine PwPD reported 2 problems, 5 reported 3 problems (3 of these were a combination of sleep onset and maintenance insomnia and RLS), 4 reported 4 problems and 1 reported 5 problems. Table 3.4. shows how these frequencies break down, and indicates in how many cases the problem was present before PD symptoms were noticed. Nearly half of the reported parasomnias pre-dated PD and insomnias, and restless legs syndrome showed the most marked increases in incidence. Some of these increases however, could be age- rather than PD-related. The remainder showed wide variations in duration with some reported to be very long term and others of recent onset. In contrast with other research that has linked LPD in particular with some kinds of sleep problem (Stavitsky *et al.* 2008), 66% of the RPD and 48% of LPD, who said they experienced parasomnias, reported at least one of the conditions listed in Table 3.4.

Table 3.4.

Incidence and Current Frequency (f) of Parasomnias in 35 out of 61 PwPD

Parasomnia	Current f	f present before PD
Sleep onset insomnia	10	1
Sleep maintenance insomnia	18	4
Restless legs syndrome	13	5
Nightmares	8	7
Snoring	15	12
Sleep apnoea	3	3
Sleep walking	0	0
Sleep talking	3	2
Total	70	34

3.3.4. Location of sleep and sleep disturbances and current sleepiness.

Partners were asked to indicate whether they usually slept in the same room or a different room from their partner and whether they were disturbed due to their partner's PD. Partners could also indicate whether they had choice over where to sleep, and three out of 58 indicated that they would choose to sleep on their own but had no alternative. No association was found between disturbance and place ($X^2_{(1)} = 0.51$, $p = .57$, two-tailed), however Yarrow (1999) and Giunta *et al.* (2002) showed that 50% of PD caregivers report problems with sleep, and these figures are in accord with the 54% of partners in this study who were sleep disturbed due to PD which included the 15% who slept in a different room. In Yarrow's UK study, 50% of caregivers had rated getting a good night's sleep as important but were unable to get it. In Giunta's US study, 50% of carers were moderately or extremely upset by the PD person waking them up at night. Both of these findings are supported in this study. The differences, while small, are consistent. On a ten point scale, disturbed partners rated good sleep as only marginally more important (M disturbed = 9.08, M undisturbed = 8.28, $F_{(1, 47)} = 2.54$, $p = .12$, two-tailed) but reported significantly more distress than undisturbed partners about disturbed sleep (M disturbed = 4.81, M undisturbed = 2.96, $F_{(1, 47)} = 4.31$, $p = .04$, two tailed), patterns that showed no interaction with where they slept for both importance of good sleep and distress ($F_{(1, 47)} = 0.37$, $p = .55$ and $F_{(1, 47)} = 0.01$ $p = .94$).

The need for partners to get out of bed to help with PD related matters showed a strong positive skew; 43 (72%) never needed to help and 14 (28%) reported getting out of bed to help their partner at least once. For those partners who reported being disturbed due to PD only, the correlation between distress about sleep disturbance and importance of good sleep, was positive (rho = .54, $p = .005$, two tailed, N = 26). Partial correlation, controlling for duration of disturbance, made little difference to this value ($r = .47$, $p = .02$, two tailed, N = 26) indicating that duration of disturbance is not influential.

For PwPD, distributions of various kinds of sleep disturbance were positively skewed. Only six out of 59 (10%) of PwPD reported being woken by their partner at night. Twenty-one out of 60 (36%) got out of bed for PD-related reasons while two (3%) reported having to get up three times a night. Total night-time disturbances (awakening but not getting out of bed + getting out of bed) were three or less for 58% of PwPD (compared to 56% for partners) with four individuals (7%) reporting eight to 12 disturbances. The degree of disturbance was not generally affected by place of sleep, except that PwPD who slept in a different room from their partners reported getting up for PD related reasons more often than those who shared a room with their partner (M in a different room = 1.29, M in the same room = 0.47; $t_{(55)} = 2.10$, $p = .05$, two-tailed). This was possibly a contributory factor in the decision to sleep apart. In common with partners, PwPD also showed a positive correlation between the importance of good sleep and distress about being disturbed (rho = .39, $p = .002$, two-tailed, N = 60).

A sleep fragmentation index (SFI) was calculated as a measure of sleep continuity during the night by dividing current total number of awakenings, which included getting out of bed, by sleep hours. It is thought to mark shifts from deeper NREM or REM sleep to Stage 1 sleep (Haba-Rubio *et al.*, 2004). Lower values indicate better sleep continuity and zero indicates no awakening at all. For partners (n = 48), the average SFI was M = 0.47 (SD = 0.39) and the average number of awakenings per night was M = 3.81 (SD = 2.90) during an average night of M = 8.14 hours (SD = 0.87). SFI was strongly positively skewed in partners, indicating relatively good levels of sleep continuity for most people, and it correlated positively with distress, ESS, mood scales and naps but not with CFQ and sleep quality ($r \geq .33$, $p \leq .05$, two-tailed). None of these correlations for RPD and LPD were significant with the sole exception of SFI with distress for RPD ($r = .43$, $p = .03$, two-tailed).

Current subjective sleepiness was measured using the Epworth Sleepiness Scale (ESS, Johns 1991). Scores on this scale can range from 0 to 24. Zero to 10 is classified as normal, 11-14 as mildly sleepy, 15-18 as moderately sleepy and 19-24 as severely sleepy. Normal ESS frequencies outnumbered sleepy frequencies by a ratio of 79:38 indicating that there were approximately twice as many normal ESS scores as sleepy ones. Forty-three partners (75%) scored within the normal range, 14 (25%) were classed as mildly sleepy (n = 12) or moderately sleepy. For the purposes of most analyses, mildly and moderately sleepy individuals' data were combined. Another measure taken was 'napability', which is defined as the ease with which an individual can fall asleep in the day when not particularly tired. ESS scores and napability are correlated even when total sleep time (sleep hours + nap hours per day) is controlled (r = 0.54, N = 55, p < .001, two tailed). Separately, they correlate positively with daytime nap hours (ESS with nap hours, r = .43, p = .001, two tailed; napability with nap hours, r = .44, p = .001, two tailed) and negatively with night-time sleep hours (ESS with sleep hours, r = -.31, p = .02, two tailed; napability with sleep hours, -.26, p = .06, two-tailed). Neither of them correlates with total sleep time, suggesting that total night-time sleep plus daytime nap hours is independent of sleepiness. ESS scores did not differ between partners disturbed due to PD or not ($t_{(47)}$ = 0.34, p = .74, two-tailed).

For 36 (60%) of 60 PwPD, ESS scores fell within the normal range, 22 (37%) were mildly or moderately sleepy and 2 (3%) were severely sleepy. In common with partners, napability and ESS were positively correlated even when total sleep time (sleep hours + nap hours in the day) was controlled (r = .42, p = .002, two tailed). Separately, neither ESS nor napability correlated with current sleep duration but they both correlated with napping in the day (r = .45 and .47 respectively, p < .001, two tailed) and with total sleep time (r = .52 and .53 respectively, p < .001, two tailed). Partners and PwPD did not differ in ESS scores ($F_{(2, 91)}$ = 0.95 p = .39).

3.3.5. Predictors of Cognitive Failures Questionnaire (CFQ) scores in partners and PwPD.

In accordance with Ferrara and De Gennaro (2001), who recommended taking account of individual somnotypology in sleep disruption studies, age, gender, preferred length of sleep, sleepability (napability) and morningness/eveningness (circadian preference) were first considered as predictors of CFQ scores. Regression analyses showed that just one relationship was significant for PwPD alone: higher CFQ scores were associated with higher napability (r = .34, p = .03, two-tailed, N = 43). It was thus concluded that, for these samples at least, individual differences in somnotypology were not predictors of CFQ scores.

Table 3.5. summarises variables analysed in this section. It had been suggested by Foster *et al.* (2011) that RPD are more at risk of depression than LPD, but only when disease duration was taken into account, so partners were initially compared with right side symptoms (RPD) and left side symptoms (LPD) PwPD groups separately. Partners (both

male and female) did not differ from either group of PwPD on CFQ, ESS and HADSANX scores ($F_{(2, 89)} = 1.16$, $p = .32$; $F_{(2, 89)} = 0.63$, $p = 53$; $F_{(2, 90)} = 0.78$, $p = .46$) and Helmert contrasts used to compare partners against all PwPD showed no overall significant differences ($p \geq .20$). PwPD however scored higher on the HADSDEP scale ($F_{(2, 90)} = 6.80$, $p = .002$); partners were marginally less depressed than LPD ($p = .08$) and significantly less depressed than RPD ($p < .001$). Disease duration as a covariate had no effect on this pattern. Helmert contrasts showed that all PwPD together were more depressed than partners ($p =.001$).

Table 3.5.

M (SD) CFQ, ESS and HADSANX and HADSDEP Scales for Partners and PwPD

	Partner	PwPD	
Scale	M (SD)	M (SD)	Scale range
CFQ	34.83 (14.79)	39.32(14.82)	0-100
ESS	7.30 (3.90)	8.34 (5.27)	0-24
HADSANX	6.43 (4.00)	7.27 (3.67)	0-21
HADSDEP	4.23 (2.73)	6.36 (3.03)	0-21

Note: Partners N = 47, PwPD N = 44 for PwPD which includes both RPD and LPD.

Depression and anxiety measures were then correlated for partners and PwPD. Depression and anxiety were comorbid in both groups ($r . \geq .47$, $p \leq .05$, two-tailed) and there was a weak but significant relationship between partners' depression and PwPDs' anxiety but otherwise little correspondence between mood states in couples.

Prior to the following analyses, checks were carried out to ensure that the data were suitable for multiple regression. ESS and the HADS scales for anxiety (HADSANX) and depression (HADSDEP) were used as predictors of total CFQ. For partners, $AdjR^2 = .47$ ($p < .001$) indicating that these IVs account for nearly half the variation in CFQ scores. Field (2005) describes this as a large effect size and a 'good' fit, however, only ESS and HADSANX were significant and HADSANX accounted for the greatest amount of variation in CFQ scores. The analysis was repeated for PwPD. The ability of ESS, HADSANX and HADSDEP to predict CFQ in PwPD was much weaker than it was for partners. $AdjR^2 = .20$

($p < .05$) indicating that these IVs together accounted for 20% of the variation in CFQ scores. Depression was the only significant predictor, a pattern that was the same when PwPD were split by side of predominant symptoms. Again, Field (2005) describes this as a medium to large effect size and a 'good' fit but, in this case, only HADSDEP was significant. These analyses are summarised in Table 3.6.

Table 3.6.

ESS and Mood Variables as Predictors of CFQ Scores in Partners and PwPD

Partners: Scale, predictor (N = 47)	*Beta*	*Sig.*
CFQ, HADSANX	.46	< .001
CFQ, ESS	.28	< .05
CFQ, HADSDEP	.15	—
Partners: Scale, final model predictors	*Adjusted R^2*	*Sig.*
CFQ, HADSANX, ESS, HADSDEP	.47	< .001
PwPD: Scale, predictor (N = 44)	*Beta*	*Sig.*
CFQ, HADSDEP	0.40	< .05
CFQ, HADSANX	0.14	—
CFQ, ESS	0.08	—
PwPD: Scale, final model predictors	*Adjusted R^2*	*Sig.*
CFQ, HADSDEP, HADSANX, ESS	.20	< .01

ESS – Epworth Sleepiness Scale scores; HADSANX – HADS anxiety subscale scores; HADSDEP = HADS depression subscale scores; CFQ – Cognitive Failure Questionnaire scores.

Accident proneness was added at the end of CFQ questions (Larson *et al.,* 1997; Nicholls *et al*., 2007, 2008; Shmuel *et al.*, 2003) since the CFQ does not ask about this directly. Correlations between this measure and ESS, HADSANX and HADSDEP were positive and significant for partners ($r \geq .37$, $p < .01$, two-tailed) and for CFQ alone for both LPD and RPD ($r \geq .43$, $p < .05$, two-tailed).

3.3.6. Line bisection and sleepiness in partners and PwPD

The following analyses of LB data exclude people who had indicated that they were left- or mixed-handed writers. This was done because of the findings reported in a meta-analysis of factors affecting pseudoneglect in LB tasks, Jewell and McCourt (2000: 104-105) in which *'Both dextrals and sinistrals demonstrate an overall leftward deviation, where dextral subjects are biased slightly more leftward than sinistral subjects.'* In addition they say: '*This is not unexpected if the sinistral group included subjects who are left-lateralized for spatial attention, and who therefore might be expected to make rightward errors.*' For these reasons, it was thought to be important to control for both possible differences in leftward bias and in spatial attention by including dextrals alone.

Table 3.7. shows LB scores for partners, RPD and LPD further divided by sleepiness as classified on the ESS. LPD and RPD groups were separated in case of possible biases in spatial attention due to side of onset and continuing predominance of symptoms. Negative values indicate a drift to the left of centre and positive values indicate a drift to the right of centre. Zero indicates no drift.

Table 3.7.

Mean (SD) Deviations from Centre in mm on the Line Bisection Task for Partners, LPD and RPD in Normal and Sleepy ESS Groups

	Partner		LPD		RPD	
Line position	Normal (N = 36)	Sleepy (N = 12)	Normal (N = 11)	Sleepy (N = 7)	Normal (N = 14)	Sleepy (N = 11)
Top right	-4.75 (5.00)	-5.00 (3.97)	-6.05 (5.11)	-2.29 (5.33)	-6.47 (9.42)	-3.09 (6.62)
Central	-2.00 (6.08)	-3.91 (3.11)	-0.91 (3.36)	-1.14 (5.67)	0.10 (7.29)	1.50 (9.38)
Bottom left	0.57 (4.58)	-4.50 (5.08)	1.59 (5.07)	-1.64 (3.29)	6.20 (14.27)	5.95 (14.92)

Right-handed partners who rated themselves as normal or sleepy on the ESS were first compared. A 2 x (3) factorial ANOVA was carried out with the independent factor of ESS on two levels (normal and sleepy) and the repeated factor of line position on three levels (top right, central and bottom left). The independent variable was LB deviation from exact centre in mm. There was a main effect for line position in the expected direction ($F_{(2, 92)} = 4.41$, $p = .02$) such that bisections drifted slightly to the left on the central line, further to the left on the top right and rightwards on the bottom left. There was also a main effect for ESS group ($F_{(1, 46)} = 3.96$, $p = .05$; sleepy ESS M = -4.47; normal ESS M = -2.06) such that sleepy people were erring more to the left on average across all line positions. There was also an interaction between ESS group and line position ($F_{(2, 92)} = 3.02$, $p = .05$). Post hoc analysis, treating sleepy and normal partners separately, showed significant differences in LB means in the expected direction for normal ESS partners ($F_{(2, 70)} = 14.57$, $p < .001$) but no differences between LB means for sleepy ESS partners ($F_{(2, 22)} = 0.19$, $p = .83$). This supports the impression that the typical rightward drift that occurs as the stimulus line shifts from right to left, has not occurred in mildly sleepy partners. In the manual line bisection test, alert participants tend to overestimate the left hand side of the line and bisect to the left and, as expected, this has become more exaggerated in the sleepy group. This supports Casagrande and Bertini (2008a, 2008b) who proposed that the right hemisphere remains more vigilant and for longer than the left as alertness decreases.

LB scores for LPD were compared next. Again there was a main effect for line position ($F_{(1.47, 23.56)} = 4.10$, $p = .04$), but not for ESS ($F_{(1, 16)} = 0.004$, $p = .95$). The interaction between ESS and line position was marginal ($F_{(1. 47, 23.56)} = 2.70$, $p = .10$). Post hoc analysis, treating sleepy and normal LPD separately, showed significant differences in LB means in the expected direction for normal ESS PwPD ($F_{(2, 20)} = 7.82$, $p = .003$ but no differences between LB means for sleepy ESS PwPD ($F_{(2, 12)} = 0.14$, $p = .87$). This, again, supports the impression that the typical rightward drift that occurs as the stimulus line shifts from right to left, has not occurred in mildly sleepy people with LPD.

Finally, LB scores for RPD were compared. Again there was a main effect of line position ($F_{(1. 09, 26.15)} = 8.02$, $p = .008$), but not for ESS ($F_{(1, 24)} = 0.27$, $p = .61$). The interaction between ESS and line position was non-significant ($F_{(1. 09, 26.15)} = 0.22$, $p = .80$). Post hoc analysis, treating sleepy and normal RPD separately, however, showed significant differences in LB means in the expected direction for both normal ESS RPD ($F_{(1.07, 14.96)}$ = 5.42, p = .01 and marginally for sleepy RPD ($F_{(1.13, 11.30)}$ = 3.29, p = .09). This suggests that RPD, combined with sleepiness, somehow preserved the normal drifting tendency in LBs that had apparently disappeared in partners and LPD when they were sleepy. In this case it would appear that the right hemisphere in RPD has not remained more vigilant than the left when they are sleepy. Comparisons of LBs in sleepy and normal partners, left PwPd and right PwPD are illustrated in Figures 3.1 and 3.2

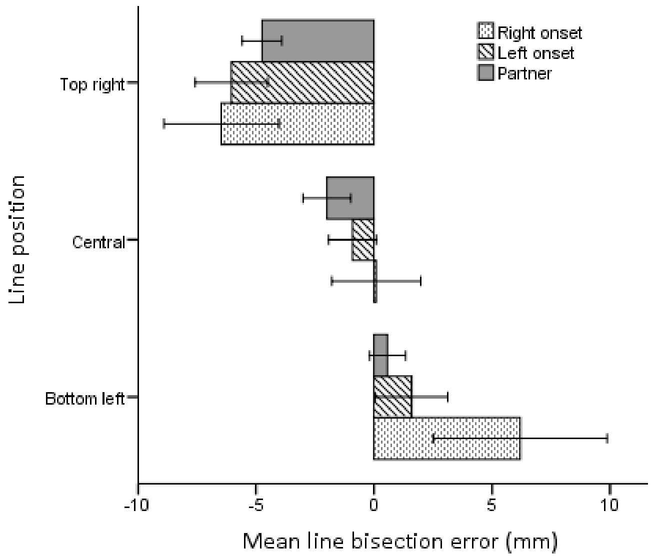


Figure 3.1
Line Bisection Error Means ± 1 SE for Normal ESS Partners N = 48, LPD N = 18 and RPD N = 26.

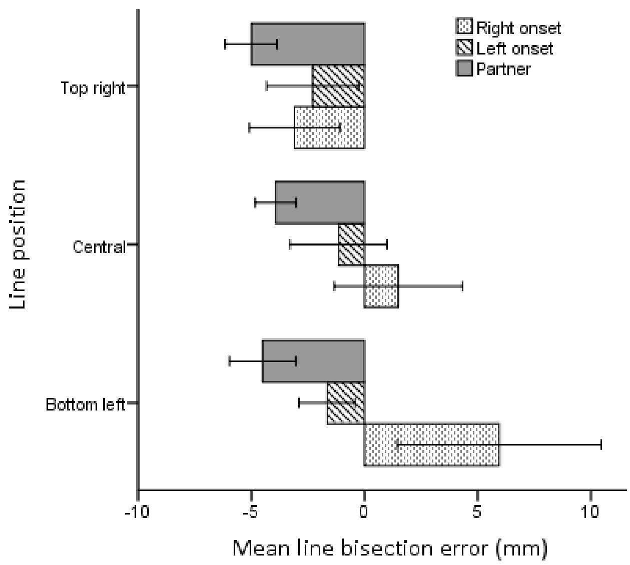


Figure 3.2.

Line Bisection Error Means ± 1 SE for Sleepy ESS Partners N = 48, LPD N = 18 and RPD N = 26.

Given unequal N and heterogeneity of variance in some of the samples in these analyses as well as concerns about the unqualified use of .05 p values (Field, 2009), a further method of assessing these effects was used. Field (2009) recommends the use of Omega squared (ω^2) to give more conservative population estimates of effect sizes. Omega squared can be calculated by hand using a method described by Field (2009: 480) and he suggests values of .01 for a small effect, .06 for a medium effect and .14 for a large effect (Field, 2009: 390). For normal ESS partners, the line position effect is large (ω^2 = .14) but for sleepy partners it is zero. Similarly, for normal LPD it is large (ω^2 = .30) but for sleepy LPD it is zero. In the normal ESS RPD, the line position effect is large (ω^2 = .15) and in the sleepy RPD group it is medium (ω^2 = .07).

Finally, focused comparisons of LBs relative to the centre line in each participant group and sleepiness category were made using the effect size statistic r as described by Field, 2009: 481) and these results appear in Table 3.8. All differences were in the expected direction with right-side lines being bisected to the left of the central condition and left-side lines being bisected to the right of the central condition. For normal ESS Partners, LPD and RPD, the effect sizes were consistently small to medium. For sleepy partners and LPD effect sizes were negligible but for sleepy RPD they remained small to medium.

Table 3.8.

Effect sizes (r) for Line Position in the Line Bisection Task for Partners, LPD and RPD in Normal and Sleepy ESS Groups

	Partner		LPD		RPD	
Line position comparison	Normal (N = 36)	Sleepy (N = 12)	Normal (N = 11)	Sleepy (N = 7)	Normal (N = 14)	Sleepy (N = 11)
Centre with bottom left	.17*	.01	.20*	.09	.26*	.30**
Centre with top right	.17*	.05	.48**	.07	.32**	.10*

Note: Effect sizes for r: .10 = small*, .30 = medium**, .50 = large***

It is important to consider the possible role of age in these effects as Jewell and McCourt (2000) found that participants show a trend to err more to the right, although not significantly so, with increasing age, possibly due to *HAROLD* (Cabeza, 2002). It could also be expected that there would be changes in sleep patterns in participants whose ages ranged from 44-89 years. When age was used as a covariate in the LB analyses only the LB by sleepiness group interaction for partners remained ($F_{(2, 90)} = 3.12$, $p = .05$). All other effects were no longer significant. Field (2009) however, cautions that a covariate should be independent of other IVs in analysis of covariance. In these data, this is true for participants' health status (partners and PwPD groups did not differ in age: $F_{(2, 91)} = 1.07$, $p = .35$, M partners = 66.22, N = 49; M LPD = 70.32, N = 19; M RPD = 67.73, N = 26). There was, however, an effect for sleepiness. Sleepy people tended to be younger ($t_{(92)} = 1.81$, $p = .07$, two-tailed; normal ESS M age = 68.78, N = 64; sleepy ESS M age = 64.64, N = 30; $r = .19$: a small to medium effect size), a pattern that is consistent when partners and PwPD groups were considered separately. Furthermore, age did not interact with LB ($F_{(2, 170)} = 1.29$, $p = .28$) except for mildly sleepy RPD who tended to err more leftward on average with increasing age ($r = -.61$, $p = .05$, N = 11). These mixed findings cast doubt over the usefulness of age as a covariate, especially in the relatively small PwPD samples, and leaves its effect uncertain.

3.4. Discussion

3.4.1. Sleep patterns and disturbance in partners and PwPD

The 50% return rate from 120 respondents in this survey was high, probably reflecting the personal interest and investment respondents may have had in such research. Nevertheless, the final sample was self-selected and there is no way of knowing whether respondents differed systematically from those who chose not to take part. With regard to measurement in general, responses to a postal survey are inevitably self-report and the possibility of social desirability bias, even in anonymous responding, remains. Although couples' anonymity was guaranteed between participants and the researcher and participants were asked to complete questionnaires without conferring, partners may have discussed their sleep patterns with each other and shown each other their responses, so the possibility of them influencing each other cannot be ruled out. All of these limitations apply in the following discussion.

All partners in this survey were able to recognise a sleep pattern which was normal for them as individuals and felt that their current sleep experiences fell short of this in all measures except for nap times. They reported sleeping for approximately one hour longer at night, waking twice as often and experiencing slightly poorer sleep quality than normal. These differences persisted even when partners who reported they were disturbed by the PwPD were separated from those who were not disturbed. Responses to '*waking earlier than preferred'* placed them, on average, at the mid-point of the scale, they were unlikely to oversleep or be late for work or appointments and rated the importance of good sleep very highly. The incidence of parasomnias was relatively low, with 18 out of 58 partners reporting at least one, and 10 of these were the common problem of snoring. Descriptive analysis of partner's responses to questions about their sleep confirmed that about half of them had disturbed sleep and 54% of them said they were disturbed due to the PwPD. This concurs with Yarrow (1999) and Giunta *et al.* (2002) who also found that about 50% of PD carers in their surveys had problems with sleep. Place of sleep, however, seemed to have little bearing on this as no association was found between whether partners were disturbed by the PwPD and whether they shared a bedroom with the PwPD or not. Also in accord with Yarrow (1999) and Giunta *et al.* (2002), partners whose sleep was disturbed reported more distress about this than undisturbed partners, but this too was unaffected by where partners slept. The association between sharing a bedroom with the PwPD and night-time wakenings was only marginally significant.

The most persistent pattern, however, was the association between disturbed sleep due to PD and distress reported by partners, and this suggested a situation which more closely resembled sleeping with someone who snores. Studies by Ulfberg *et al.* (2000) Billman and Ware (2002) and Strawbridge *et al.* (2004) suggested adverse effects of snoring on partners ranging from daytime sleepiness and depressed mood to marital dissatisfaction. There was however, no evidence, as suggested by Alapin *et al.* (2000), that distress due to disturbed sleep exacerbated other symptoms in partners because, although distress correlated positively with the key variables of CFQ, HADSANX and HADSDEP (but not ESS) in all partners, these variables did not differ between disturbed and undisturbed partners ($p \geq .40$ in all cases). People whose sleep is disturbed by PwPD report more distress about disturbed sleep but this does not render them more vulnerable to other negative effects.

The sleep fragmentation index (SFI) correlated positively with key measures in this survey, including ESS, HADSANX and HADSDEP, distress and nap time. In accord with this, Blumen *et al.* (2009) had found that women who spent one night sleeping apart from their snoring husbands slept more deeply and felt more alert in the day and Bonnet and Arand (2003) had concluded that sleep fragmentation and deprivation in otherwise healthy sleepers were associated with subjective and objective measures of impairment in daytime alertness and mood. Ferrara and De Gennaro (2001) reached the conclusion that PSD increases sleepiness and affects certain kinds of cognitive performance but no correlation was found here between SFI and CFQ. The general pattern of inter-correlations between sleep disturbance, fragmentation, distress and mood here however, suggested that there may be common ground amongst these measures and that they are possibly linked by general negative affect (Clark and Watson, 1991).

Approximately 25% of partners scored within the sleepy range on the ESS and sleepy people also reported greater napability irrespective of total sleep time. Sleepy people with high napability also tended to take more daytime naps and slept for fewer hours at night, suggesting that participants were managing their total sleep time over 24 hours to try to compensate for their propensity to feel sleepy in the day. Furthermore, the lack of correlations between daytime sleepiness, napability and total sleep time may reflect differences in their individual needs for sleep duration in order to feel refreshed (Violani, *et al.*, 1996). These figures may also include some people who have "…*high sleepability with no other evidence of sleepiness (HSNS)"* (Harrison and Horne, 1996: 16) but it is impossible to distinguish who they might be from these data. ESS and napability did not differ with disturbance due to PD and the aforementioned correlations were not changed by controlling for sleep fragmentation.

These findings suggest that, in spite of 54% of partners claiming to be disturbed because of their partner's PD, their sleep was relatively unaffected by the PwPD and probably differed little from sleep disturbances in partners who are both in good health (e.g. the

National Sleep Foundation, 2005, in the USA found that 65% of adults reported being affected by their partners' snoring). Daytime sleepiness appeared to be a feature of life for some participants, and it may be because of sleep disturbance by extraneous events or simply a reflection of individual somnotypology or both. Lloyd (1998) commented that every case of PD progresses in its own way and a hallmark of the disease is its diversity, but in this survey uniformity was more striking. Analysis of returns showed that PwPD had noticed the first symptom M = 7.05 years (SD = 4.61) ago, 91% were taking medication for PD and symptom severity at best scored M = 3.44 on a 24-point scale. In addition, the frequency of care reported by partners was low (45% said that no help was needed and most reported very little), and independence reported by PwPD was high (50% of them stated that they spent no time in the day specifically managing their PD and 63% said they did not need any help). This suggests a fairly homogenous sample of partners who could not be placed in the same category as the 'carers' as in the surveys by Yarrow (1999) and Giunta *et al.* (2002) that included cases in which PD was more advanced. These factors, and the fact that it was not demonstrable that sleep problems in partners could be reliably linked to disturbance due to PD, or even shown to be more frequent than in general disturbances amongst couples, suggests that the final analysis was based on partners who were arguably no more affected by the PwPD's sleep patterns than couples in which PD was not present.

More PwPD fell into sleepy ESS categories than partners, which may have been due to age, but as they were significantly but not much older (M = 68.93) than their partners (M = 66.29) it seems more likely that this was due to PD, although Abdelgabar and Sharma (2003) believe that it is controversial whether sleep disorders correlate with the severity of PD symptoms or the amount of associated disability, probably because of the diverse nature of the PD. Nevertheless their ESS score overall did not differ from that of partners. Indeed, PwPD showed similar patterns of sleep to partners in that they perceived discrepancies between ideal and actual sleep patterns, and experienced similar amounts of night-time disturbances that did not seem to relate to where people slept. Similarly, the relationships between ESS, napability, total sleep hours and night time sleep hours were very similar to that of partners, with the exception of the negative correlations which partners showed between ESS and napability and night-time sleep duration. The most marked differences between PwPD and partners was in frequency of parasomnias in

PwPD, notably in insomnia and restless legs, that had become much more prevalent since the onset of PD. Snoring, however, remained a common problem for both groups. In summary, these PwPD appeared to be in the early stages of the condition when sleep problems are less likely to be severe. This reinforced the view that couples were managing their situation very well, and that there is no convincing case that the presence of PD in the relationship played a major part in affecting the sleep of partners.

3.4.2. Predictors of cognitive failures

Age, gender, preferred length of sleep, napability and morningness/eveningness bore no relation to self-reported cognitive failures (CFQ) in partners and PwPD with the sole exception of napability which, in PwPD, correlated positively with CFQ scores. In this sample, therefore, there was little evidence that individual somnotypology (Ferrara and De Gennaro, 2001) predicted this particular measure. Sleepiness and mood however were associated with CFQ. Firstly, it should be taken into account that partners did not differ from PwPD (both RPD and LPD) on overall CFQ, ESS and HADSANX but they were significantly less depressed than PwPD in general and, in accord with Foster *et al.* (2011), RPD reported more depression than LPD. However, Lou *et al.* (2001) found that depression in PD correlated with fatigue, not sleepiness, and Foster *et al.* (2011) found that it correlated with length of illness in RPD only. Fatigue was not measured in this survey and so its effect was uncertain. Disease duration used as a covariate, however, did not alter the relationships found here.

In spite of the finding that anxiety and depression were comorbid in both partners and PwPD, differences in depression measures meant that partners and PwPDs were subsequently treated separately. In partners, HADSANX and ESS together predicted 47% of the variance in CFQ and in PwPD, depression alone accounted for 20% of the variance in CFQ. For partners, these findings accord with those of Caswell *et al. (*2003) who found that '*distress'*, a measure which incorporated mood and sleep problems, appeared to mediate the relationship between caregiver status and cognitive test performance but depression had no effect. Although the measures were different, a similar pattern has emerged here; in partners for whom caregiving duties were negligible, anxiety and sleepiness were significant predictors of CFQ and depression appeared to play no part in this.

The comorbidity of anxiety and depression in all participants suggested by their shared variance, however, calls into question the suggestion that depression has no role at all in the association between sleepiness and CFQ. Clark and Watson's (1991: 316) '*tripartite*' model proposes that anxiety and depression share negative affect, and while it was not directly measured in this study, it may account for the fact that anxiety and depression not only correlated with each other but also correlated with sleepiness. The relationship between sleepiness, mood and CFQ could, therefore, be further explored by breaking down the tripartite model into its components and assessing their ability to predict CFQ along with sleepiness. Also, considering men and women separately as recommended by Lee (2012) may have been informative, but sample sizes were too small.

Accident proneness as an aspect of cognitive failures (Larson *et al.,* 1997) was positively correlated, in right-handed partners, with ESS, CFQ, HADSANX and HADDEP but only with CFQ for PwPD. The type and seriousness of accidents was not specified (e.g. Shmuel *et al.*, 2003, specifically asked about driving accidents) so this would need to be clarified in the future. Nevertheless, partners who were more sleepy, anxious and depressed saw themselves at greater risk of accidents however they personally defined them.

Established measures used within the questionnaire were carefully chosen for their suitability in this survey but were not without limitations. The ESS for example, includes an item asking how likely it is that a respondent would doze or sleep while '*stopped for a few minutes in traffic while driving'* which clearly is not applicable to non-drivers. Three out of 57 partners, however, rated this item 1 and three out of 60 PwPD gave this item 1, 2 and 3 on a scale of 0-4. Eleven of the partners and 20 of the PwPD said they did not drive and some left this item blank so it is hoped that any effects on the data were minimal. With regard to the validity of the CFQ, Cheyne *et al.* (2006) commented that the test was specifically designed by Broadbent *et al.* (1982) to be non-specific about underlying cognitive processes and was intended to measure everyday slips that result from attention lapses, but they believe it measures more than just attention-related errors. There has also been much debate over whether it has an underlying factor structure, (e.g. Wallace, 2004; Wallace *et al*., 2002; Wallace, Vodanovich and Restino, 2003) found that memory accounted for the majority of the variance (37.79%) in CFQ scores. Cheyne *et al.* (2006: 580) say that '*… the CFQ assesses both attention lapses without action errors as well as a variety of action errors and cognitive failures potentially resulting from several underlying cognitive failures*...' so it would appear, from one point of view at least, that the CFQ largely assesses lapses of memory.

The most consistent finding with regard to CFQ in partners, but not in PwPD, was that scores could be predicted from ESS scores and anxiety. These too are self-report measures that could concur at least partly because people who perceive themselves as sleepy and anxious, and possibly also low in mood, expect to function inefficiently or even construe normal levels of cognitive failures more negatively. In this sample however, on the 100 point CFQ scale, the overall M CFQ = 35.23 with an M age of 66.29 years that was not significantly higher ($p = .14$, two-tailed) than figures provided by Knight *et al.* (2004) for 270 mentally and physically healthy men and women aged 65 and over (M CFQ = 32.10). This suggests that, even in a sample of participants specifically asked about ESS and mood, the average CFQ was not inflated as a consequence.

3.4.3. Line bisection

The ESS and CFQ and HADS scales are self-report measures and it is possible that participants' expectations might be at least partly responsible for the statistical correspondence between them found here. The LB test, however, was unfamiliar to participants and, therefore, less likely to be biased in this way.

Manly, Dobler, Dodds and George (2005) and Dufour *et al.* (2007) both presented evidence that concurs with the view that the right hemisphere remains more vigilant than the left when sleepy (Casagrande and Bertini, 2008a, 2008b). Considering the LB findings in the light of these studies, a similar interpretation can be suggested. Alert partners showed the expected pattern of bisection drift from left to right as they shifted from the right, through central to the left visual field. When they were sleepy, however, they did not show this drift. In all three conditions, their performance was similar to the right-hand line condition and all bisections erred to the left. It therefore appears that they continued to behave as though they were attending to the left even when their attention was deliberately re-directed, implicating persistent dominance of the right hemisphere and reduced left hemisphere activity. This is further borne out by the pattern of results for LPD who performed similarly to partners when alert and sleepy, in the former case showing the usual pattern of drift and, in the latter, consistently bisecting lines to the left. RPD however continued to perform as if they were alert even when sleepy and showed a similar pattern of rightward drift in both conditions. In this respect, people with RPD could be said either to have some sort of compensatory mechanism that preserves LB performance even in the presence of sleepiness or, more likely, a lack of more pronounced asymmetry in hemispheric activity that partners and LPD show when sleepy. Casagrande and Bertini (2008a: 76) have shown that the appearance of hemispheric asymmetry, in which the left hemisphere '...*goes to sleep first...*' is associated with early sleep onset. If this is the case, it could be that right-handed, partners with healthy hemispheric function and LPD who, compared to RPD, arguably have relatively healthy left hemispheres, both demonstrate the effects of increased asymmetry when sleepy but RPD do not. The speculative conclusion is that right hemispheric functioning is dominant in alert RPD and left hemispheric functioning is compromised, but sleepiness does not bring about asymmetry as it does in partners and LPD hence the lack of change in RPD LB performance. Indeed it has been shown e.g. by Rodríguez-Violante *et al.* (2011) that sleep problems present differently in RPD as opposed to LPD. Cronin-Golomb's (2010) view that PD could be a disconnection syndrome might also be invoked to explain why partners and LPD both show a normal pattern of asymmetry when sleepy but RPD do not. In RPD, the way in which the two hemispheres communicate at sub-cortical and/or cortical levels might be disconnected in a particular manner, leading them to combine input from the left and right visual fields in the same way as partners and LPD when alert but not when sleepy.

One of the unavoidable disadvantages of the postal survey, however, was that there was no control over how people self-administered the LB task. Participants were asked to align the stimulus lines at mid-sagittal position before bisecting them but there was no control over viewing distance, illumination, order of responding, scanning direction or starting position on each line. It is likely that the right-handed participants selected for the analysis began on the right and moved leftwards from line to line, possibly obscuring parts of them with the right hand. In their review of factors affecting LB, Jewell and McCourt (2000) identified a number of variables affecting manual LB that were relevant here. Dextrals tended to bisect slightly further to the left than sinistrals and more to the left when using the left hand. Only dextrals were used in this analysis as recommended by Casagrande and Bertini (2008a) and, although it is unknown whether any dextrals used their left hand in this survey, it seems unlikely that they would have done so, thus controlling for any bias due to handedness or hand used. Scanning direction, however, was not controlled and is a potential source of error. Jewell and McCourt report that this was the most consistent source of bias found by researchers in that scanning from the left to right tended to produce more leftward errors and vice versa.

Finally, with regard to gender and age, Jewell and McCourt (2000) found that most studies did not separate male from female participants in their analyses, and those that did tended to find no differences, while a minority found that males tend to mis-bisect lines further to the right than do females. Sample sizes in some of the analyses presented in this chapter, especially when participants were sub-divided into RPD and LPD and sleepy or alert, tended to be small, which meant that separate analyses for PwPD by gender were not possible. However, there were no gender differences in right-handed partners, which accords with most of the studies reviewed by Jewell and McCourt. When age was examined, by Jewell and McCourt, participants older than middle-aged or younger tended to err more to the right, although not significantly so, but in this survey, age did not correlate with LB. The role of age is uncertain in the data analysed here in that significant LB by sleepiness group effects disappeared when it was treated as a covariate for all participants except partners but, although age did not co-vary with participants' status it did co-vary with sleepiness which Field (2009) argues obscures effects looked for in analysis of covariance. Thus it could be that the sleepiness effect on partners was a robust one, even when age was taken into account, but this conclusion is qualified by the fact that sleepy people tended also to be younger.

3.4.4. Conclusion

The preceding analysis and discussion strongly suggest that the sleep of healthy partners of PwPD in this sample was not affected by the presence of PD in their relationship and was no more disturbed than might be expected in couples in general. Anxiety in particular, accompanied by sleepiness, however, was implicated in predicting everyday cognitive failures in partners. Sleep fragmented for whatever reason (SFI), was directly predictive of ESS and slightly more strongly predictive of daytime naps. ESS and napability were directly related to daytime naps and inversely related to nocturnal sleep time suggesting that participants, who were able to, were managing their sleep time over 24-hour periods. SFI, however, was not related to sleep quality, therefore the reasons why some participants were sleepy were unexplained. Nevertheless, slight sleepiness was sufficient to predict a shift in lateral attention suggestive of sustained vigilance in the right hemisphere in partners and LPD, but not in RPD, for reasons that are debatable. Detrimental effects of everyday sleepiness, therefore, were demonstrable at a basic level of spatial attention and were associated with more complex cognitive failures, in which attention plays a part, at a subjective level.

In chapters 1 and 2, healthy adults have shown sleepiness-related changes in both self-reported and objectively measured aspects of cognition, but in neither case were these reliably linked with sleep disruption. To further investigate the possible relationship between such changes and sleep disruption therefore, it is necessary to turn to another group of healthy adults in some of whom sleep is known to be disrupted. Mothers of babies and young children are one such group. Furthermore, while sleepiness-related changes in spatial attention are important, and may have clear practical implications, such as in the study of pseudoneglect and bumping into doorways (Nicholls *et al.*, 2007, 2008), they are only one aspect of cognition that may be affected by sub-optimal sleep. As there is so little research to suggest what other aspects of daily functioning may be affected by sleep disruption, the next stage of this thesis aims to explore, as fully as possible, what mothers believe its effects to be. This will allow for the development of a more wide-ranging definition of cognitive effects that can then be assessed both objectively and by self-report

Chapter 4

PERCEIVED EFFECTS OF SLEEP DISRUPTION DUE TO CHILDREN IN AN ONLINE COMMUNITY OF MOTHERS

4.1. Introduction

Hoban (2004) describes a typical, and somewhat idealised, developmental pattern of sleep as follows:

> *'Newborn infants may spend up to 16 to 18 hours per day asleep, usually in the form of 3- to 4-hour sleep periods spanning both daytime and night-time hours. Beginning in the first month of life, these sleep periods begin to adapt to a day-night cycle and other environmental cues, with gradual lengthening of both night-time sleep period and daytime wakefulness. By 6 months of age, total sleep duration averages 14.2 hours and the longest period of continuous night-time sleep lengthens to ~6 hours. Between 1 and 2 years of age, total sleep time declines from an average of 13.9 hours to 13.2 hours while daytime sleep consolidates into a single nap, usually in the afternoon. Most children give up daytime napping about age 3 and overall sleep time declines gradually to an average of 11.4 hours by 5 years of age.'* (Hoban, 2004: 1.)

It can be difficult to distinguish sleep states in infancy using EEG and polysomnography measures. Nevertheless it is estimated that up to 50% of full-term new-borns' sleep consists of active REM sleep (Hoban, 2004) which, unlike REM in adults, appears at the start of a sleep period and re-occurs approximately hourly. The intervals in between consist of quiet sleep and indeterminate sleep (Hoban, 2004; Anders, Emde and Parmelee, 1971). By about three months of age, full-term infants' sleep-onset REM fades, indeterminate sleep disappears and quiet sleep starts to show EEG characteristics of adult NREM sleep which, as in adults, now appears at the start of a sleep period. REM sleep constitutes around 30% of all daily sleep by three years of age and sleep cycles last for 45-50 minutes compared to the normal adolescent and adult cycle of 90-100 minutes (Hoban 2004).

Polysomnographic studies, described in a review article by Anders and Weinstein (1972), show how the behavioural changes described by Hoban (2004) are underpinned by maturational changes in infants' EEG patterns, such that both the organisation of sleep and sleep state alter with age. Anders and Weinstein (1972) add that, in the first month after birth, 95% of infants rouse from sleep every three to four hours and will self-soothe back to sleep. This time interval increases to six to seven hours by eight months of age for 60-70% of infants, and there may be an increase in night wakenings at around one year of age that may be due to '*separation issues*' (Middlemiss, 2004: 101). Anders and Weinstein (1972) claim that, by the age of three months, 70% of babies will sleep through continuously from midnight to early morning. By six months, a further 13% will have joined them, but 10% of babies never sleep through in the first year. In the following years, physical, psychological and cognitive maturation are associated with the kinds of disturbances and sleep disorders that may persist into adulthood (Horne, 1992).

In another recent review, Middlemiss (2004: 99) gave evidence to support the idea that, while there is much information provided by health professionals for parents about pregnancy, labour and birth, around 90% of them depended on advice from family, friends, '*mothers' instinct*', books, magazines and television when it came to establishing healthy sleep patterns in their infants. Normative information, such as that provided by Horne (1992), Hoban (2004) and Anders and Weinstein (1972), was not routinely given, yet understanding such patterns could do much to allay parents' expectations and anxieties.

In contrast with the general developmental trends described so far, however, there are wide variations in the normal sleep of children of all ages. Horne (1992), for example, estimated that, in a group of 25 one-week-old babies, at least one could be found that was sleeping twice as long as another. He went on to discuss a number of reasons why babies' sleep might be unsettled. These are arguably self-limiting or manageable and include night-feeding, difficulty in self-settling and milk intolerance. Later however, a range of problems in older children as well as disorders that affect adults may occur. These include delayed sleep-phase onset and daytime sleepiness (particularly in teenagers), REM sleep disorders such as sleep paralysis, NREM sleep disorders, such as sleep-walking and night terrors, and other parasomnias such as bed-wetting, head banging and body rocking, sleep-talking and teeth grinding. Other studies confirm wide variations in children's sleep patterns. As part of the '*Avon Longitudinal Study of*

Parents and Children', also known as Bristol, UK-based '*Children of the 90s',* Sadler (1994: 166) surveyed 640 babies and showed that '... *many six-month-old babies have broken nights. Only 16% slept through the night at six months old. Half woke occasionally, 9% woke most nights, 5% woke once every night and a further 17% woke more than once per night, ranging from twice to eight times. For 16% of six-month-olds there was no regular sleeping pattern.'*

In her review, Middlemiss (2004) further identified premature birth, mode of feeding, maternal and infant attachment, parental presence during settling and sleeping arrangements as variables influencing parents' and infants' sleep. Middlemiss also identified infant temperament as a possible influence on sleep patterns, but Hayes, McCoy, Fukumizu, Wellman and DiPietro (2011) found both irritable temperament in particular, and sleep-wake behaviour from 6 weeks to 24 months of age, to be both stable and independent of each other. Finally, in a comparison of over 29,000 parents and infants from birth to 36 months in 17 predominantly Asian and predominantly Caucasian countries and regions, Mindell, Sadeh, Wiegand, How and Goh (2010) demonstrated the importance of cultural background to our understanding of *'substantial differences in sleep patterns in young children'* (Mindell *et al.*, 2010: 274). They say that this shapes the way parents view sleep patterns in their offspring and their ideas about what is and is not 'normal'.

4.1.1. Effects of disturbed sleep in parents due to children's health problems

Sleep disturbance in parents as a result of their children's sleep patterns occurs for many reasons and at any stage of the children's growing up years, and can have complex reciprocal effects (Meltzer and Montgomery-Downs, 2011). The research outlined next is based on a variety of parental experiences of sleep disturbance due to health problems of babies and young children. All of them are remarkably similar in their conclusions in spite of different cultural backgrounds that had been identified as important by Mindell *et al.* (2010).

Byars, Yeomans-Maldonado and Noll (2011) studied 160 parent-child pairs in Cincinnati, USA who had been referred to an insomnia clinic for children (ages ranged from 1.5 to 10 years; M ± SD = 5.66 ± 2.51 years). Byars *et al.* measured a number of dimensions of parenting stress, children's sleep habits and daytime behaviour. Parenting stress, which they defined as a mismatch between parents' perceptions of the demands made upon them and their ability to cope, was found to be strongly associated with parents' daytime sleepiness but also with the children's daytime sleepiness and behavioural problems. Other factors such as parents' own sleep problems, psychiatric condition and child's age and gender and other aspects of children's sleep, such as bedtime resistance, sleep duration, night wakings and parasomnias were unrelated to the stress measure. Furthermore 47% of parents were classified as highly stressed.

Sepa, Frodi and Ludvigsson (2004) found that children's sleep problems stood out for Scandinavian parents as a significantly greater source of stress than other health problems that children might have, such as ear infections or infectious diseases. Further research into sleep in parents of children with diagnosed clinical conditions also points to the same conclusion, e.g. Hoffman, Sweeney, Lopez-Wagner, Hodge, Nam and Botts, (2008) found that maternal stress in 72 Californian mothers of children with autistic spectrum disorder (ASD) was significantly predicted by children's sleep even after controlling for children's age, gender and severity of autism and for mothers' sleep. Doo and Wing (2006) measured parenting stress in 210 Chinese parents of children with pervasive development disorders, such as Asperger syndrome and ASD, and found that 64.5% scored in the clinically significant range for parenting stress, compared with 90% who were dealing with both a disorder and sleep problems in their children. Chu and Richdale (2008) surveyed 46 Australian mothers of children with a variety of developmental disorders such as ASD and Downs' syndrome and found that children's sleep and behaviour problems were negatively related to maternal sleep quality and also to psychological well-being such that poor sleep predicted greater depression, anxiety and stress in mothers.

Even in the short-term, disrupted sleep can be an added stressor for new parents at a very demanding time in their lives, especially if their infant is unwell. Lee, Lee, Rankin, Weiss and Alkon (2007) recruited 22 Chinese American mothers and 17 fathers whose infants had been hospitalised in intensive care units (ICU) for between three and ten days. A variety of measures were used, including sleep, fatigue, parental stress scales, sleep diaries and wrist actigraphy, to assess the parents' well-being for a period of 48 hours while their infant was in ICU. Only parents who slept at home during this time were included in the analysis but it is unclear whether they slept together or apart. Sleep disturbance due to worrying about their infant was reported by 93% of mothers and 60% of fathers. While perceived stress, impaired sleep and fatigue were associated for both mothers and fathers, mothers fared worst in terms of total sleep time and sleep quality. For mothers, the negative effects may have been exacerbated by the physical demands of the immediate post-partum period. Nevertheless, the authors suggest that, for both parents, daytime fatigue could impair their ability to participate fully and with clarity of thought in decisions about their infant's care. McCann (2008) added to these findings with a study of 102 parents/carers in Australia who had spent one night or more sleeping in hospital to be near their children. The mean number of hours of fragmented sleep obtained by the participants was just 4.6 and they reported feeling stressed and exhausted the following day. These studies suggest that children's and parents' sleep problems add substantial extra difficulties to an already challenging situation.

4.1.2. Effects of disturbed sleep in parents of healthy children

In a review of 30 years of research into sleep during pregnancy and postpartum, Lee (1998: 239) wrote: *'...the extensive state of sleep deprivation seen in postpartum women has implications for the health and well-being of both parents and infants...this reduced sleep efficiency is even greater for first time mothers compared to experienced mothers but significant sleep loss is evident for all new parents.'* It is well-documented that the arrival of a child has a profound impact on a couples' relationship and that disrupted sleep for both partners adds to the challenges they face.

The effect of disrupted sleep on mothers, but particularly on fathers, is barely documented. Much of the published research in this area concerns fatigue, which Piper (1989: 189) defines as "…*an overwhelming sustained sense of exhaustion and decreased capacity for physical and mental work*". For mothers in particular, fatigue may occur independently of changes to sleep patterns. Troy (2003) has been conducting research into fatigue in new mothers since 1992 and believes that it is still poorly understood and not well-managed. In a study published in 1999, she claimed that such fatigue can continue for as long as 19 months after delivery. On this occasion she found that fatigue did not correlate with quality of sleep, which is contrary to other findings (e.g. Gardner and Campbell, 1991), and this underlines the importance of separating the two. For this reason, the research subsequently to be described in this section will concern studies that focus specifically on sleep.

In an attempt to clarify the degree of sleep disturbance in mothers of young children, Crowe, Clark and Qualls (1996) compared the sleep patterns of three groups of mothers (n = 45 in each), of children aged six months to five years of age, using seven-day diaries. One group of mothers had typically developing children, the second had children who were multiply disabled and the third group had children with Down's syndrome. They found that many mothers often had their nightly sleep disturbed by their child, but this was especially marked for mothers of typically developing children who reported an average of 6.7 child-related awakenings each week. The range of experience in this group was wide (0-25 times per week), and the length of time spent attending to the child was also variable (from 0-7.9 hours per week). Although the pattern of disturbance seemed to be closely related to the age of the child, Crowe *et al.* speculated about the cumulative effect of long term sleep disturbance on those mothers and their families whose children were still interrupting their sleep at five years of age. As this paper is mainly descriptive, it does not assess the impact of such disturbance on mothers and further research into this is warranted.

A more recent survey (Gay, Lee and Lee, 2004) sought to describe sleep patterns in new mothers and (unusually) fathers, arguing that disturbed sleep could have implications for their physical and mental health, relationships, employment and parental competence. Seventy two couples expecting their first child were recruited and studied using wrist actigraphy and questionnaires during the last month of pregnancy and the first month after the birth. Both mothers and fathers reported increased sleep disturbance after the birth and, in spite of the fact that it was worst for mothers, both parents felt equally fatigued at this time. Working fathers did not differ from non-working fathers in fatigue, possibly because non-working fathers might have had more involvement in night-time care of the infant, and this offset the fact that they were not working. Gay *et al.* suggest that further research is necessary to assess the impact of new parenthood on psychosocial functioning and job performance.

Other factors associated with sleep disturbance have been reviewed by a number of researchers. These include maternal depression, low mood, increased feelings of stress, reduced sense of well-being and excessive daytime sleepiness (Crowe *et al.*, 1996). Quillin (1997) found that postpartum mothers described themselves as feeling exhausted in spite of evidence from sleep logs that they had adequate total sleep time. This was possibly because, in combination with hormonal changes, lack of sleep continuity was a key factor in perceived exhaustion.

Some studies have examined sleep in older children. In a study by Kahn *et al.* (1989) concerning 972 third to fifth grade Belgian children, 24% of parents reported sleeping poorly and 43% of the children had sleep problems lasting for more than six months. In a large-scale survey of the sleep patterns of 14,372 five-year-old Scottish and English children, Rona, Gulliford and Chinn (1998) found that about 4% of children had disturbed sleep more than once a week. They note that the resulting exhaustion in the parents could cause serious problems in the family, compromising parents' ability to cope, heightening conflict, curtailing family and social life and leading to feelings of desperation. A paper by Pollak and Perlick (1991) highlights the difficulties of people who are both carers and have disrupted sleep. They found that 70% of carers cited sleep problems, and hence disruption to their own sleep, as important in making them decide to institutionalise a dependent parent, which, of course, parents cannot do with their sleep disrupting young children.

4.1.3. Parenthood, sleep and marital harmony.

A number of studies have explored the role of sleep disturbance in parents with respect to the quality of their partnership, arguing that a better understanding of this might help to protect their relationship. Lawrence, Cobb, Rothman, Rothman and Bradbury (2008) conducted a study of 104 parent and 52 non-parent American couples, beginning at 6 months after their first marriage through to one year after the birth of the first child. Compared to non-parents, it was found that parenthood accelerated marital decline, although planning the pregnancy and a higher level of pre-parental marital satisfaction was protective to some extent. The reasons for the decline are many and complex but a contributory factor is changing sleep patterns.

In common with Lawrence *et al.* (2008) Meijer and Van Den Wittenboer (2007) followed first-time Dutch parents (N = 107) for 12 months after the birth of their first child. They too found evidence for a decline in marital satisfaction, which was more pronounced for mothers than for fathers, and this was linked to problems with sleep which, again, were greater for mothers than for fathers. Loutzenhiser and Sevigny's (2008) Canadian study, however, only partly concurred with this. They also followed 72 first–time parents from the third trimester of pregnancy until the infants' first birthdays. When infants were 3 months old, they measured infant sleep duration and parents' psychological and relational functioning. They found that, for fathers, lower infant sleep duration predicted higher stress but for mothers there were no effects. The inconsistency of this study's findings with others however is probably due to the one-off testing time at a relatively early stage in the infants' lives, as well as the somewhat crude measure of infant sleep, which was of duration alone, without taking into account number of awakenings or the parents' sleep patterns in response to these.

One reason why parenthood is associated with marital decline could be because new temporal demands cause partners to become out of step with each other. Leonhard and Randler (2009) compared groups of German women who were childless, pregnant without children, pregnant with children and non-pregnant with children. For women with children (N = 95) there was a marked shift towards morningness, particularly for the pregnant group, which brought them into line with their children. Morningness was part of a general synchrony index developed by the researchers, with which they were also able to show that mothers synchronised temporally with their children to a greater extent than fathers and that parents' synchrony decreased to a level even below this. There was a marked reduction in parents' synchrony compared to partners without children, and it persisted up to at least M = 3.3 years of children's age. Apart from the influence of children's chronicity on mothers, parents' responses to it can actively influence the extent of parental desynchronisation. Kennedy, Gardiner, Gay and Lee (2007), for example, reported a qualitative study of 20 Californian new mothers. They found that sleep disturbance was universal for mothers in the post-partum period and that they often negotiated with partners in order to manage it e.g. taking turns to rise early or nap at different times from each other, both of which would further desynchronise partners' time together.

It seems plausible to suggest that desynchrony may also impair the ability of partners to assess each other's current situation with accuracy. Insana, Costello and Montgomery-Downs (2011) provided evidence that sleep disturbance is associated with inaccurate perceptions of partner's sleep in 21 American first-time parents when tested at 3-8 weeks post-partum. Total self-reported sleep time, validated by wrist actigraphy data, was directly related to relationship satisfaction, but perception of one's partner's sleep was inaccurate. Both partners underestimated each other's nocturnal awakenings and mothers over-estimated fathers' self-reported sleep quality. Insana *et al.* acknowledge that their findings are purely correlational, but suggest that partners' misperceptions could be construed as a subtle lack of support, that could reduce relationship satisfaction, but that could potentially be easily addressed.

Ironically, desynchrony could work in partners' favour if it were already present in the form of differing chronotypes. Yamazaki, Lee, Kennedy and Weiss (2005) assessed morningness/eveningness in 101 Japanese couples, and followed them for four to five weeks after they had become parents for the first time. Couples in which mothers were morning types and fathers were evening types (N = 9) had infants who slept for slightly, but not significantly, longer and cried and fussed significantly less than infants whose parents were both morning types (N = 6). No other differences in variables such as total parental sleep were found. If Leonhard and Randler (2009) are correct about maternal shift to morningness, the impact of parenthood should be less for mothers who are already morning-types and, if their partner is already an evening type it may be possible for the father to take over care of the infant in the evening. Yamazaki *et al.* are cautious about drawing conclusions from such small samples of data and in which other combinations of chronotypes were scarce, but suggest that sharing the burden in this way could be mutually supportive in parents who are already used to each other's differing chronotypes.

It should be noted that, although parenthood is challenging, it does not affect all couples in the same way. Belsky and Rovine (1990) were critical of studies that use means to distinguish between groups of parents arguing that this gives a false impression of universal marital decline. They studied 128 American families from the last trimester of pregnancy with their first child to the child's third birthday. They noted an overall mean decline in marital quality, especially for women, but, when the data were examined more closely, they were able to classify marital quality into at least four types: accelerating decline, linear decline, no change, and modest positive increase with over 50% of men and women perceiving no change or a modest improvement in their relationship. Clearly change in marital quality has multiple causes so Belsky and Rovine sought to distinguish marriages that declined as opposed to those that remained stable or improved. They found that infant temperament reliably increased the distinction between these groups and was much more salient for women. The temperament measure, which assessed how easy or difficult the infant was to care for, included assessment of infant napping and sleep.

Questions remain about whether sleep problems in children initiate or exacerbate partners' disharmony, whether disharmony begets sleep problems in children or whether they are unrelated. A number of studies have found complex reciprocal relationships between marital conflict in American families and reduced quality and quantity of sleep and daytime sleepiness in their older, 8-10 year old children (El-Sheikh, Buckhalt, Mize and Acebo, 2006; Bell and Belsky, 2008; Kelly and El-Sheikh, 2011) but the causal pathways remained unclear. A rare exception is a study by Mannering *et al.* (2011) who sought to understand the pathways between marital instability and infants' sleep patterns in 357 American families with an adopted child (hence the effect of shared genetic influence was controlled). Families were assessed twice when the child was 9 months and 18 months old. Marital instability was generally low and remained similar across time as did infant sleep problems but, while marital instability predicted sleep problems at both ages, sleep problems did not predict marital instability. This pattern was strengthened when birth order, parental anxiety and infant temperament were controlled and held true when mothers and fathers were considered separately. The authors acknowledge that, at 9 months, they may have missed a particularly acute period of adjustment for new parents as many of the studies discussed so far utilise the immediate post-partum period. They have, however, carried out probably the only study to date that is prospective and longitudinal and can thus show direction and non-existence of effects.

While many studies have focused on the immediate post-partum period, others have found persistent sleep disruption in families with older children. Meltzer and Mindell (2007) studied 47 American mothers with between one and five children aged between three and 14.4 years (M = 7.4, SD = 2.7 years). They found that quality of maternal and filial sleep was correlated and that there was significantly more depression, parenting stress, sleepiness and fatigue in mothers with poor-quality sleep although, again, the direction of causality is unclear. Other papers concur that persistent disrupted sleep and inability to rest have tangible, detrimental effects, a view also supported in Swedish studies by Nyström and Öhrling (2004) and Nilsson (2010). In addition, an Australian study of nearly 10,000 families with infants and pre-school children (Martin, Hiscock, Hardy, Davey and Wake, 2007) found associations between disrupted infant sleep and mothers' and fathers' poor general health and mothers' poor mental health in particular. Specifically, 17% of infants and 14% of preschool-aged children were identified as having moderate to severe sleep problems, 3% to 5% of parents were classed as in severe psychological distress as a result and 8% to 11% in poor general health. Giallo, Rose and Vittorino (2011) supported this in another Australian study of 164 mothers of children aged 0-4 years, as did Gelman and King (2001) in 36 mothers whose children slept well compared with 36 whose infants, aged 10-42 months, disturbed their sleep. Furthermore Dennis and Ross (2005) identified 505 Canadian women who were not depressed at one week post-partum. When tested at four and eight weeks post-partum, however, they found that those who developed major depressive symptomatology were also more fatigued and more likely to report less than six hours of sleep with at least three nocturnal awakenings per 24-hour period during the preceding week because of their children.

To summarise, although some researchers (e.g. Gay *et al.*, 2004) have used objective measures, most of the research into parenthood and the associated effects of changes to sleep patterns is descriptive, correlational and depends on self-report. The explanatory value of the findings is, therefore, questionable. Nevertheless, research into the sleep patterns of parents (predominantly mothers) shows that naturalistic sleep disruption is common and that successful intervention can significantly improve family well-being and children's daytime behaviour (Eckerberg, 2004). While it is important to begin from the basis of good descriptive accounts of the problem, the cognitive correlates and consequences of sleep disruption in healthy people who could sleep normally but are prevented from doing so are yet to be fully addressed. There is little, if any, published research in this area.

4.1.4. Sleep disruption, stress and coping

In a study by Möller-Levet *et al.* (2013) 26 adults in their twenties underwent a week of restricted sleep and a week of sufficient sleep and various aspects of their responses to this were assessed. As expected, in the restricted condition, participants were sleepier and less vigilant than when sleep was sufficient, but the main thrust of the study was to examine effects on the blood transcriptome. Möller-Levet *et al.* found altered gene expression in red blood cells in restricted sleep, including those involved in regulation of stress and immune responses, even though the sleep would have been of relatively good quality and continuity. Stress is typically defined as a mismatch between the demands of a situation and one's perceived ability to deal with them (Lazarus and Folkman, 1984) and it has well-known physical effects in addition to those found by Möller-Levet *et al.* Stressors activate the sympathetic nervous system (SNS) and hypothalamic pituitary adrenal axis (HPA), which produces corticosteroids and mobilises energy and, while these responses are adaptive and protective in the short term, they can have negative effects if prolonged (Taylor and Stanton, 2007). Parents may experience sleep restriction for much longer than a week with added complications of disruption and poor quality. This could constitute a chronic stressor with the potential to affect both physical and mental health, but research that directly makes this link is sparse, although many of the aforementioned papers do report an increase in subjectively-reported stress in sleep disrupted parents (Byars *et al.,* 2011;

Chu and Richdale, 2008; Crowe *et al.,* 1996; Doo and Wing, 2006; Kurth, Kennedy, Spichiger, Hosli and Zemp Stutz, 2011; Lee *et al.,* 2007; McCann, 2008; Meltzer and Mindell, 2007; Sepa *et al.,* 2004). In addition, there are very few studies that address the *'action–orientated and intra-psychic efforts to manage the demands of stressful events'*, that constitute '*coping'* (Taylor and Stanton, 2007: 377) in parents faced with sleep disruption, with the exception of Runquist's (2007) study of perseverance through post-partum fatigue to be described in the next section. Other than anecdotal evidence, little is known about the coping resources and strategies that parents can access and employ in such circumstances and how effective these are in mitigating the effects of stress.

4.1.5. Parental sleep disruption and cognitive function

Some studies have examined the relationship between infant day- and night-time crying and maternal tiredness and these were reviewed by Kurth *et al.* (2011). They conducted a systematic review of papers published in the UK, USA, Canada and Germany between 1980 and 2007 (N = 10) that were chosen because they contained data on both infant crying and maternal tiredness and fatigue. There were six quantitative studies, five of which showed a direct association between infant crying and fatigue. Most of the mothers were tested up to a maximum of 9 weeks post-partum, and two studies extended the period to three and six months. Nevertheless, the findings were very consistent in spite of the fact that different fatigue measures were used in all of them. The remaining four studies (Runquist, 2007, USA; Long and Johnson, 2001, UK; Drummond, Wiebe and Elliott, 1994, Canada; Thompson, Harris and Bitowski, 1986, USA) used a total of 101 individuals and generally supported these findings but, because of their qualitative nature, were able to explore participants' subjective experiences more closely and at a wider variety of time intervals.

Thompson *et al.* (1986) interviewed 50 parents, nursing staff and physicians for their study and coined the term '*parent colic'* (Thompson *et al.,* 1986: 1) to describe parents' feeling of tearfulness, fatigue, guilt and resentment of their infants. The longer the problem lasted, the less parents felt they had a positive emotional and reciprocal relationship with their child. They felt that the child took a disproportionate amount emotionally from the relationship and that they were increasingly unable to cope even to the point of crisis, poor self-image and greater risk of child abuse. While some of this information was gathered for professionals in health-care settings, some was also gathered from parents at an information booth in a shopping mall so the representativeness of self-selected participants is unknown. The consistency of the findings is, however, corroborated by multiple sources of information.

Runquist (2007) interviewed 13 mothers between two and five weeks post-partum and used a Grounded Theory approach to develop a model that she called '*Persevering through post-partum fatigue'* (Runquist, 2007: 13). Fatigued mothers felt that their physical and mental well-being was adversely affected and this was exacerbated by stress, worry and frustration arising from such feelings as self-doubt, impatience and helplessness. Factors that influenced this included infant characteristics, infant-mother sleep-pattern conflict and fatigue-limiting possibilities. These led the mothers to employ a number of coping techniques such as increased caffeine intake, early bed-times and positive thinking about the purpose and meaning motherhood gave to their lives. Self-transcendence was necessary in order to continue to care for the infant, and any older children, and to cope with other responsibilities so, in spite of almost overwhelming sleep pressure, mothers put their own needs for sleep and self-care second to their children's needs.

In a general exception to the majority of findings, in the literature reviewed by Kurth *et al.*, Drummond *et al.* (1994) interviewed 18 mothers at six, 10 and 16 weeks post-partum and found that most of them adjusted their understanding of their infants' crying over time and came to view it as communication that could be responded to in increasingly effective ways. Only one mother, who perceived herself to be particularly exhausted and unsupported, and her infant as particularly labile, felt less empathetic towards her child and experienced moments of despair.

Eight of the 10 papers in the review by Kurth *et al.* (2011) clearly link parents' experience of fatigue with a number of adverse psychological consequences. While these papers tend to focus on parents in particularly trying situations, the findings agree with many of the other studies described in this chapter. Parents disturbed by their children's sleep consistently report such things as stress, increased fatigue, lowered mood and marital disharmony. However, the only paper reviewed by Kurth *et al.* that acknowledges cognitive effects of disturbed sleep is by Long and Johnson (2001) who studied 14 mothers and six fathers of babies up to one year old. Kurth *et al.* capture the essence of the papers' findings about the experience of persistent tiredness and fatigue in these parents:

> *'...repeatedly disturbed nights caused exhaustion, conversations were distorted, marital relations strained, daily activities stopped...Sleep shortage reduced ability to concentrate, which could lead to varying risks, e.g. driving while exhausted. Inability to soothe the infant undermined parents' sense of competence and led to feelings of guilt. Fatigue further obliterated optimistic perspectives. Most significant fear of parents was to lose control and non-accidentally injure the infant. Parents sought to cope with various strategies, such as seeking a cure for excessive crying, establishing a routine with the infant, taking time-outs, resignation.'* (Kurth *et al.* 2011: 192.)

While the findings about exhaustion, mood and marital relationships concur with other research in this area, there are some key additions. Distorted conversations, poor concentration and clumsiness implicate various kinds of cognitive failures. Furthermore, parents clearly recognise that they need to actively manage the situation, sometimes by reducing cognitive load e.g. by being less demanding on themselves and simplifying routines.

While it is important to acknowledge that there must be a complex interplay between the many variables relating to parents' sleep disruption such as life changes, mood, stress, infant temperament and relationships with others, the nature of cognitive changes in this naturalistic situation has not been explored yet it has potentially serious implications for the physical and psychological well-being of both parents and their children. The purpose of this study, therefore, is two-fold. In stage one, '*Living with sleep disruption'*, general aspects of sleep disruption that parents attribute to their children and their perceived effects will be identified. In stage two, '*Cognitive effects of sleep disruption'*, associated cognitive changes will be extracted and analysed. In both cases, findings will be linked with relevant research literature and this combination of data analysis with published findings will constitute a form of reliability checking known as '*data triangulation'* (Willig, 2008: 32). The purpose of the first stage is to contextualise any perceived cognitive effects of naturally occurring sleep disruption found in the second stage and will inform the development of the study which is intended to quantify and explain some of these effects.

4.2. Method

4.2.1. Design

The development of the Internet has enabled individuals to communicate instantly and globally with others. The ease of such communication, at any time of the day or night from any part of the world with Internet access, is a potentially valuable source of naturally occurring 'talk' between individuals with personal interest in, and direct experience of, a particular situation. Online discussion forums provide an accessible source of information for people with common interests, so an English language website where parents discuss their concerns about the effects of sleep disruption was sought. The popularity of a forum, the number of different participants and the length and variety of the discussion strings and their duration online can be taken as a crude indication of how salient being in a particular situation is to the contributors. *Mumsnet: by parents for parents* was chosen as it is a high quality online resource. It is a very active, independently funded and non-political group that is described on its own website as follows:

> *'Mumsnet was conceived at the fag-end of the last millennium when Justine went on a disastrous family holiday. The idea was to create a website where parents could swap advice about holidays, sleepless nights and their other halves. Many moons later, who'd have thought it would come to this? The site gets nearly five million visits a month.*
>
> mumsnet.com

Mumsnet includes *Mumsnet Talk,* which is an online, internet discussion forum on issues of concern to parents. They say:

> *Our aim is to:*
>
> - *Make parents' lives easier by pooling knowledge, advice and support.*
> - *We try, as far as possible to let the conversation flow and not to over-moderate. Mumsnet is a site for grown-ups.'*
>
> mumsnet.com/Talk

Forums such as these provide a rich source of qualitative data in the form of discussion strings. *Mumsnet Talk* advises participants '...*you're free to talk on any subject you like.'* so the content of discussion strings is determined by what is relevant to participants at any given time. Online discussions are less constrained than in face-to-face communication because participants are unlikely to know each other, so they are less concerned about impression management. They have little fear of being judged (Bane, Cornish, Erspamer and Kampman, 2010) and may be better able to express themselves, for example socially anxious individuals can feel liberated by being on an equal footing to others online (McKenna, 2008). In addition, the ease with which they can locate others in similar circumstances to themselves enhances their perceptions of empathy and shared interests (McKenna and Bargh, 1998). Furthermore, anonymity of participants, who post under pseudonyms, makes self-disclosure less risky so it tends to be deeper, more intense and more rapid (Suler, 2004). Unlike face-to-face communication in real time, online communication with strangers tends to be briefer and to the point (Bane *et al.,* 2010) and that is likely to lead to a desirable distillation of key issues especially when a discussion is closely focused. Strings that are unsolicited by the researcher have the additional potential to provide unexpected insights.

In discussing uses of his qualitative method of discourse analysis, Potter (2002: 539) distinguished between data that are '*got up*' specifically for research purposes as opposed to '*natural*'. The former includes data collected using methods such as interviews and focus groups, which tend to be constructed and planned in advance, while the latter comprises data that tend to come into being fortuitously. In contrived research situations participants are fully aware that they are taking part in a study and Potter argued that this changes the nature of the data.

The online discussions used in the current study were natural data in the sense that they emerged in the context of participants' everyday lives and not in a formal situation contrived by the researcher. Participants did not produce them for research purposes or with any knowledge that they would be analysed. Potter (2002) would see this as desirable because such talk is not shaped by the researcher's preconceptions or biases, participants were actively and freely involved in producing it and did not have to construct a version of events for research purposes. Potter continued that data produced in this way can challenge researchers' expectations, provide unexpected insights and are often rich enough to free the researcher from having to make inferences about missing information. For these reasons, *Mumsnet Talk* discussion strings, in which parents discuss the effects of sleep disruption, were selected. They were considered to constitute a form of naturally occurring talk which, while appearing to be subjective, would provide valid insights into the objective reality of the effects of sleep disruption.

Data were analysed using Thematic Analysis (TA) as described by Braun and Clarke (2006). Their paper was written in response to the view that thematic analysis *'...is a poorly demarcated and rarely-acknowledged, yet widely-used qualitative analytic method...within and beyond psychology...'* (Braun and Clarke, 2006: 77). They aimed to clarify the nature of TA and describe how to do it in a way that was *'...theoretically and methodologically sound*' (Braun and Clarke, 2006: 78). They acknowledge that many forms of qualitative analysis involve a degree of TA often as a preliminary means to an end, for example in approaches driven by particular epistemological positions such as Interpretative Phenomenological Analysis (IPA: Smith, Flowers and Larkin, 2009) and Grounded Theory (Glaser, 1992; Strauss and Corbin, 1998). In common with TA, such approaches acknowledge that naturally occurring talk has an essential validity as a source of information about people's experiences regardless of the epistemological assumptions behind how it should be analysed.

Neither IPA nor Grounded Theory (Charmaz, 2006), in its various forms, were considered suitable for this study. IPA is a phenomenological approach that aims to provide a detailed understanding of people's lived experiences, while Grounded Theory aims to develop useful models, grounded in the data, of how people '...*negotiate and manage social situations*' (Willig, 2008: 48). These approaches assume that people occupy an objective reality and researchers aim to bear witness to and interpret aspects of their lives within it while incorporating reflexivity into the analysis. While the epistemological assumptions of these approaches drive the analysis, neither is theory driven in the hypothetico-deductive sense, rather they are discovery-based in that engagement with the data results in the identification of patterns and themes that are then subjected to various types of interpretation. The type of TA used here is distinguished from such approaches by Braun and Clarke (2006) as a method in its own right, i.e. not as a means to an end but an end in itself. In common with IPA and, arguably, some forms of Grounded Theory, it can be a realist/experiential approach but is flexible enough to also be constructionist and this is one of its key advantages.

The flexibility of TA allows for different levels of interpretation that makes it well-suited to the analysis carried out here. The first phase was semantic, descriptive and interpretative and aimed to understand what it is like to live with sleep disruption and to link that with existing research literature. The second phase similarly identified specific instances of the perceived effects of sleep disruption on cognitive processes. These were of particular interest and, it was hoped, would later be amenable to measurement while bearing in mind their context and possible inter-relationships with other effects of sleep disruption, such as altered mood, identified in the first phase. To complete the second phase, the cognitive effects described by participants were used to provide clues about what processes might underpin them by comparing them to research findings on the effects of sleep disruption, thus moving from description to a degree of interpretation or '*latent level analysis*' (Braun and Clarke, 2006). TA was also considered to be suitable for this study because its flexibility allows inductive, 'bottom up', data-driven, exploratory analysis as advocated by Boyatzis (1998). This is valuable because it can lead to further research questions particularly in under-researched areas. It is also arguably deductive, 'top down' and theory driven although, unusually, by consulting the research literature both during and after the data had been analysed. This combination of inductive and deductive analysis improves the rigour of TA (Fereday and Muir-Cochrane, 2006). Finally, TA was thought to be suitable because the naturally occurring talk in *Mumsnet Talk* was not gathered by systematic means specifically for research as might be the case with IPA and Grounded Theory approaches; it included many individuals all with different levels of engagement. This does not necessarily mean that it is unsuitable for such approaches, but some researchers may consider that it is not possible to trust the data to be rich or newsworthy enough to reach '*saturation*' (Willig, 2008: 73).

The British Psychological Society's (BPS) *Code of Human Research Ethics* (2011) was followed in the conduct of this research and, as the data were online, this was supplemented with the BPS's *Guidelines for Ethical Practice in Psychological Research Online* (2007). According to the latter, internet mediated research (IMR) can be classified on two dimensions with regard to participants who are either identifiable or anonymous and either recruited or unaware. The *Mumsnet Talk* participants were anonymous but were neither recruited nor unaware; they were not taking part in response to a researcher's invitation, but consciously made their posts in the context of online discussion knowing that these were in the public domain and could be observed by others. Deception was, therefore, minimal because of the *Mumsnet Talk* conditions of participation. With regard to anonymity, participants were required to use pseudonyms or 'nicknames' so their identities could not be verified and they could not give informed consent or withdraw data. They could, however, be assured of data protection. Debriefing in the form of a research summary (Appendix K) was given to *Mumsnet* by way of thanks at which point protection of participants was paramount. It was important not to cause them undue anxiety about the negative effects of sleep disruption so it was vital to word the research summary sensitively and equivocally.

Mumsnet Talk provides a further layer of ethical protection by stipulating conditions of participation in the forum and policing postings:

> *'...You need to be a member of Mumsnet, and have a Talk nickname to use the board. Please be aware this is a public forum and your postings are open for all to see. Please note that Mumsnet has non-exclusive copyright in all submissions to Mumsnet Talk, and reserves the right to edit and re-publish these in print form.'*
>
> *Mumsnet's raison d'être is to make parents' lives easier. Our policy is to keep intervention to a minimum and let the conversation flow. Having said that, we will remove postings that are obscene, contain personal attacks or break the law.*
>
> *Please do bear in mind how difficult this parenting business can be, and if there's one thing all of us could do with, it's some moral support. You are free to change your nickname but please note that we don't allow nickname changes for inflammatory, malicious or misleading purposes.'*
>
> Mumsnet.com/Talk

As *Mumsnet* owns the copyright to submissions to the discussion forum, ethical clearance to use selected postings was sought by personal communication with *Mumsnet HQ*. The researcher's university affiliation, academic status and purpose of the proposed research were explained and permission to use discussion strings was granted following her agreement to register with *Mumsnet*, credit it in any publications and protect the identity of discussion participants.

4.2.2. Participants

Participants comprised 122 English-speaking, self-selected, *Mumsnet Talk* registered users from three selected discussion strings (Table 4.1.). No pseudonyms appeared in more than one string so, assuming no pseudonym changes, this represents 122 different individuals (further reduced to 108 – see *Materials*). The overwhelming majority was female as far as could be judged from their pseudonyms and postings although it is possible that some fathers also posted. The ages and locations of participants, their relationship status, the number and ages of their children, their educational level and somnotypology were unknown to the researcher. All of them however were parents with a shared experience of sleep disruption due to their children.

4.2.3. Materials

Mumsnet Talk comprises discussion strings on topics chosen and initiated by individuals. In December 2011, strings with the term 'sleep depriv*' in the title were located using the *Mumsnet Talk* advanced search facility. This resulted in 74 hits and formed the '*data corpus'* (Braun and Clarke, 2006: 79). Strings were then excluded if they asked for advice with specific problems, contained little of relevance to this study, discussed strategies for training infants to sleep, were not responded to or were simply too short. Two strings were selected because the effects of sleep deprivation were the main focus: *'You know you're sleep deprived when...'* and '*You know you're sleep deprived when...just for fun.'* A third string entitled '*Let's all meet here for a sleep deprivation support group'* proved extremely popular, having attracted 220 postings in 17 days. Examination of this string showed that postings about the effects of sleep deprivation appeared frequently even though they were not directly solicited by the initiator. These three strings constituted the '*data set*' (Braun and Clarke, 2006: 79)

Table 4.1.

Mumsnet Talk Strings, Dates, Number of Participants (N) and Postings Statistics

String	A. You know you're sleep deprived when...	B. You know you're sleep deprived when...just for fun.	C. Let's all meet here for a sleep deprivation support group.
Dates	13 Feb - 21 Feb 2010	2 Jul - 4 Aug 2011	15 Nov - 2 Dec 2011
N	21	56	45
Number of postings (*)	38 (26*)	69 (65*)	220 (169*)
Range of postings per person	1 - 3	1 - 4	1 - 21
Postings mean, median, mode	(1.30, 1.00. 1*)	1.23, 1.00, 1	(3.84, 1.00, 1*)

Note: String addresses:
A. http://www.mumsnet.com/Talk/sleep/912353-You-know-you-39-re-sleep-deprived-when/AllOnOnePage
B. http://www.mumsnet.com/Talk/sleep/1250073-You-know-youre-sleep-deprived-when/AllOnOnePage
C. http://www.mumsnet.com/Talk/sleep/1343563-Lets-all-meet-here-for-a-sleep-deprivation-support-group
*Figures in parentheses exclude initiator of string

Table 4.1. shows the number of different contributors in each string and the number and range of different posts. Unlike real time discussions, participants can leave and join and contribute at any time, they can post once with a discrete contribution or take part in a conversation and they can make brief or lengthy contributions. The mean, median and mode statistics show a pronounced skew in the number of postings with most people making very few. In two of the strings, the initiator made a relatively high number of contributions, as though acting as a facilitator, so their contributions are not included in some of the calculations. Two of the strings were finite and the third ('*Let's all meet here for a sleep deprivation support group*') was still active six months after initiation. Only the first 220 postings were considered from the latter once it became apparent that no new themes were emerging and that there was much that

was irrelevant to this study. The range of postings per person was much higher in this string, which reflected the variety of topics being discussed relative to the other two and the more frequent involvement of certain individuals in this lengthy, still live discussion. Nevertheless, 31 of the 45 participants in the string spontaneously mentioned the effects of sleep deprivation. This meant that a total of 108 out of the 122 participants provided useable information on this topic.

4.2.4. Procedure

The six-step procedure for conducting TA described by Braun and Clarke (2006) was used to analyse the data. The first step involved immersion in the data for familiarisation purposes. The chosen discussion strings were transcribed in their entirety, discussion strings were letter-coded A, B or C and each line was numbered to assist with the audit trail (Lincoln and Guba, 1985). Transcripts were then read and re-read while making notes about first impressions. The second step involved generating initial semantic codes. As the focus of the analysis was on how parents were personally affected by and coped with sleep disruption, factual descriptions of children's health or behaviour, pleas for advice, offers of moral support and general advice about such things as breast-feeding and sleep-training techniques were excluded. Individual postings in the string were treated as '*data items*' and the topics within them as '*data extracts*' (Braun and Clarke, 2006: 79). For example, in string C, a participant posted this data item:

> *168-70C We had a hellish night last night as ds2* [son 2] *has the cold and basically spent the night gurning and clambering around the bed. I got 1hrs sleep and am totally f-ed! Hoping for a nap later. I'm having a not-functioning day.*

Initial codes generated from topic extracts in this item were 'experiencing the night as a living hell', 'prevented from sleeping by son's activity', 'drastically curtailed sleep', 'feeling completely incapacitated', 'planning remedial action' and 'failing to function in the day'.

The third step in the analysis involved searching for themes that stayed as close to the original meaning of extracts as possible. Delineating and coding the data extracts revealed similarities between some of them and a clustering into distinct groups became possible, for example a number of data items containing extracts about coping with sleep deprivation by spending some days doing as little as possible were put together. In the fourth step these themes were constantly reviewed, compared and adjusted as more extracts were identified in order to ensure a good fit between the themes and the data until a ‘*thematic map’* (Braun and Clarke, 2006: 87) of the entire data set began to develop. At this stage, sub-themes clustered under superordinate themes were proposed (Willig, 2008) so that in the fifth step it was possible finally to decide on theme names, for example references to coping with sleep disruption by doing as little as possible in the day were gathered under the *in vivo* theme ‘Bare minimum days’ and this eventually became a sub-theme under the superordinate theme of ‘Accept and live with limitations’. At the end of step 5, a hierarchical summary table of superordinate themes was produced, each with between one and nine sub-themes, using a numerical system as follows:

1. Superordinate theme

1.1. Sub-theme

1.1.1. Data extract with transcript line numbers and string code

Strings A and B were finite and so were analysed in their entirety. String C was still live at the time of analysis but coding stopped after the first 220 posts as no new themes were found, meaning that 327 data items in total were analysed. At that stage a further random selection of 20 of the 74 strings in the original data corpus were checked for new themes and none were found. In IPA and Grounded Theory terms this is known as the point of ‘*saturation’* (Willig, 2008: 73).

Although these steps have been described as though they are sequential, the process of TA is not ‘*linear’* but ‘*recursive’* (Braun and Clarke, 2006: 86) with constant movement back and forth, writing notes, adjusting themes and checking for good fit between the data and the themes and between superordinate themes and sub-themes. This recursive analysis continued during the sixth and final step while the findings were written up and discussed.

4.3. Results analysis and discussion

Long and Johnson's (2001) study of mothers and fathers of babies up to one year old and reviewed by Kurth *et al.* (2011) helped to contextualise sleep disruption and describe how it is experienced but also touched on cognitive effects. The choice of discussion strings enabled the analysis of data to fall into two main sections that mirror this division. String C ('*Let's all meet here for a sleep deprivation support group'*) had a wider scope and contained more experiential detail of sleep disruption but also contained spontaneous descriptions of its perceived effects. Strings A and B '*You know you're sleep deprived when...*' and '*You know you're sleep deprived when...just for fun*' invited specific examples of the effects of sleep disruption but also contained spontaneous comments about context and experience. How participants experience and deal with sleep disruption and what they perceive the cognitive effects to be were thus analysed and discussed separately but drew on information from all three strings.

4.3.1. Stage 1: Living with sleep disruption

Figure 4.1. shows a summary of the 10 superordinate themes, along with subthemese, identified under the general heading of *Living with sleep disruption*. The superordinate themes that share common ground have been grouped into categories: A. 'Impact on sleep', B. 'Social impact', C. 'Impact on self', and D, 'Coping strategies'. At an intrapersonal level (A), mothers identified a number of ways in which their sleep pattern had changed to their detriment and expressed these in ways that suggested a changed relationship with sleep characterised by negativity, urgency and intensity. They also noticed the consequences of sleep disruption on an interpersonal level (B) in that it permeated their social interactions with others and, again, at an intrapersonal level in the effects on their mood and physical well-being (C). These changes led them to employ a variety of coping strategies (D). While sleep disruption is the most likely trigger for these effects, and mothers talked as if this were the case, Figure 4.1. is not intended to suggest casual pathways. Relationships between categories are probably complex and reciprocal, for example, the effectiveness of coping strategies is just as likely to affect well-being, interactions with others and sleep need as these things are to influence coping.

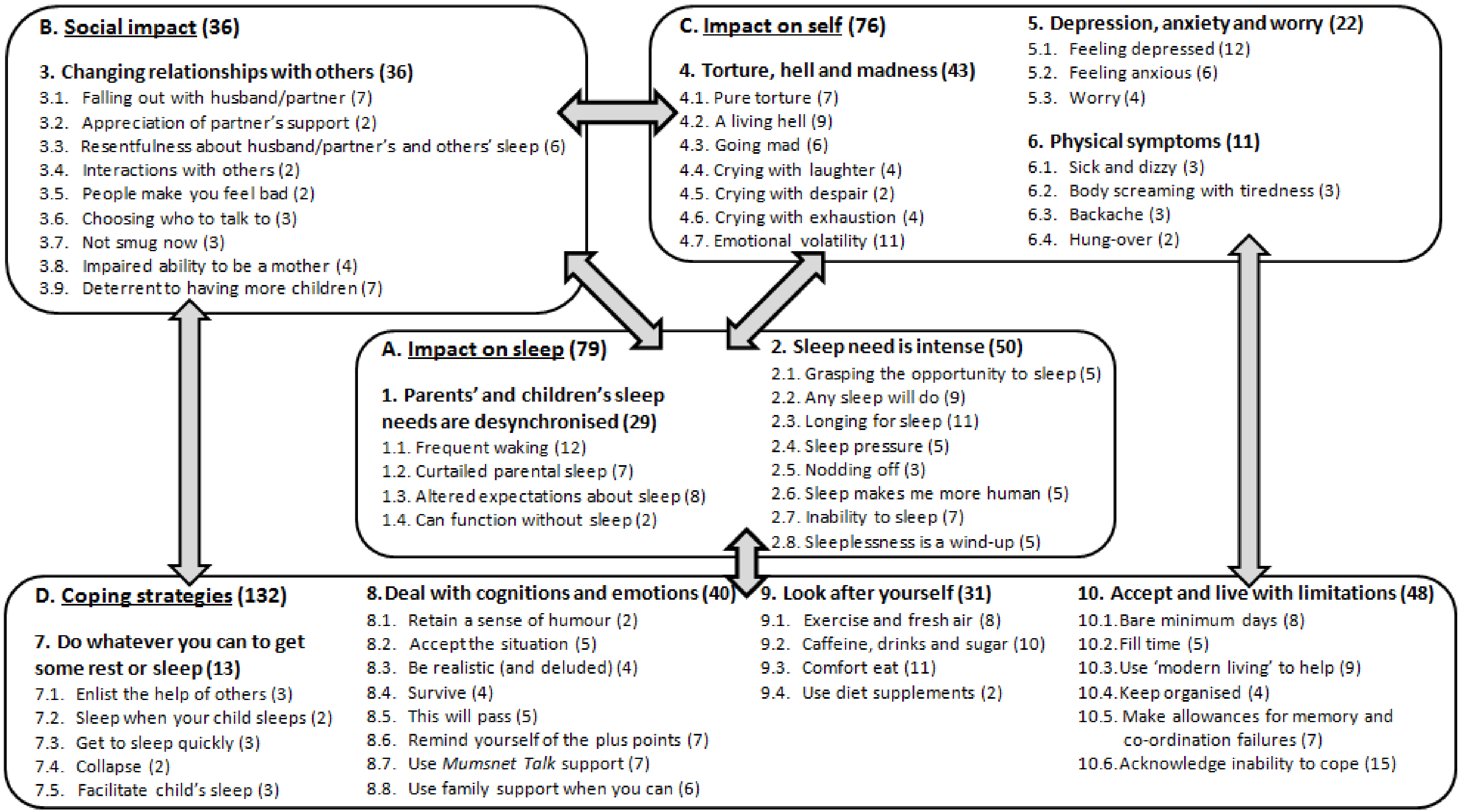


Figure 4.1. Living with Sleep Disruption: Grouped Superordinate and Sub-themes (Number of Posts).

A Grounded Theory approach (Glaser, 1992; Strauss and Corbin 1998) would be suited to understanding these relationships more clearly, but, as the purpose of this study was to identify potentially measureable effects of sleep disruption, analysis at a thematic level was considered sugfficient.

In the discussion that follows data extracts are presented with their code and line numbers. Abbreviations, such as *dh*, *ds* and *dd,* were frequently used by *Mumsnetters* and these are indicated e.g. as [darling husband], [darling son] or [darling daughter] in the quoted data extracts.

1. Parents' and children's sleep needs are desynchronised.

Desynchrony between children's and parents' sleep needs had a profound effect on parents' sleep patterns. Parents' sleep was characterised by frequent interruptions and was often of inadequate duration. The absence of opportunities to compensate for sleep disruption resulted in parents giving up hope that they would be able to sleep to suit themselves. For some parents, chronic sleep disruption resulted in being unable to sleep or even feel sleepy, as if they had gone beyond sleep-hunger and had supposedly adapted to being sleep-starved.

1.1. Frequent waking. Twenty-nine posts alluded to the desynchronisation of parents' preferred sleep patterns with their children's behaviour. Such desynchrony is important because it was identified by Kennedy *et al.* (2007) and Insana *et al.* (2011) as a possible contributory factor to marital disharmony in the immediate post-partum period and by Leonhard and Randler (2009) in the longer term (up to M = 3.3 years of children's age). In *Mumsnet Talk*, parents referred to frequent disturbance during the night and chronic lack of sleep continuity. Sometimes disturbances were due to children's feeding, teething or illness and sometimes they were just perceived as naturally wakeful. In some cases, frequency of parental waking was compounded by desynchronisation with more than one child. There were no posts in which parents referred to the advantages of differing chronotypes between themselves and their partners that Yamazaki *et al.* (2005) had suggested might work to their advantage:

1.1.1.	*My problem now is that both dc* [children] *are waking at different times in the night, two or three times each.*	40-41A
1.1.11.	*I'm averaging 3 hours sleep a night, all in snatches of about an hour/ 45 minutes*	1108-9C
1.1.12.	*Worst was ages 4 - 10 months I don't think she ever slept more than 2 hours without waking*	1014-5C

1.2. Curtailed parental sleep. As well as experiencing lack of continuity in sleep, parents also referred to times when their total and average sleep length was severely curtailed. Again this was sometimes due to teething, feeding or illness but it was also seen as characteristic of particular children to wake frequently. Some parents were able to negotiate recovery time in the form of naps even if these further desynchronised time with the partner (Kennedy *et al.* 2007; see superordinate theme 7. *Do whatever you can to get some rest or sleep*). In some cases sleep disruption had continued for some considerable time:

1.2.1.	*A bad night last night - 4 hours sleep in total.*	7-8A
1.2.2.	*Haven't had more than three hours unbroken sleep since dd2* [daughter 2] *was born 10 months ago.*	146-7A
1.2.6.	*I got 1hrs sleep and am totally f-ed! Hoping for a nap later.*	169-70C

1.3. Altered expectations about sleep. Good or bad nights were defined in terms of the number and length of children's awakenings and time of rising in the morning. Parents also made comparisons between their own experiences and those of others. This was the first sub-theme indicating that sleep problems were a stressor with which they were having to cope. As Folkman and Moskowitz (2004) suggested in their contextual cognitive model, coping is complex and multidimensional, involving cognitive appraisal aimed at assessing both the internal and external demands of a situation. The focus may then be on managing emotions, the problem itself and its meaning all in a particular social context. One facet of the assessment is how controllable the problem is perceived to be and how flexibly people can respond to it. In this case, parents did not talk about strategies they might use to improve the situation but had adjusted their beliefs about what it was reasonable to expect within the constraints of a baby's sleep patterns. None of the nights they described would have been judged as good prior to experiencing sleep disruption, indicating that, over time, they shifted their expectations about what constituted a good night. Lazarus and Folkman (1984) might explain this as the result of a coping strategy aimed at reducing, although not eradicating, the mismatch between demands and resources such that the focus is shifted from the problem, which is relatively uncontrollable, to managing the negative emotions it provokes. In a recent re-appraisal of how coping strategies could be conceptualised, Skinner, Edge, Altman and Sherwood (2003: 240) refer to this strategy as '*cognitive restructuring'*:

1.3.4.	*...four wakings would be an ok night here too. Bad night includes 2 awake for an hour spells, he's nearly 14mo and I am quite sick of it frankly.*	216-7A
1.3.5.	*You are jealous of parents whose babies sleep until 5.30am as you consider 5.30am to be a lie in.*	241-2B

1.4. Can 'function' without sleep. Some parents acknowledged that they had developed sufficient resilience to manage the situation relatively well and contrasted this with an earlier time in their lives when their priorities were different. This apparently emotion-focused, mismatch reducing, coping strategy is not dissimilar to the one suggested in 1.3. ('*Altered expectations about sleep'*). A number of research studies (Runquist, 2007; Long and Johnson, 2001; Drummond *et al.*, 1994) also refer to adjustment over time in situations where parents may be able to ameliorate the problem to some extent but not solve it completely:

1.4.1.	*You wonder why you wasted so much partying time in your twenties not staying out all night when you can so clearly "function" without any sleep now*	392-4B
1.4.2.	*makes me realise how tough I am too; 10 years ago I might have bragged about going to bed at 2 or 3am occasionally, then being in work at 9 next day. Nowadays I never get that much sleep and still function and look after 2 children!*	1908-11C

2. Sleep need is intense

Fifty posts referred to how sleep disruption led to a preoccupation with sleep characterised by shifting priorities and the realisation that parents were engaged in a daily battle to cope with sleep disruption. Themes 2.1. to 2.5. in this section accord with Runquist's (2007) findings about how women persevere through fatigue, but also showed that it extended beyond the five-week, post-partum period covered in her research. Themes 2.1. to 2.3., like 1.3 and 1.4., appear to involve adjustment of expectations using cognitive appraisal about a problem that seems to be insoluble, at least in the short term, but with an added emotional dimension. Skinner, Edge and Sherwood (2003) also suggested that rumination was a common category of coping and, while it at first seemed to indicate helplessness, pondering possibilities still indicated engagement with managing emotions and the problem as all available options, no matter how fanciful, are examined. In addition, 2.1 and 2.4 also involve problem-focused coping strategies (Lazarus and Folkman, 1984) aimed at actually increasing sleep or resisting extreme sleepiness:

2.1. Grasping the opportunity to sleep. Parents described grasping the opportunity to sleep at times when, compared to the time when they did not have children, they would not have done so. Although the personal circumstances of these parents was not known, it was notable that time with family members, friends or a partner was not prioritised implicating *Changed relationships with others* (superordinate theme 3):

2.1.1.	*And on your first child free night you forget a night out or cracking open a bottle of wine but instead go to bed at 9pm and enjoy 10 hours of blissful uninterrupted sleep.*	245-47B
2.1.2.	*I'm going to Ibiza without baby for 2 days soon and I fully intend to sleep for 48 hours.*	319-20B

2.2. Any sleep will do. Some parents were prepared to compromise on the conditions under which they could obtain sleep, not caring about where it was, how comfortable they would be or the barriers they would have to overcome. Some even envied hospitalised friends or contemplated being institutionalised, both of which would absolve them of their parental responsibility and enable them to escape:

2.2.1.	*The bathroom floor looks to be an inviting place for a nap.*	46B
2.2.5	*A friend text to let me know she was in hospital for investigations. Instead of thinking sympathetic thoughts for my friend, my first thoughts were of jealousy that she'd get an uninterrupted night's sleep.*	450-2B
2.2.8.	*Right now I might voluntarily section myself just so I can get some sleep.*	753C

2.3. Longing for sleep. Parents sometimes engaged in wishful thinking and fantasy about getting sufficient sleep. They often wistfully expressed hope that the next night would be the turning point when they would be able to sleep, or at least not have to wake very early, and yearned for it to continue in that way.

2.3.3.	*am trying not to wish away the new-born stage because this is our last time but PLEASE baby - can we have at least 1 three hour stretch at night?*	501-2C
2.3.6.	*I am starting to fantasise about sleep in the way I used to fantasise about boys when I was a teenager... You know, obsessively.*	720-4C
2.3.8.	*go to bed every night thinking "maybe, just maybe this is the night they will magically sleep through?!"*	1194-5C

2.4. Sleep pressure. Some parents experienced almost irresistible sleep pressure that they had to actively resist in order to remain vigilant. In some cases this did not always work, resulting in absent-minded moments that put children at risk:

2.4.4.	*Yesterday I could feel myself falling asleep as I sat of the sofa with DC* [children] *and I had to literally slap myself to come round...*	1109-10C
2.4.5.	*I nearly fell asleep in the corner of a playgroup this afternoon while another mum was rescuing DD* [daughter] *from escaping into the cold outside as I hadn't even noticed*	795-6C

2.5. Nodding off. On occasion, parents were unable to resist sleep and were apt to nod off rapidly, unexpectedly and inappropriately, sometimes in the middle of what they were doing:

2.5.1.	*I remember falling asleep on the settee, upright, for a few mins. When I woke up/came round I realised I still had food in my mouth and fallen asleep before I could swallow it*	219-21A
2.5.2.	*You nod off in the time it takes Facebook to load a page*	37B

2.6. Sleep makes me more human. Occasional good sleep could have immediate effects, restoring parents to a normal 'human' state in which they could function normally, cope effectively and think clearly:

2.6.1.	*Last night was a good night...I feel decidedly human today!*	144-5C
2.6.4.	*I'm feeling like a different person today from having had sleep*	1431-2C

2.7. Inability to sleep. Ironically, when the opportunity to sleep arose, some parents could not take advantage of it and were unable to sleep. Constant disruption seemed to have destroyed any sleep habit and architecture they may have had so that familiar personal and environmental sleep cues no longer functioned for them. In spite of being exhausted, they could not fall asleep, sometimes had lost the ability to feel sleepy or just could not sleep because of being 'on duty'. Folkman and Moskowitz (2004) acknowledge that chronic stress may be only partly resolvable, and this is echoed in the sub-themes 2.1 to 2.6, but at times, parents appear to have simply reached an impasse:

2.7.1.	*I can't just command sleep instantly!*	83C
2.7.4.	*I think you get too tired to sleep bizarrely. Or to sleep easily. I have gone past feeling sleepy*	777-8C
2.7.6.	*I can't sleep any more with him in the bed, I just lie there looking at him waiting for the next call*	1045-6C

2.8. Sleeplessness is a wind up. On occasion, parents had the opportunity to sleep, either by good fortune or design, but were unable to and this was experienced as frustrating enough to make parents feel angry. They sometimes appeared to prefer not to fall asleep at all because sleeplessness was less unpleasant than being unwillingly woken up:

2.8.1.	*I am knackered and have that dread of going to bed as I know I will finally fall asleep only to be woken and it will be foul and cold and moan moan moan...*	41-3A
2.8.2.	*Had the chance to sleep between 4 and 7 this morning, (a lie in!) and laid awake fuming instead*	185-6C
2.8.4.	*Snap! My dad took oldest, baby was (for once) sleeping like a baby and I couldn't sleep! Grrrrr!*	765-6C

3. Changing relationships with others.

Thirty–six posts expressed how sleep disruption had wide-ranging effects on how parents felt about their partners and how they viewed others and themselves in relation to others. Themes in this section have in common a sense that the sleep disrupted individual feels varying degrees of isolation from others similar to the growing sense of introversion described by Long and Johnson (2001) in their study of persistent crying. There may be a distance from and lack of understanding between partners, deliberate attempts to select or avoid contact with certain people, a feeling of less than optimal interaction with one's own children and some reluctance to have more children. While sub-theme 3.1 might be interpreted as an emotional coping strategy, which involves 'letting off steam' (Folkman and Moskowitz, 2004; Taylor and Stanton, 2007) and possibly mobilising social support when apologies follow, sub-themes 3.2 to 3.6 suggest that there are also elements of social withdrawal (Skinner *et al*., 2003), sometimes into the relationship with the partner, but also away from others whose unhelpful behaviour and apparent lack of understanding exacerbate negative feelings.

3.1. Falling out with husband/partner. Several parents acknowledged an increase in the amount of conflict in their relationship with their partners but, at the same time, stated that the reasons for it were unclear. Participants frequently could not remember why an argument had started and often were aware that it was trivial or even stupid. The self-deprecating and rueful way in which some of the posts were expressed suggested that they saw the conflicts, which ranged from rows to bickering, as not fundamentally serious but clearly due to sleep disruption, a finding that concurs with Long and Johnson’s (2001) study of infant crying:

3.1.1.	*I'm snappy at partner*	1309C
3.1.6.	*DP* [partner] *and I have started doing that competitive who's the most tired thing which really is a stupid thing to argue about.*	2071-2C
3.1.7.	*We seem to spend a lot of our time bickering and then apologising for arguing over nothing.*	2072-3C

A direct link between sleep disruption and aggression in adults is, however, not well borne out by research. Recent studies tend to be correlational and use adolescent participants, many of whom are troubled (Haynes, Bootzin, Smith, Cousins and Stevens, 2006; Ireland and Culpin, 2006; Meijer, Habekothe and Van Den Wittenboer, 2000; Kahn-Greene, Lipizzi, Conrad, Kamimori and Killgore, 2006). Vohs, Glass, Maddox and Markman (2011) found that there is a strong lay belief that sleep disruption and aggression are correlated and this expectation may account for concurring research findings. To support an alternative explanation, they varied both sleep deprivation and ‘*ego depletion’* (Vohs *et al.*: 166) in 58 Army personnel and students. Based on the assumption that resources for self-control are limited, ego-depletion was achieved by instructing some participants to suppress emotional reactions to disgusting film clips and it was this, rather than sleep deprivation, that led to higher levels of aggression in a subsequent test. Parents themselves link sleep disruption with increased aggression but the possibility remains that ego depletion acts as a mediator. Parents who expend energy on constant, public, self-control and denial of their own needs may show less inhibited aggression towards each other and close family members, often '*over nothing'* (2073C), as an indirect result of ego-depletion.

3.2 Appreciation of partner's support. Just two references were made to the supportiveness of husbands and partners, for example:

3.2.2.	*I am thankful to have a very supportive DP* [partner] *who regularly helps with the night wakings - without him, I think I'd have probably cracked a long time ago.*	1261-2C

Partners' work patterns were sometimes alluded to as a reason why it was difficult for them to be regularly involved, for example, working away, working shifts or working very long hours necessitated good recovery sleep in order to continue to support the family. Participants seemed to implicitly acknowledge that this was a way of sharing the burden and making the effort put into family life more equitable.

3.3. Resentfulness about husband/partner's and others' sleep. Participants described their feelings of resentfulness and lack of sympathy towards people who they saw as able to sleep adequately. This appeared to be underpinned and exacerbated by other's lack of awareness of the sleep-disrupted person's problems, leading them to feel isolated:

3.3.1.	*very resentful of snory dh* [husband]...	158-9C
3.3.5.	*Everyone is now up looking happily hung-over, reminiscing about fun evening... I am feeling grumpy and jealous. Does anyone else find themselves feeling really unfairly resentful of those that get sleep?*	587-9C

3.4. Interactions with others. On occasion participants felt that their sleep-deprived state had the potential to make a poor impression on strangers such that they might appear to be failing to function adequately. Sometimes they experienced this as being sympathetically recognised and, at other times, it needed to be excused so that it was made clear that this was not how they would normally behave:

3.4.1.	*then going up to the attendant to complain that I had to 'seek assistance' when it had plenty of money on it* [confuses work pass with underground pass]. *He gave me a sympathetic/pitying look, kindly managing to refrain from laughing.*	184-7B
3.4.2.	*Preceding every sentence to another adult human with: "You'll have to excuse me but I'm terribly sleep-deprived" in the hope that it'll stop them from thinking I'm a complete lunatic*	509-11B

3.5. People make you feel bad. A further sense of isolation stemmed from perceived lack of sensitivity in others who were not in the same position or who had not experienced significant sleep disruption. Such people appeared to know better but were seen as failing to understand how little control participants had to improve things and not realising that sleep-disrupted parents would bring about change if they knew how to:

3.5.1.	*People are making me feel bad for constantly feeding, like I am causing the problem.*	1640-1C
3.5.2.	*All those people with their comments about how wonderfully x baby sleeps/eats/crawls/poops make my blood curdle, joking or not! I know lots of people mean well but they are not the ones waking up every hour or whenever to a crying child who cannot be calmed or can only be soothed by constant feeding.*	2131-5C

3.6. Choosing who to talk to. Some parents coped with others' lack of understanding by being selective about who they discussed sleep disruption with. They would deliberately avoid situations that would make them feel judged either by discussing it only with those in a similar position or avoiding conversations with those they thought could not understand.

3.6.1.	*...choosing who I talk about with it to. Someone who hasn't been through it won't understand.*	830-1C
3.6.2.	*I also try to avoid speaking to those that are smug with perfect sleeping babies, I'm definitely past the new-born pity stage and into the "what are you doing wrong" stage*	108 -9C

3.7. Not smug now. Some parents acknowledged that they had been judgemental of parents experiencing sleep disruption until they experienced it themselves. This tended to happen when their first born children were good sleepers but there were problems with later-born children. These were experienced parents who had the confidence to know that they were not necessarily causing the problem and so were able to empathise with other sleep-disrupted parents. Smugness gave way to humility in the face of realising that sleep disruption can be a complex and often intractable problem to deal with. This is the first theme to raise the possibility of relatively positive emotion as a coping resource as an example of what Folkman (2008: 3) called '*benefit finding*' and Folkman and Moskowitz (2004: 766) referred to as '*stress-related growth'* in which people refer to becoming wiser as a result of a stressful experience:

3.7.1.	*I was a smug bastard with ds1* [son 1] *who was a good sleeper. Not smug now!*	31-2C
3.7.3.	*I was sooooo smug with DS,* [son] *I really thought it was people making problems by not being firm, but I have well and truly learnt my lesson*	967-8C

3.8. Impaired ability to be a mother. While sleep disruption was acknowledged as impacting upon relationships with other adults, it was also seen as detrimental to parents' ability to be available to their children in a positive way. In these examples, a rested mother is seen as one who provides a positive and happy environment, while a sleep-disrupted one is '*bad*' and capable of having a negative effect on the child. In much the same way that some parents felt unable to reduce sleep disruption, they also expressed helplessness (Skinner *et al.,* 2003) over being able to overcome their tiredness. Paradoxically, this could also be seen as a coping strategy in that recognising limitations and letting go of an idealised maternal image might help parents towards a more positive cognitive restructuring of the situation which, although disappointing, is more realistic and therefore more manageable.

3.8.2.	*Am so knackered that I'm a bad mummy when she's awake - too tired for fun and games*	770-1C
3.8.3.	*I love my children but tiredness is impacting on my abilities to be a mother...I keep bursting into tears and I know it is affecting my toddler seeing me like this. Also feel like my tiredness is spoiling what should be a really happy time...*	1048-51C

3.9. Deterrent to having more children. Parents acknowledged that sleep disruption had a negative effect on their interactions with and feelings about other adults and children already present in their lives, but they also saw it as affecting their feelings about having children in the future. Some currently sleep-disrupted parents reflected seriously on whether they would have more children. Others thought it could be manageable with a suitable time interval between children and some, with the benefit of experience, realised that, as memories of how difficult the situation was fade with time, so does the reluctance to have more children.

3.9.4.	*I'm put off wanting more dc* [children], *I'm sure we still will but I think at least three years gap is needed.*	135-6C
3.9.5.	*I have always wanted 3 and every night I urge myself to write a stern letter to my future self, urging myself not to and reminding myself how it feels!*	153-5C
3.9.6.	*didnt stop me having more kids. once you get half decent sleep you forget (like childbirth) how hard it can be*	224-6C

Lazarus and Folkman (1984) would identify a decision not to have more children as a form of coping that is both problem- and emotion-focused and avoidant but it could also been seen as '*future-oriented pro-active coping*' (Folkman and Moskowitz, 2004: 757) in which individuals anticipate stressors and make preparations for them, for example by acknowledging the temporary nature of a future stressor or by building up reserves.

4. Torture, hell and madness

Taylor and Stanton (2007) report that chronic stress is a feature of many mental health problems such as depression, anxiety and low self-esteem and, although causal pathways are unclear, negative mental health effects of inadequate sleep have been implicated in a number of studies (Dennis and Ross, 2005; Gelman and King, 2001; Giallo, Wade, Cooklin and Rose, 2011; Martin *et al*., 2007; Meltzer and Mindell, 2007). Forty-six posts likened living with sleep disruption to being tortured, experiencing the situation as hellish and feeling as if it was beyond their coping resources and damaging their mental health.

4.1. Pure torture. The use of the word '*torture'* (314C, 714C, 2011C, 1120C) underlines how difficult it is to bear sleep disruption. Participants described being sleep deprived in general and being constantly disturbed as torturous. Two participants alluded to the use of sleep deprivation as torture against prisoners in Guantanamo Bay as if comparing their own situation to being imprisoned and under the malign control of someone else. Sleep disruption as '*torture'* suggests that the experience is against one's will, painful, uncontrollable, unpredictable and in breach of basic human rights. One participant said the situation was killing her, while another said she was losing the will to live:

4.1.2.	*Am tortured by the constant interruptions every time I start to fall asleep*	714-5C
4.1.3	*am seriously sleep deprived. The UN convention on human rights should have a section on parenting children under the age of 5.*	751-3C
4.1.7.	*It is pure torture being so sleep deprived*	1120C

4.2 A living hell. Participants likened their sleep-disruption to a kind of living hell and something they wished they could escape. They knew that it would not last for ever but were desperate for it to end, even to the point of metaphorically preferring death as a form of oblivion and escape:

4.2.1.	*We had a hellish night last night*	168C
4.2.5.	*I know this will pass, but my god why can't it be over now?*	264-5C
4.2.7.	*I won't die from tiredness though, this is what I keep telling myself - even though I wish I would some mornings*	812-3C

4.3. Going mad. For some participants, sleep disruption was seen as responsible for pushing them towards mental breakdown. They described themselves as '*going mad'* (706C), being '*driven to the edge'* (1183C), '*broken*' (830C) and '*in bits'* (1299C):

4.3.1.	*I am going slowly mad from sleep deprivation*	706C
4.3.2.	*Have gone mad*	714C
4.3.5.	*I know that driven to the edge thing all too well*	1183-4C

4.4., 4.5., 4.6. Crying with laughter, despair and exhaustion.

Ten posts referred to an increased tendency to cry due to sleep disruption and these were separated into three types because they seemed to give different reasons. On occasion, participant's found other people's posts funny to the point of crying with laughter, while recognising that this was out of proportion to the actual event and that it was not particularly amusing to others who could not empathise with the situation being described. On other occasions crying was triggered by despair with one's own situation or by sheer exhaustion. Participants' descriptions of themselves were reminiscent of over-tired children, unable to control their emotions being literally 'crying tired':

4.4.3.	*You find yourself laughing manically at pointless things that really aren't **that** funny*	416-7B
4.4.4.	*Hilarious, thank you - sat here crying with laughter (makes a change from crying from lack of sleep!)*	456-7B
4.5.1.	*crying no stomach wrenching sobbing while making my bed longing to crawl into it and not get out of it for a week*	105-6A
4.5.2.	*I just got off the phone from another friend with a younger baby that just started sleeping through by itself this week and burst into tears cos I felt like such a failure at having yet another non sleeper*	1710-2C
4.6.2.	*We've both* [self and daughter] *been crying quite a lot today as we're both so tired*	1412C
4.6.4.	*a day of completely losing it having been woken hourly Thursday night! Suffice to say I had lots of tears yesterday*	1225-6C

4.7. Emotional volatility. In 4.4., 4.5. and 4.6 participants reported crying easily and with increased frequency. In addition, they identified a tendency to privately over-react and consciously have to control themselves in a variety of situations which, in other circumstances, might seem trivial. This '*affective reactivity*' (Walker, 2009: 185) occurred for a number of reasons including disappointment, frustration and anger. Again this was recognised as being disproportionate and different to how one would normally behave:

4.7.2.	*The swimming instructor tells you your DS* [son] *will have to repeat Stage One and you feel close to tears. Your DS is 5 months old*	200-1B
4.7.8.	*had to laugh breezily and brush it off when I felt like laying on the floor crying when they told me I had wrong da*y [for an appointment]	805-6C
4.7.11.	*Well-meaning but smug people who asked if I'd tried a bedtime routine incite violent rage in me and inward screaming of 'WTF DO YOU THINK I'VE BEEN DOING FOR MONTHS? DO I LOOK LIKE AN IDIOT??!!''*	2102-4C

This accords with findings from Dinges *et al.* (1997) who noted increased difficulties in subjectively experienced emotional regulation in 16 young adults following sleep restriction to 4-5 hours per night over seven nights. This did not normalise until three further days and two full nights' sleep had elapsed. In an attempt to explain increased affective reactivity, Zohar, Tzischinsky and Epstein (2003) proposed a cognitive energy model that posits that challenging situations require '*effortful self-regulation*' (Zohar, Tzischinsky, Epstein and Lavie 2005: 47) leaving less energy available for emotional regulation. This is similar to the idea of '*ego depletion*' suggested by Vohs *et al.* (2011) and discussed in 3.1 in relation to increased conflict between parents. Inadequate recovery sleep further depletes energy resources. Zohar *et al.* (2005: 48) say that '*Unless the available energy resources match the demands associated with the pursuit of an important goal, this misfit will be assessed as a threat, resulting in negative emotion, whereas assessment of the situation as a challenge based on adequate resources will result in positive emotion.*' In a naturalistic work pattern, not unlike one which could be experienced by parents, they studied day-time emotional responses in 78 Israeli medical residents who were working regular day-time hours mixed with some night-shifts. They found that negative emotional responses to disruptive events became more pronounced with increasing sleep fragmentation and reduced sleep duration. On the other hand, positive emotional responses were unexpectedly elevated by sleep disruption and unaffected by enhancing events, leading them to propose that this resulted either from compensatory effort or a temporary elevation of mood following curtailed sleep such as that observed in treatments for depression (Schilgen and Tölle, 1980). *Mumsnetter's* post 4.7.8 above suggests the use of compensatory effort as does this: *'[son] woke so pleased that his gro clock was telling him it was ok to get up. Had to act thrilled through the dizzy haze of inside my head* (186-8C). The disagreement between Vohs *et al.* (2011), who thought that '*ego depletion'* alone could explain aggressive disinhibition, and Zohar *et al.* (2005) could be explained by design differences in the two studies, with the former being laboratory-based and reductionist in nature and the latter being a natural experiment. However, participant reactivity can be ruled out of neither.

A physiological basis for increased affective reactivity was suggested by Yoo, Gujar, Hu, Jolesz and Walker (2007) and more recently supported by Marín and Lopera (2009) and Chuah, Dolcos, Chen, Zheng, Parimal and Chee, (2010). Yoo *et al.* monitored fMRI task scanning in 26 young adults who either slept normally or remained continuously awake for 35 hours. The magnitude of amygdala activity increased as participants viewed stimuli changing from neutral to increasing emotional negativity but this was 60% more active in the sleep-deprived group for whom activation was also more widespread. Furthermore, they found that connectivity between the amygdala and medial pre-frontal cortex (mPFC) was significantly reduced in sleep deprived individuals relative to controls, especially in the left mPFC. In addition they found '...*greater amygdala connectivity in the deprivation group with autonomic-activating centers of brainstem, including the locus coeruleus and midbrain*.' (Yoo *et al.,* 2007: R878). Since the limbic system activity is associated with emotional behaviour, increased limbic connectivity accompanied by a loss of mPFC top-down control could account for heightened sensitivity to emotional stimuli when sleep-deprived that is re-balanced following adequate sleep.

5. Depression, anxiety and worry

Medical residents and research volunteers in the research described in 4.7. were both able to compensate for disrupted sleep but parents cannot always do this and the crying and emotional volatility they describe in 4.4. to 4.7. was often persistent. *Mumsnet* participants also talked about mood changes, such as anxiety and depression, which have been widely reported in studies of both acute and chronic sleep deprivation. While much of this evidence is correlational (e.g. Campos-Morales Valencia-Flores and Castano-Meneses, 2005) it has also been supported experimentally (Babson, Trainor, Feldner and Blumenthal, 2010). Similar patterns of neural connectivity to those suggested by Zohar *et al.* (2005) and Yoo *et al.* (2007) have been implicated in mood disorders (e.g. Benca, Obermeyer, Thisted, and Gillin, 1992; Davidson, 2002; New *et al.*, 2007) suggesting that they do not just co-occur with sleep problems but might be causally connected. Twenty-two posts talked about the negative effects of sleep disruption on mood. Depression was mentioned most (12 posts) followed by anxiety (six posts) and worry (four posts).

5.1. Feeling depressed. Sleep curtailment may be helpful for some depressed individuals (Schilgen and Tölle, 1980) and Zohar *et al.* (2005) found that it could even lift the mood in healthy adults. None of the *Mumsnetters* voiced this directly although it might be implied by '*crying with laughter'* (4.4). In fact sleep disruption is generally associated with increased negative affect in healthy individuals (Babson *et al.* 2010). Many studies also implicate poor sleep in post-natal depression (PND) in mothers e.g. a survey of 2830 Norwegian mothers at seven weeks post-partum by Dørheim, Bondevik, Eberhard-Gran and Bjorvatn (2009) found that poor sleep quality and sleep disturbances were most strongly linked with PND, even when other risk factors were controlled, but they did caution that, as the other measures also correlated with PND, poor sleep could not be the only factor. *Mumsnetters* described a sense of time slowing down (5.1.3.) and being '*miserable*' (999C) with exhaustion, '*down'* (16C), '*fed-up'* (803C, 854C), '*grumpy'* (330C), and '*pissed off*' (1667C):

5.1.2.	*I am having a very down day*	16C
5.1.5.	*I go through these phases of hating it and being very grumpy indeed*	329-30C
5.1.7.	*I am bloody fed up.*	803C
5.1.11.	*can feel depression slipping in.*	1312C

5.2. Feeling anxious. The positive correlation between anxiety and sleep deprivation is more clearly established in the literature than the link with depression (Babson *et al*., 2010, Zohar *et al.,* 2005) but anxiety was discussed by *Mumsnetters* less frequently. When anxiety did appear it was thought to be intensified by sleep disruption even to the point of developing into panic attacks. Some participants tried to explain the physiological reasons for their anxiety in terms of '*sensitised'* (809C) nerves, lowered reserves and over-active adrenal glands (5.2.6.). This suggests that anxiety could be a response to uncontrollable and chronic stress in terms of a mismatch between the perceived demands of the situation and ability to cope with it (Lazarus and Folkman, 1984) but Babson, Feldner, Trainor and Smith (2009: 239) also showed that '...*a 5-minute 10% carbon dioxide-enriched air laboratory-based biological challenge*...' induced greater state anxiety and fearfulness in sleep deprived than rested individuals suggesting that sleep deprivation may be a factor in panic development:

5.2.2.	*Anyone else developed panic attacks? I'm normally a fairly chilled person but I had a stressful pregnancy (PE)* [pre-eclampsia] *and now with the sleep deprivation I seem to be having them regularly and they are scary as hell.*	367-9C
5.2.3.	*get anxious more*	778-9C
5.2.4.	*I get so much more anxious these days too, I think the constant sleep interruptions mean your nerves become sensitised. I am jumpy and reactive about the smallest things.*	808-10C

5.3. Worry. Both anxiety and depression appeared to have a further dimension for participants in the form of worry, specifically about whether they were getting parenting 'right'. This was tinged with self-blame for sleep disruption, doubt about what was being done, or about what to do, and feelings that they were just not good enough parents and might even harm their children in some way. These findings were echoed in Kurth *et al.* (2011):

5.3.1.	*Am worried that am reinforcing behaviour when go in or co-sleep or feed to sleep, yet simultaneously worry am harming him if I don't do those things.*	265-7C
5.3.2.	*Am driving myself insane worrying about what to do, what not to do*	532C
5.3.3.	*The thing that gets me down the most about it is the feeling that I'm must be doing everything wrong and it's all my fault*	1648-9C

The relationship between anxiety and depression, which are often comorbid, has long been pondered by clinicians and Clark and Watson's (1991: 316) '*tripartite*' model has received considerable support (Watson, Weber, Assenheimer, Clark, Strauss and McCormick, 1995a; Joiner, 1996; Brown, Chorpita and Barlow, 1998). They proposed that they are linked by negative affect (NA), positive affect (PA) and physiological hyper-arousal (PH) such that they have NA in common but anxiety is additionally characterised by high PH and depression by low PA. Babson *et al.* (2010) extended this model to incorporate the effects of sleep deprivation, arguing that the resulting increase in agitation (Everson, 1998) would exacerbate PH, and increased depressive thinking and anhedonia (Kahn-Greene, Killgore, Kamimori, Balkin and Killgore, 2007) would decrease PA. Babson *et al.* recruited 88 healthy adults and 43 of them underwent 24 hours of continuous wakefulness while the rest acted as controls. The three measures of the tripartite model all changed in the predicted direction for sleep-deprived participants between pre- and post-testing periods. In accord with this *Mumsnetters* complain of feeling '*jittery*' (5.2.6.; 6.4.2) and a sense that the body is '*screaming*' with tiredness (6.2) and others felt that being tired was '*tipping*' (1432C) them into depression and allowing *'depression* [to slip] *in'* (5.1.11.). Babson *et al.* continue: '*Furthermore, consequences of sleep loss that may not be specific to symptoms of state anxiety or depression, but rather common to both...are likely to increase general distress...*' (Babson *et al*., 2010: 298). '*Worry*' (5.3) might be one result of this; while Baranski (2007) found that confidence in judgements of one's own performance on a variety of cognitive tasks was accurate even after 24 hours of continuous wakefulness, *Mumsnetters* appear to lose confidence in their judgement, which may result from longer term sleep disruption. Nevertheless, as Skinner *et al.*

(2003) suggested, rumination can constitute a coping mechanism in which possibilities for change are still contemplated as opposed to giving up hope completely.

Babson *et al.* (2010) acknowledge that, while laboratory studies of acute sleep deprivation show measurable changes in mood, the mechanisms involved may not be the same as those operating in chronic, naturalistic sleep disruption. They do, however, attempt an explanation. Differences in the effects on depressed and healthy individuals are also discussed citing evidence from Adrien (2002) and Dieter and Berger (1998). In depressed people, sleep deprivation increases serotonin, noradrenaline and synaptic dopamine and this may have a short-term anti-depressant effect. Healthy individuals start from a higher baseline and so do not feel any noticeable benefit from this. Instead, the effects of sleep deprivation, such as fatigue, and loss of pleasure in daily life, mimic symptoms of depression. Furthermore Babson *et al.* speculate that a physiological basis for the link between sleep and mood may be explained by the overlapping role of the hypothalamus in both mood and sleep regulation. Saper, Scammell and Lu (2005: 1257) refer to a hypothalamic sleep '*switch*'; a group of neurons in the hypothalamus known as the ventro-lateral preoptic nucleus (VLPO), which are mostly active during NREM sleep and inhibit other neurons that are active in wakefulness. Inhibition of the VLPO by neurotransmitters such as serotonin and noradrenaline may lead to sleep disruption and these, as well as GABA, are also implicated in mood regulation. Constant disruption of this system may also help to explain why some sleep deprived parents '*...can't just command sleep instantly...*' (2.7.1.).

6. Physical symptoms

In their test of the tripartite model, Babson *et al.* (2010) used a measure of PH that focused on physical symptoms of anxiety such as dizziness (6.1.) and agitation or jitteriness (6.2.). It is likely that some of the physical symptoms experienced by *Mumsnetters* are an expression of anxiety but others may simply be due to fatigue (6.3. and 6.4.). Eleven posts identified physical symptoms that they attributed to sleep disruption. In strings other than the three analysed here, (e.g. '*Effects of sleep deprivation on parents'* initiated on 18 September 2011) *Mumsnetters,* one of whom contributed to the '*Sleep deprivation support group'* string, also complained of persistent or recurrent sore throats and flu-like symptoms that they attributed to compromised immunity due to exhaustion.

6.1. Sick and dizzy. Feelings of nausea and dizziness were mixed with feelings of needing to steady oneself for fear of fainting or falling over. These were directly blamed on poor sleep:

6.1.1.	*Actually feeling sick and dizzy with exhaustion, holding onto the side in the kitchen for fear of falling over.*	200-1A
6.1.2.	*I had such a bad night last night. Feeling dizzy and sick today*	158C

6.2. Body screaming with tiredness. While some participants experienced sleep pressure and falling asleep (2.4. and 2.5.) unexpectedly, the need to sleep was so pressing for some that they experienced it as if the body were silently '*screaming'* for sleep and yet this powerful signal could not be heeded. This may be a facet of increased agitation following sleep deprivation as noted by Everson (1998) and Babson *et al.* (2010) and discussed in 5. ('*Depression, anxiety and worry*').

6.2.2.	*body screaming with tiredness. I get that if I've only been asleep a short time and have to do a feed and even though I'm lying down it's not how I like to sleep and it's like every fibre of my being is SCREAMING to lie on my front and pass out!*	958-60C
6.2.3.	*I totally get the body screaming thing right now!*	1001C

6.3. Backache. One research paper linked total sleep deprivation (TSD) with reduced thresholds for tolerance of heat and cold but not with increased generalised pain (Kundermann, Spernal, Huber, Krieg and Lautenbacher, 2004), and another linked it with increased intolerance of pressure pain but not heat (Hakkionen, Alloui, Gross, Eschallier and Dubray, 2001). There is very little research into the link between curtailed sleep and increased pain (hyperalgesia) except for a study by Haack and Mullington (2005). Forty, healthy, Israeli, male and female, paid volunteers aged 21-40 were recruited and divided into two groups. One group was allowed to sleep from 2300-0700h and the other from 2300-0300h for 12 consecutive nights. The latter group remained in bed from 0300-0700h each night but was kept awake with various activities so all participants had the same amount of time in bed. Two-hourly assessments of mood and pain-related symptoms were made upon waking and every two subsequent hours. Generalised body pain, upset stomach and backache were significantly greater in the sleep restricted group by the second night, and continued to increase until they plateaued on the fourth night, remaining raised until a night of recovery sleep returned the measures to normal. Headache, joint pain and muscular pain followed a similar but non-significant trend. Controlling for fatigue attenuated these effects suggesting that it too plays a part in the experience of pain. Although backache is a common complaint for many people, and the most common pain reported by men and younger age-groups (25-34 years) in the UK (Elliott, Smith, Penny, Smith and Chambers, 1999), lifting and carrying children combined with a lack of restful sleep increases the risk of its occurrence for parents adding real physical and, possibly, elevated pain to their tiredness. However, it should be borne in mind that parents may well be out of bed more often than Haack and Mullington's participants in order to attend to their children:

6.3.2.	*I've had the worst backache since DD* [daughter] *did the every hour marathon!*	1591C
6.3.3.	*I know what you mean about backache, I feel about 100 since this baby with lower back and/or shoulders aching all the time!*	1623-4C

6.4. Hung-over. Dawson and Reid (1997) claimed that, after about 17 hours of continuous wakefulness, performance in a group of individuals on a hand-eye co-ordination task deteriorated to the same level as in those who had drunk alcohol until their blood alcohol concentration was 0.05%; a level of which is considered to be intoxication in many western industrialized countries. Indeed, a number of participants likened the effects of sleep disruption to having been poisoned by alcohol and cigarettes. They referred to '*cotton wool head'* (2229C) and a brain like a *'soggy flannel'* (986C) and this was reminiscent for them of having a hangover. However, unlike a hang-over, they could not recover from it with rest and recuperation and, unlike alcohol intoxication, sleep disruption would not make them behave in ways that looked like drunkenness to others (Citek, Elmont, Jons, Krezelok, Neron and Plummer, 2011):

6.4.1.	*You realise that being hung-over has more to do with being very tired and sleeping badly than the alcohol consumed when you get up after yet another night awake all night feeling like you have drunk 10 pints and smoked 20 Marlborough Lights!!*	*387-90B*

7. Do whatever you can to get some rest or sleep.

Further clues about the impact of disrupted sleep on parents can be gleaned from the coping strategies discussed by participants. Participants offered many kinds of practical advice to help each other minimise the impact of disrupted sleep. These were not to do with particular kinds of sleep training for babies but, instead, acknowledged that sleep disruption is ubiquitous and needs to be addressed pragmatically, hence the emphasis here would appear to be on problem-focused coping (Folkman and Moskowitz, 2004). This first theme concerned grasping any opportunity to sleep as much as possible. Sleep was seen as an absolute necessity and a precious commodity no matter how short it had to be.

7.1. Enlist the help of others. On occasions when others offered help, participants felt it should be accepted without hesitation, reluctance or a sense of selfishness. For those with partners, it was sometimes possible to negotiate taking turns with a lie-in or nap. Participants thus recognised that they sometimes needed to share the burden with others for the sake of their own well-being:

7.1.1.	*If people offer to take your precious one off your hands for a few hours or even just an hour...snatch their hands off...then lie on the sofa for an hour, close your eyes and sleeeeeep.*	59-61C

7.2. Sleep when your child sleeps. In theme 1, parents recognised desynchronisation between their own and their children's sleep patterns but here, they also saw that, at times, it was necessary to fall in with the child's sleep and resist the wish to be doing other things:

7.2.1.	*When your DS/DD* [son/daughter] *falls asleep in the car, you pull over somewhere safe and join them...*	211-2B
7.2.2.	*When ds* [son] *went to bed at 7pm, by 7.15pm, i too would be in bed, not every night but at least two nights a week.*	56-7C

7.3. Get to sleep quickly. Maximising sleep also meant minimising the time it took to settle following night-time disturbance. Some sleep-disrupted parents appeared to lose any sleep habit they may have had, could not sleep when the opportunity arose (2.7.) and found this a '*wind up*' (2.8.). Keeping warm was one suggested strategy as was taking mild, over-the-counter sleep aids to induce sleepiness at night.

7.3.1.	*Make sure you are warm enough when you have to get up in the night. Have dressing gown and slippers by your bed if necessary. This also helps you get back to sleep quickly, should you be fortunate enough to have the opportunity!*	9-11C

7.4. Collapse. Some participants advocated arranging the environment at home or elsewhere in order to minimise demands on oneself while keeping children safe. There was a sense of recognising that one's resources were limited and needed to be managed carefully. Allowing oneself to '*collapse*' (7.3) without sleeping was seen as a helpful form of rest and way of abdicating some responsibility while still being on duty:

7.4.2.	*I take DD* [daughter] *to Gymboree 2 or 3 days a week now she's crawling so I don't have to chase her around the living room saying "no". Soft play is a blessing - at least I can collapse in one place and know she won't hurt herself!*	103-5C

7.5. Facilitate child's sleep. As well as facilitating one's own sleep (7.3.) strategies for maximising children's sleep were suggested, usually in the form of physically tiring the child but also in terms of managing the child's sleeping environment.

7.5.2.	*spend as long as possible in the park this morning to wear out toddler*	2202C
7.5.3.	*Must be quiet as dd* [daughter] *is a light sleeper & if she hears me she will be up & chattering away & that will be the end of sleep for the night (she is almost 9, not a baby but needs very little sleep)*	990-2C

8. Deal with cognitions and emotions.

Recognising that the extent and duration of sleep disruption was unknown encouraged participants to adopt coping strategies that were largely about changing the way they viewed their situation in order to help deal with negative feelings. The emphasis here would, therefore, seem to be much more on emotion-focused coping (Lazarus and Folkman, 1984; Folkman and Moskowitz, 2004). This self-management was also backed up on occasion by seeking moral support from others (‘*support-seeking*, Skinner *et al.* 2003: 240). Zohar *et al.* (2005) further propose that individual differences in neuroticism and locus of control and the effects of emotion on cognition may play a part in responses to sleep disruption and also need to be accounted for in such research. For example, McCrae and Costa (1986) showed that greater neuroticism tends to aggravate responses to stressful events while greater extraversion complements them. Kahn-Greene *et al.* (2006) correlated individual differences in various aspects of emotional intelligence to reactions to frustration following sleep loss. In addition, Hill, Welch and Godfrey (1996) found that sleep deprivation was associated with mood disturbance in university students with external locus of control but not in those with internal locus of control. Clearly, individual differences such as these play a part in how individuals construe a trying situation and consequently in how they deal with it. In terms of coping categories proposed by Skinner *et al.* (2003: 240) many of the sub-themes in this section involve ‘*positive cognitive restructuring’*, which can be helpful when letting go of hope that a situation can be fully resolved.

8.1. Retain a sense of humour. Seeing the funny side of things was helpful to some individuals. This seemed to chime with the impression that sleep disruption led them to do things that, under normal circumstances, would be ridiculous and laughable. Recently, stress and coping research has focused more on the role that positive emotions can play as, even in very difficult situations, positive emotions are reported (Folkman and Moskowitz, 2004) even as often as negative ones (Moskowitz, Folkman and Acree, 2003). Individuals may deliberately seek out reasons to feel positive as respite from a difficult situation:

8.1.1.	*Retained my sense of humour though...*	29A
8.1.2.	*Laughing at the situation helps a lot.*	72A

8.2. Accept the situation. The uncontrollability of sleep disruption was managed by some participants by coming to terms with how things were and a number of posts alluded to giving up fighting the situation and yearning for things to be different. A philosophical mind-set similar to what Long and Johnson (2001: 159) called '*resignation'* was helpful for some:

8.2.3.	*I have found accepting the situation an enormous help to me, psychologically.*	447C
8.2.4.	*none of this is our fault, lots of people do the same as us and have beautifully sleeping babies.*	2043-4C

8.3. Be realistic (and deluded). Some participants adjusted their expectations about what sleep they could reasonably expect under the circumstances. One participant talked about being '*less melodramatic'* (1039C) about sleep disruption and others simply changed their minds about the sleep they could hope for. In some cases, participants tried consciously to delude themselves about their own sleep and saw others as similarly deluded, calling parents of perfectly sleeping babies '*liars'* (953C):

8.3.2.	*I feel we expect a good night's sleep and think of it as a right or a necessity. It isn't. The 8hrs uninterrupted thing is a fake, airbrushed ideal, probably promoted by mattress sales people.*	448-50C
8.3.4.	*I delude myself I sleep less but sleep more deeply when I do.*	701C

8.4. Survive. Several posts talked about a survival mentality as a method of coping. Sleep disruption was so challenging for some participants that all they could hope to do was get by. Priorities shifted to the present and getting through from day to day:

8.4.2.	*Just survive however you need to, anything else can be sorted later once she had mastered sleeping*	337-8C
8.4.3.	*It is possible to survive, but, by god, it is hard.*	458C

8.5. This will pass. As well as surviving in the present, another coping strategy was to look ahead to a time without sleep disruption. Participants acknowledged that they were finding the current situation difficult but recognised that it was self-limiting and was bound to improve at some indeterminate time in the future as their children grew up:

8.5.3.	*Keep telling yourself that this will pass, that at some point they (and you) will sleep better again.*	543-5C
8.5.4.	*I know, it's really hard. There is no answer, I hang onto the fact that, even if we do nothing, they will sleep through at some point!*	1415-6C

8.6. Remind yourself of the plus points. Positive thinking was another strategy that participants used to change their cognitions. They made downward comparisons between their own situation and that of others who they saw as worse off, for example couples who had difficulty conceiving. The reminded themselves that infancy and childhood were short and precious and that they were fortunate and loved their children. Folkman (2008: 7-8) referred to this as a form of '*meaning focused coping'* in which people draw on personal beliefs for the purposes of '*benefit finding'* or '*benefit reminding'* to improve their sense of well-being:

8.6.1.	*it is so, so bloody difficult to bear this in mind, I know but: try to remember millions worse off for whatever reasons.*	181-2C
8.6.2.	*It won't be long till they won't want cuddles all the time, and much less to sleep with us so I'm just making the most of this precious time while I can!*	296-7C
8.6.6.	*I try and remind myself of the plus points of having a high need baby whenever I'm feeling really down.*	1079-80C

8.7. Use *Mumsnet* Talk support. Seeking moral support from other members of the discussion forum seemed to be helpful to some participants. This echoed sub-theme 3.6 in which parents said they were selective about who they discussed sleep deprivation with, as they found lack of understanding and implied blame difficult to cope with. People in the same situation were seen as able to understand what sleep disruption was like; they provided a welcome sounding-board and were non-judgemental:

8.7.5.	*I really appreciate people not flaming me and just being understanding.*	186-7C

8.8. Use family support when you can. Some participants found a source of strength in family members. Sometimes, positive contact was enough but at other times a partner could help a mother to get some sleep. However, participants were selective in how they managed this support. Sometimes a mother wanted to ask their partner for help but realised that it would make their working-life difficult and so refrained from doing so. In addition, as in 3.6 ('*Choosing who to talk to*'), they would only express how they felt to understanding relatives:

8.8.1.	*So far I am buoyed by having seen my family so am relatively patient.*	64C
8.8.3.	*I do all night wakings as DD* [daughter] *is ebf,* [exclusively breast fed] *and then I can get DH* [husband] *(unemployed) to do the lion's share of stuff during the day if I've had a bad night.*	973-4C
8.8.5.	*... frequently venting to my mum (she understands: my sister only needs about 4 to 5 hrs sleep a night, and sadly for my mum it was already the case as a new-born).*	949-50C

9. Look after yourself.

Participants advocated a number of health-related strategies for keeping oneself as well as possible in order to be strong enough to cope with the demands of sleep disruption. In most cases these were constructive solutions but, in other cases, mothers appeared to need to mother themselves with treats. This is a further example of what Folkman and Moskowitz (2004: 757) called '*future oriented pro-active coping*' designed to anticipate future challenges and lay down reserves.

9.1. Exercise and fresh air. Exercise, which was mainly in the form of daily walks with children, was seen as beneficial and fresh air as invigorating. Exercise is often advocated as supportive of treatment for depression but in a review of 25 randomised control trials, which compared various forms of exercise and established therapeutic techniques with controls, Mead, Morley, Campbell, Greig, McMurdo and Lawlor (2010) concluded that it had a moderate but non-significant effect. Mead *et al.* thought that the effect on mood was in a positive direction but that it was not fully understood what other factors, such as type of exercise, might mediate this. A number of *Mumsnetters* agreed with its benefits however, and talked about disciplining themselves to get outside every day, whatever the weather:

9.1.1	*Getting out in the fresh air helps me*	*30C*
9.1.2.	*I have dogs so they get us out daily which always helps.*	*80C*
9.1.3.	*Yoga in the evening*	*800C*

9.2. Caffeine, drinks and sugar. Participants frequently advocated caffeine as a stimulant to be taken throughout the day, the need for hydration generally and for sugary foods to provide energy. In a review of 41 double-blind, placebo-controlled trials over 15 years on caffeine intake and cognitive function, mood and physical performance, Ruxton (2008: 15) concluded '*that the range of caffeine intake that appeared to maximise benefit and minimise risk is 38 to 400 mg per day, equating to 1 to 8 cups of tea per day, or 0.3 to 4 cups of brewed coffee per day*'. No dehydration effects were found even up to 400 mg per day. In a more recent study of the effects of stimulants on executive performance following 44 hours of continuous wakefulness, a dose of 600mg caffeine, compared to modafinil, dextroamphetamine and a control condition, led participants to solve the Tower of Hanoi problem in significantly fewer moves, apparently conferring advantages in *'...planning, strategy, sequencing* [and] *inhibition of pre-potent responses...'* Killgore, Kahn-Greene, Grugle, Killgore and Balkin, 2009: 206). In a related study however, Killgore, Muckle, Grugle, Killgore and Balkin (2008) found a gender difference in that, in placebo and caffeine conditions following sleep deprivation, women performed worse than men on a cognitive test of time, distance, weight and quantity estimation. These last two studies show mixed effects but in different tasks and following considerably more caffeine than advocated by Ruxton (2008).

Mumsnetters were not specific about the kinds of functioning that caffeine helped them with or how much water they drank, but some clearly felt they could not function or get through the day without caffeine:

9.2.4.	*Good coffee is a help in the morning.*	*27C*
9.2.5.	*Drinking lots and lots of water.*	*177C*
9.2.7.	*Caffeine, sugar, protein at breakfast. Fruit and yoghurt don't cut it.*	*697C*

9.3. Comfort-eat. Eleven participants mentioned comfort-eating, particularly of high-calorie sweet foods such as biscuits, chocolate and '*yum yums*' (doughnuts) as a coping strategy. While this was seen by some to be purely occupational, or over-done in some cases, in others it was a deliberate strategy to pamper and care for oneself, although, on occasion, this was tempered by realising that it could lead to unwanted weight-gain. In other cases, participants referred to eating unhealthily just as a means to getting through the day, for example eating '*crap'* (853C):

9.3.1.	*I must try to break my custard cream habit. They are cheap though, so I like to kid myself that I am helping the purse strings by having a fistful of them instead of some fruit...*	*156-8A*
9.3.3.	*Have lovely breakfast things in. I always have expensive cereal in the cupboards Just For Me.*	*13-14C*
9.3.6.	*I'm sitting here...stuffing chocolate*	*365-6C*

Although *Mumsnetters* presented comfort-eating as a habit, over-indulgence or a treat, there is some evidence to suggest a physiological basis for this in the form of changed endocrine function. Spiegel, Tasali, Penev and Van Cauter (2004b) showed that, in healthy young men who experienced two consecutive nights of just four hours sleep, levels of the anorexigenic hormone, leptin, decreased while levels of the orexigenic hormone, ghrelin, increased. There were associated increases in hunger (24%) and appetite (23%), especially for sweets, salty snacks and starchy foods as opposed to fruit and protein ('*Fruit and yoghurt don't cut it':* 697C). This finding was more recently supported by Schmid, Hallschmid, Jauch-Chara, Born and Schultes (2008) who compared leptin and ghrelin levels after 7 hours or 4.5 hours of sleep or

TSD in nine healthy young German men. Spiegel *et al.* (2004b) acknowledge that they did not rigorously control for energy expenditure, and hence calorific need, but did try to ensure that participants were in a state of quiet wakefulness when sleep was being restricted. In accord with this, in a study of naturalistic sleep patterns in a sample of over 1000 American participants, Taheri, Lin, Austin, Young and Mignot (2004) showed similar changes in leptin and ghrelin levels in those who slept for 7.7 hours or less per night on average. There was also a tendency to higher body mass index (BMI) in these individuals, a finding that Taheri *et al.* claim holds across all age groups.

It is not clear yet whether greater wakefulness simply leads to more time in which to eat and/or being awake for longer leads to significantly more calorific expenditure but Spiegel, Leproult, L'Hermite-Baleriaux, Copinschi, Penev and Van Cauter (2004a) are doubtful about the latter, suggesting that increased activity in the sympathetic nervous system may be responsible for suppressing leptin and increasing ghrelin. Some support for this is provided by Pejovic *et al.* (2010), who found increased leptin levels and unaffected hunger in young healthy adults after one night of acute, sleep loss, but argued that this was because the experience was non-stressful. In the study by Spiegel *et al.* (2004a) the addition of stress, which parents may also experience, decreased leptin and increased ghrelin. In a longer-term study lasting 14 days, Nedeltcheva, Kilkus, Imperial, Kasza, Schoeller, and Penev (2009) compared participants who were allowed 5.5 or 8.5 hours of sleep per night and found no differences in leptin or ghrelin levels, energy expenditure or calories from regular meals but an increased intake of, particularly sweet, snacks. In the absence of stress or any measurable physiological differences, this suggests that snacking was driven by factors such as boredom, time-filling or reward seeking. This may account for some of the extra snacking in *Mumsnetters* but does not take into account that their experience of sleep disruption is likely also to be stressful, which Spiegel *et al.* (2004a) and Pejovic (2010) thought was a contributory factor in modulating hunger.

In a recent, population-based, German study of 1369 men and women aged 35–74 years Häfner *et al.* (2012) compared levels of leptin in normal weight women without depression and sleep disturbances with those in women who were depressed and not disturbed, not depressed and disturbed and both depressed and disturbed, and found a consecutive rise across these groups. The rise in leptin seems counter to research discussed here, but Häfner *et al.* asked questions about difficulties getting to sleep and staying asleep and about mood, but did not ask about appetite so it remains to be determined what the relationship with this might be.

9.4. Use diet supplements. A few participants mentioned supplementing their diet with iron tablets or multivitamins in the hope that it would improve their energy levels and general feeling of well-being:

9.4.1.	*I bought some iron supplements as dh* [husband] *pointed out that I feel just like I do when anaemic, so hoping they will help.*	605-6C
9.4.2.	*I cope with Berocca* [a multivitamin]...	948C

10. Accept and live with limitations.

A large number of posts (48) dealt with accepting the situation as less than ideal and lowering expectations about oneself as a parent and daily living. A number of constructive solutions were offered for dealing with sleep disruption. These resonate with Folkman's (2008: 10) suggestion that meaning focused coping, which calls on positive emotions to manage stress can be helpful. In this theme there are many examples of what he called '*adaptive goal processes',* in which an original goal is relinquished and a new, more obtainable, one substituted, and *'re-ordering priorities'* which mostly involve less exacting standards, forgiveness of personal limitations and a simpler life-style*.* Only in 10.6 (*Acknowledge inability to cope*) did this strategy seem to be inadequate.

10.1. Bare minimum days. Several posts mentioned deliberately doing just enough to get through the day satisfactorily. This was recommended as a consciously chosen strategy that involved making some days as undemanding as possible while still meeting the family's basic needs. Food was kept simple, triggers for battles with toddlers avoided and non-essential tasks postponed or left undone. The pace of life slowed as parents spent days where '*we don't really do anything'* (1558C):

10.1.1.	*Have "lazy days" where you slob about in the house in tracky bottoms and sweater*	52C
10.1.5.	*no food battles today. Toddler is getting the fail safes, toast and marmite, juice, sausage roll for lunch, yogurt, fish fingers and peas for tea*	2203-4C
10.1.7.	*"bare minimum" days. I "grant" myself them every now and again. No housework, everything goes in the dishwasher, no bath for DD* [daughter].	2212-4C

10.2. Fill time. Another coping strategy was to find ways of filling time during the day by getting out, keeping busy and dividing the day up into smaller chunks of time in which tasks could be completed and '*ticked...off*' (35C). Parents talked about killing time and just getting through the day:

10.2.3.	*We went to the library, to visit friends, to soft play anything to get out for a few hours.*	50C
10.2.4.	*i used to put water in the bath and a load of toys and chuck ds* [son] *in to play for an hour...he loved it and it killed an hour!*	52-4C
10.2.5.	*Decided that my only tips so far are too keep as busy as possible after a bad night to try to block out the tiredness.*	597-9C

10.3. Use 'modern living' to help. Modern technology came to the rescue in a number of forms, for example, driving short distances instead of walking, shopping on the Internet, filling time at night with an iPhone and using children's TV as a babysitter. In some instances these appeared simply to be solutions to practical problems but in others they were welcome distractions from an otherwise trying situation:

10.3.1.	*You feel tired to walk half a mile to the clinic and take the car instead.*	159-160B
10.3.3.	*now only do home shopping*	499B
10.3.4.	*Another thing which keeps me going in the night is my iPhone...I know I am very lucky and it was an extravagance but really felt I needed something to help make things less grim when I felt like the only person awake in the world*	208-11C

10.3.6.	*My (shameful) top tip if you have older children has to be C beebies!... we are now watching postman pat with coffee (me) milk (toddler) and a plate of toast. Suddenly it's all a bit more bearable!*	570, 2-3C

10.4. Keep organised. Some participants disciplined themselves by keeping organised, mainly by making lists, so that jobs were sure to be done. Time management and efficiency were also helpful strategies:

10.4.1.	*Make a to-do list.*	109C
10.4.2.	*I make packed lunch for DH* [husband] *and do an extra one for me, so I don't have to find time at lunchtime. I make two cups of tea or coffee at a time and keep one hot with a saucer on top or zap it in the microwave later.*	96-9C

10.5. Make allowances for memory and co-ordination failures. Some participants realised that they were functioning cognitively at a less than optimum level and needed to safeguard themselves against this. Sometimes it was necessary to use memory aids or to guard against clumsiness or distractibility:

10.5.2.	*After searching through handbag and changing bag* [for car keys], *I always find them on the driver's seat, where I have tossed them because I knew I would forget.*	340-2A
10.5.3.	*I also have a list of preposterously mundane tasks on the white board that I'd forget to perform if they weren't written down (things like 'hang out washing') because I can't keep track of whether it's Sunday or Wednesday. I've had to buy a mini white board to go on my fridge. On it I write the day and date (changing it every night during the midnight feed)*	553-557B
10.5.5.	*On the subject of driving, we are all taking great care not to drive if we've reached the winking bathmats level, aren't we? Tiredness on the road is not at all funny.*	345-6A

10.6. Acknowledge inability to cope. In a relatively large number of posts (15/48) about day to day living with sleep disruption, participants admitted that they had no coping resources left and were failing to manage the situation. They described themselves as '*overwhelmed*' (82C), at their '*wits end*' (1312C) and '[not knowing] *what to do any* *more*' (1678C). Others said they '[could not] *go on like this'* (1406C) or were simply '*unable to cope*' (1226C):

10.6.1.	*I just can't seem to get it together*	70C
10.6.5.	*I just feel like I can't go on like this.*	1108-9C
10.6.7.	*I'm at my wits end*	1312C
10.6.14.	*Seriously want to enjoy my baby I go back to work in Feb and want to have happy times but I just can't cope.*	1824-5C

4.3.2. Stage 2: Cognitive effects of sleep disruption

Table 4.2. provides a summary of the six superordinate themes and sub-themes identified under the general heading of *Cognitive effects of sleep disruption*. In the discussion that follows, data extracts are again presented with their string-code and line numbers.

11. Hallucinations and visual disturbances

11.1., 11.2., 11.3. Visual hallucinations, auditory hallucinations and visual disturbances. Much of the research literature linking sleep patterns with hallucinations concerns people with clinical conditions and, although visual tasks are often used to test the effects of sleep deprivation or disruption, few have investigated their incidence in normal populations (Barnes, Koch, Wilford and Boubert, 2011). Coren (1997, 1998) noted that, in the record-breaking attempts to go without sleep for over 200 hours undertaken by 17-year-old student Randy Gardner (Ross, 1965; Dement, 1999) and 32 year-old disc jockey, Peter Tripp in 1959 (Dement, 1974) illusions, hallucinations and other perception distortions tended to appear during the fourth night. Dement's account of Gardner's behaviour plays down the effects of sleep deprivation but Ross (1965) reported that, by the fourth night, Gardner's speech was slurred and he hallucinated that a lamp-post was a person. According to two attendant psychiatrists, Cornelison and West (cited in Dement, 1972), Tripp had visual hallucinations, including 'seeing' mice, kittens, spiders and cobwebs, and sometimes had difficulty working out who people were. Tripp also experienced some auditory hallucinations that only.

Table 4.2.

Cognitive Effects of Sleep Disruption: Superordinate and Sub-themes (Number of Posts)

11.	Hallucinations and visual disturbances (20)
	11.1. Visual hallucinations (12) 11.2. Auditory hallucinations (3) 11.3. Visual disturbances (5)
12.	Action slips (44)
	12.1. Failures of intended action (31) 12.2. Failure by omissions in action sequence (8) 12.3. Failures in self-care (5)
13.	Nocturnal disorientation/reality check (15)
	13.1. Losing and forgetting the baby (15)
14.	Unreliable memory (36)
	14.1. Memory loss (9) 14.2. Memory lapses (27)
15.	Language production problems (20)
	15.1. Cannot find the words (10) 15.2. Find the wrong words (7) 15.3. Disfluency (3)
16.	Clumsiness (9)
	16.1. Poor co-ordination (6) 16.2. Potential risk to others (3)

appear in certain clinical conditions in the research literature. Cornelison and West noticed a roughly 90 minute cyclical pattern to the occurrence of these and they suggested that this linked to sleep cycles such that Tripp was experiencing a kind of wakeful dream state during times when he would normally be in REM sleepIn laboratory-based research a number of findings suggest visual impairments following sleep deprivation. For example Thomas *et al.* (2003) found that metabolic rate for glucose in primary visual areas after 48 and 72 hours of TSD was associated with a decrease in saccadic velocity, which is a measure of oculomotor responding, and implicated the pre-frontal thalamic network in this. Rogé, Pébayle, Kiehn and Muzet (2002) tested the effect of drowsiness on vigilance using a sustained two-hour simulated car-driving task in foggy conditions, and Rogé, Pébayle, El Hannachi and Muzet (2003) used the same test after one night of TSD. In both studies an increased tendency for '*tunnel vision'* (Rogé *et al.* 2002: 189) became apparent in which detection of occasionally presented, peripheral visual-field stimuli deteriorated over time and was significantly worse after loss of sleep. Rogé *et al.* (2003) also compared participants aged 18-30 with those aged 40 to 51 and, although the sample was small (N=19), they claimed that age increases this tendency, a finding that might be relevant to older parents. Kendall, Kautz, Russo and Killgore (2006) tested 21 male and female military personnel on a divided attention task, incorporating a vigilance test, in which participants monitored a 150° visual field for signals. Kendall *et al.* expected to find a shift to the left visual field over 40 hours of sustained wakefulness but claimed that they had only found evidence of general deterioration in vigilance in spite of a trend in the data in the expected direction ($p = .06$). Finally, in a marksmanship simulation, 72 hours of sleep deprivation in 62 male, Navy trainees caused them to take longer to sight their target and their performance to become less accurate and more varied especially when under environmental stress (McLellan *et al.*, 2005).

This research varies in terms of the participants used and the tasks employed, but does suggest that hallucinations, and a variety of visual impairments, may follow varying degrees of sleep deprivation in parents. 'Seeing things', slowness in focusing visual attention and difficulties with peripheral vision or seeing in general, along with much less common auditory hallucinations, are reflected in the following extracts:

11.1.3.	*You stir in the night and mistake DH* [husband] */ the teddy / the pillow for your baby. Sometimes you 'see' baby's face superimposed on them.*	10-11B
11.1.10.	*I was a zombie...even hallucinated was that tired [saw dwarfs waving and running round Tesco and fish swimming up the curtains].*	223-4C
11.1.12.	*I know exactly what you mean about sleep deprivation making you hallucinate. I can see wispy shadows at the corners of my vision which I am fairly sure aren't really there.*	720-2C
11.2.2.	*Yes, I've done the hallucinating thing as well. In dd1's* [daughter 1's] *first weeks I could swear I could hear a baby crying, and kept making dh* [husband] *go and check, even though the monitor was right next to me and working fine.*	109-12B
11.3.1.	*You stare and stare at the clock but your eyes are so bleary all you can make out is 8888.*	26-27B
11.3.5.	*I remember being on the postnatal ward and talking to a midwife who only had one eye. It was only the next day I realised she had both eyes, mine were just not functioning at the time and I couldn't see. Scary!*	741-3C

A further search of other sleep strings in *Mumsnet* from October 2004 to May 2012 using the term '*halluc**' found spontaneous postings about hallucinations attributed to sleep deprivation or disturbance, rather than pre-existing sleep disorders, in 82 more strings and 48 new participants. They most often (n = 35) complained of seeing things such as insects, animals, distorted faces or strange creatures and of seeing things out of the corner of the eye and having wispy peripheral vision. Four specifically mentioned driving difficulties that they attributed to visual deficits. Three people mentioned olfactory hallucinations (being able to smell burning), three mentioned auditory hallucinations (hearing crying or screaming), two mentioned tactile illusions (a feeling of someone next to them) and one mentioned an illusory sensation of moving.

12. Action slips

On the basis of findings from two diary studies, in which 98 participants recorded everyday action sequence errors (N = 625), Reason (1977, 1979) and Reason and Mycielska (1982) coined the term 'actions-not-as-planned' or 'action slips' to refer to lapses in attention that lead to unintended outcomes in otherwise good plans. They distinguished these from errors, which occur because action sequences had been poorly planned, and say that action slips are skill-based rather than knowledge- or rule-based. Four categories of action slip were identified:

- Repetitions, in which a step in a sequence was performed more times than necessary
- Wrong object errors, in which inappropriate objects were incorporated into a sequence
- Intrusion errors, where an inappropriate step was incorporated into a sequence
- Omission errors, where a necessary step was omitted from a sequence

Reason and Mycielska (1982) and Broadbent *et al.* (1982) added that these often occur in well-practised, action sequences in familiar environments, the defining feature being that, even though a sequence might seem sensible (e.g. putting sugar in your tea when you do not take sugar), the final outcome is usually unintended. Reason and Mycielska (1982: 243) suggested: *'...these mistakes are the price we pay for being able to carry out so many complex activities with only a small investment of conscious attention. They are the inevitable penalty of the necessary process of automatization'.* Action slips are associated with internally- or externally-generated distraction or preoccupation with something unrelated to the on-going activity. Reason and Mycielska (1982) and Norman and Shallice (1986) suggested that such slips result from both insufficient attention to a task as well as failure to monitor critical previous, current and future steps in its sequence; in effect, losing track of actions. According to Reason and Mycielska (1982: 17, 136) '...*the true hallmark of absent-minded error is misapplied competence*.' Another feature is the conscious realisation that an error has been made, either during the action sequence or some time afterwards, experienced as a feeling of 'coming to' with no idea of what went wrong and a sense that the slip was recognisable as related to another routine activity.

Reason and Mycielska (1982) acknowledge limitations in their data. Firstly their participants were self-selected volunteers who may have had a particular interest in the research because they were slip-prone; in fact individual differences in absent-minded slip frequency could be a relatively stable characteristic. This was supported by Broadbent *et al.* (1982) who found higher CFQ scores correlated with stress but only in individuals who were already more vulnerable to it. Second, Reason and Mycielska state that they had no way of knowing whether participants documented every slip or recorded slips in sufficient detail e.g. slip frequency estimates varied from almost daily in Reason and Mycielska's first diary study to every other day in their second

More recently, Jónsdóttir, Adólfsdóttir, Cortez, Gunnarsdóttir and Gústafsdóttir (2007) recorded almost daily slips in 20-39 year olds with a weak but significant decline up to 60 years of age. In addition, time of day seemed to exert an effect in that Reason and Mycielska found that slips peaked around 8am and 5-7pm, most likely during transition to and from work and home, and Jónsdóttir *et al.* found frequency of slips increased between 12 noon and 8pm and were fewer at weekends. The reason for these differing findings is unclear, however it may be because, in spite of being 25 years apart, both studies used a variety of volunteers across a wide age-range and both included substantial numbers of undergraduates, whose lifestyle and work hours may be less regular than in older participants. In an experimental study using the Sustained Attention to Response Test (SART), Manly, Lewis, Robertson, Watson and Dattaa (2002) tested ten undergraduates at 1am, 7am, 1pm and 7pm over four days and found that performance was best at 1pm and 7pm and worst at 7am and 1am. In all of these studies however, most of the participants would appear to be independent and autonomous individuals whose sleep is unlikely to be disturbed by others.

It is not clear from reports of the aforementioned diary studies what the personal circumstances of participants were in terms of whether they were parents or were sleep deprived or both, so particularly relevant to this analysis is a finding by Wallace, Vodanovich and Restino (2003) who used the *Cognitive Failures Questionnaire* devised by Broadbent *et al.* (1982). They found a direct correlation between questionnaire scores (measuring everyday memory failures, distractibility, blunders and forgetting names) and self-reported sleepiness in American undergraduates and military personnel aged about 23 years. This is important because it is not evident from *Mumsnet* strings whether participants perceived an increase in slips, although it is implied that they do perceive the ones they report as unusual, remarkable and due to being sleep deprived. As Cohen, Eysenck and LeVoi (1986: 39) stated: ''...*everybody finds that slips of action increase with tiredness and stress.*''

12.1. Failures of intended action. Action slips grouped under this heading were by far the most frequently reported form of error (n = 31) and appear to be a mixture of intrusion errors (n = 18) and wrong object errors (n = 13). Intrusion errors include '*behavioural spoonerisms*' (Reason and Mycielska, 1982: 169) in which partial components of action sequences are substituted for each other:

12.1.2.	*Went for coffee with my SIL* [sister-in-law] *on Friday (yesterday?!) and fed DS* [son] *some sweet potato. Stirred my cappucino for ages with a yellow plastic spoon loaded with mash and posset. I just said "Oh" weakly in its general direction and she merely nodded and raised her eyebrows as though that said it all (she has 1yr and 3yr old).*	117-20A
12.1.11.	*You look down and you've put cat food in the bowl you were intending for cereal. Then you sort it all out and go to put the cereal in the fridge.*	101-2B
12.1.16.	*You try several times to change the TV channel with your mobile.*	217B
12.1.30.	*I have also sat down in the passenger seat of the car and wondered why I wasn't going anywhere.*	547-9B

12.2. Failure by omissions in action sequence. Eight instances of omission errors were reported:

12.2.1.	*You wonder why the last load of washing isn't very clean, then realise you forgot to put any soap in (DH* [husband] *actually did this not me!)*	29-30B
12.2.2.	*You are so tired you put moisturiser on your face...without taking your glasses off first...& yes I have done it!*	264-5B
12.2.6.	*You forget to use oven gloves when taking trays out of the oven.*	440B

12.3. Failures in self-care. For the most part, participants seemed unaware of failures in self-care at first, which suggests that these are further examples of omission errors. When errors were noticed there was a tendency to feel indifferent about them:

12.3.1.	*You wear creased, un ironed clothes inside out and don't care that people notice.*	138-9B
12.3.4.	*You push the pram all the way to the post office, then realise you are still wearing your slippers and your top is on inside out.*	71-2B

Various explanations have been offered for the occurrence of action slips, for example, Norman and Shallice's (1986, 2000) model of action control proposed that we have a repertoire of interacting schemata to sequence actions some of which are controlled and others automatic. There are also two attentional systems capable of acting both independently and in combination with each other. The contention scheduling system (CS) operates by selecting from established, contending schemata to carry out well-learned, routine tasks. It resolves competition between schemata *'...preventing competitive use of common or related structures and negotiating co-operative, shared use of common structures or operations when that is possible.'* (Norman and Shallice, 2000: 379). The supervisory attention system (SAS) is one source of deliberate control over the schema selection process (motivation and internal or external 'prompts' are others) and can bias their selection by the CS. As the CS operates almost automatically and unconsciously, the intervention of the SAS is unnecessary unless it is required to consciously monitor critical steps in a well-learned task or respond to unexpected novelty. Better learned tasks can be performed automatically; they have more distinctive schemata and interference between them is minimised while others share much common ground. Action slips may occur more often in sleep-deprived people if the CS fails to adequately inhibit competing action schemata, and/or the SAS fails for some reason to consciously intervene when a routine deviates from its correct course. In the case of many posts about action slips, well-learned and mundane routines often seemed to become confused and conscious awareness of aberrations was often slow to surface.

A clue as to why cognitive failures and action slips might increase with sleep deprivation lies in clinical neuropsychological research. Contention scheduling may be associated with the activity in the corpus striatum of the basal ganglia which is innervated with dopamine projections. The normal release of dopamine can be enhanced by amphetamine and, when this occurs experimentally, it gives rise to over-activation and a virtual 'jamming' of action schemas where many are activated simultaneously, a condition that is complementary to the movement disorder aspects of Parkinsonism (Robbins and Sahakian, 1983). In addition, as Luria (1966) and Walsh (1978, cited in Darby and Walsh, 2005) noted, the prefrontal regions of the human brain plan, monitor, correct and inhibit actions. Pre-frontal lesions are linked with problems that might be associated with the SAS malfunction e.g. poor error correction, increases in perseveration, difficulty in planning ahead (Shallice and Burgess, 1991) and utilization behaviour in which action sequences are automatically triggered by the presence of objects (Lhermitte, 1983). In addition, abnormalities in the frontal lobes are associated with such conditions as dysexecutive syndrome (once known as frontal lobe syndrome), frontal apraxia and action disorganisation syndrome. Such evidence suggests that the actions of the CS and SAS are underpinned by different but interacting neural activity and if, as suggested by Horne (1993) in his pre-frontal cortex (PFC) vulnerability hypothesis, executive functions are particularly open to the detrimental effects of sleep loss, this could explain why the SAS in sleep deprived individuals fails to monitor the CS adequately and action slips increase.

13. Nocturnal disorientation/reality check

13.1. Losing and forgetting the baby. Fifteen posts referred to occasions when a parent woke in the night unable to remember where they had last left their baby. This suggests that settling the baby to sleep, in Reason and Mycielska's (1982) and Norman and Shallice's (2000) view, has become automatized so that parents sometimes had no recollection of having carried out certain steps in an action sequence or even of having a baby at all. Sleepiness and darkness further exacerbated the initial panic and anxious checking for the whereabouts of the baby who was often difficult to locate amongst bedding. One parent had found a very practical way of countering this problem: '*I've even stopped dressing him in his white sleepsuits when we have our white bedding on, as I used to think he was in there somewhere and I just couldn't see him*' (151-154B).

13.1.1.	*Still asleep yourself, You wake DH* [husband] *in the night yelling 'where's the baby?' DH points out he's in the Moses basket where he always was*	13-14B
13.1.8.	*frantic searching for baby in bed.*	325B
13.1.12.	*You are staying with friends and you think "I hope they stop that baby crying or it will wake my DS* [son]*" (who it has taken me three hours to get to sleep!!) before realising that it's your DS that is crying!!*	398-400B

14. Unreliable memory

14.1. Memory loss. Memory loss includes examples of sometimes quite simple disorientation (e.g. cannot recall what day of the week it is), and more extreme experiences where entire sequences of quite complex behaviour, such as conversations, cannot be recalled. This would appear to differ from SAS monitoring failure and is more characteristic of what Gennaro, Herrmann and Sarapata (2006: 380) call a '*memory block'* of the episodic aspect of declarative memory, which Killgore (2010) says depends on the hippocampus and medial temporal lobe structures during encoding.

The literature linking sleep with learning and memory is vast and growing yet, in a recent review, Walker and Stickgold (2006: 160) concluded '*It is now clear that sleep mediates learning and memory processing, but the way in which it does so remains largely unknown'.* Killgore (2010) stated that sleep is important both to prepare the brain to learn new information and to consolidate it afterwards and Rauchs, Desgranges, Foret and Eustache's review (2005) claimed that most research linked episodic memory consolidation to slow wave sleep (SWS) although some other research had linked it to REM sleep. Yoo, Hu, Gujar, Jolesz and Walker (2007) found that episodic memory was less efficient after just one night of sleep loss and this was associated with lower hippocampal activity during encoding. Furthermore, participants who were able to recruit prefrontal and parietal regions of the brain during encoding fared better, possibly because this acted in a compensatory fashion. Sleep disrupted people suffer from a wide variety of challenges to their sleep structure and, according to the prefrontal cortex vulnerability hypothesis (Horne, 1993), compensation may not be available to chronically sleep disrupted people.

14.1.3.	*Your sister phones for a chat and refers to a recent conversation you have no recollection of at all.*	80-81B
14.1.6.	*And just the other week DD2* [daughter 2] *(3 months) was asleep in her cot, me asleep in my bed, and I woke up with her in bed with me. It must have been me, except I've not a shred of memory of it. Unless she is really quite stellar at rolling when I'm not looking!*	287-90B

14.2. Memory lapses. Jónsdóttir *et al.* (2007) suggested that memory slips may be further examples of actions slips. This explanation seems fitting in the case of memory lapses (14.2) which accounted for 27 of the 36 examples of unreliable memory cited by participants. These seem to be errors of omission (Reason and Mycielska, 1982) because participants were already involved in familiar action sequences but became aware at the time or afterwards that something was amiss, suggesting a failure to efficiently monitor the situation:

14.2.9.	*I walked around the supermarket 3 times...because I didn't know why I was there or what I needed to buy...*	308-9A
14.2.12.	*every time I go anywhere in the car, I do the "pat the pockets and panic" dance after strapping the kids in, because I can't find my keys.*	339-40A
14.2.13.	*Looking at the full bath and wondering if you've just got out of it, or if you're just about to get in it ...*	169-170B

15. Language production problems

Verbal fluency has been found by Harrison and Horne (1997, 1998) and Kronholm, Sallinen, Suutama, Sulkava, Era and Partonen (2009) to be affected by sleep loss and to be associated with pre-frontal cortex activity (Herrmann, Ehlis and Fallgatter, 2003). In both the 1997 and 1998 studies by Harrison and Horne, controls were compared with experimental participants following 36 hours of wakefulness. In the 1997 study, sleep deprived participants showed lowered functioning in verbal fluency, a tendency to become ‘stuck’ in a semantic category and decreased intonation in speech. In the 1998 study, Harrison and Horne used the Haylings test (Burgess and Shallice, 1997), which required participants to inhibit strong verbal associations to completing sentences and produce novel endings instead, and a word fluency test, in which participants had to generate verbs associated with given nouns (e.g. apple – bite). They found that, compared with controls, there was significant impairment of function in both tests. In the examples that follow, it would appear that participants have experienced action slips in the form of omission errors in 15.1 and intrusion errors in 15.2. (Reason and Mycielska, 1982) and have also experienced disfluency (15.3) in accord with the studies described here.

15.1. Cannot find the words.

15.1.3.	*Oh...I can never finish a conversation. Even the slightest distraction and I completely forget what I'm on about, who I'm talking too.*	143-4A
15.1.7.	*You trail off in conversation, unable to finish a sentence, because you can't remember the necessary word.*	20-1B

15.2. Find the wrong words.

15.2.2.	*You say goodbye to your DH* [husband] *(who works nights) and tell him to sleep well*	439B
15.2.3.	*You confuse your friend's name with her daughter's.*	35B
15.2.7.	*I frequently lose my English, and even though it's my 1st and native language, I have found myself using French or Czech instead. Neither of which I actually speak.*	318-9A

15.3. Disfluency.

15.3.1.	*I say "right then" a lot as well... LOL.*	259A
15.3.3.	*I know what you mean about the slow motion talking...*	77A

16. Clumsiness.

16.1. Poor co-ordination. As previously mentioned in 6.4. (Hung-over), Dawson and Reid (1997) found that, after about 17 hours of continuous wakefulness, performance in a group of individuals on a hand-eye co-ordination task deteriorated to the same level as in those who had drunk alcohol until their blood alcohol concentration (BAC) was 0.05%; a level of which is considered to be intoxication in many western industrialized countries. This was corroborated by Williamson and Feyer (2000) who compared the same adults aged 30-49 during 28 hours of sleep deprivation and after hourly administration of alcohol. By about 17-19 hours of wakefulness, participants' performance was similar to when their BAC was 0.05% in simple tests of hand-eye co-ordination showing a decrement of about 10%. Kronholm, Sallinen, Era, Suutama, Sulkava and Partonen (2011) found a U-shaped relationship between sleep duration and psychomotor slowness such that short (≤ 5 hours per night) and long (≥ 10 hours per night) sleepers were slower on both simple and choice reaction tasks than those in between. The reason for the unusually long or short sleep durations is not known, but it does suggest that chronic sleep curtailment may be associated with similar effects in parents and carers of babies and young children. In 16.1., participants complain about poor co-ordination and in 16.2. they worry about the effect this might have on the safety of others and their children in particular:

16.1.2.	*I would also walk into loads of furniture and totally forget and then the next day say to my mum 'where did I get that bruise from?'*	62-3B
16.1.3.	*It takes you five goes to do up the poppers on the babygro*	67B

16.2. Risk to others. There was the occasional allusion to problems with concentration while driving, in addition to the memory lapses about making journeys, losing keys and paying for parking mentioned in 14.2, which suggests that sleep deprived parents are often tired drivers e.g. 16.2.3. 1249-53C '*My ex DP* [partner] *crashed the car with us in it at 4pm in the afternoon on a clear road we were not hurt he had just momentarily nodded off without realising it.'* Filtness, Reyner and Horne (2012) found that younger male drivers (mean age = 23 years) compared to older drivers (mean age 67 years) felt subjectively more sleepy and were particularly vulnerable to making lane drift errors in a two-hour driving simulation following just five hours of sleep. The difference held after taking experience into account, but a possible confound was that curtailed sleep is less of a departure from normal for older drivers than it is for younger drivers. Nevertheless, sleepiness is often implicated in accidents, not just in road traffic, and these again could be due to inattention errors:

16.2.2.	*I feel like I am a danger to myself and the children because I am so clumsy with tiredness*	1034-5C

4.4. Discussion.

4.4.1. Summary of findings

The aim of this study was to explore parents' experience of sleep disruption and its perceived effects in order to contextualise any cognitive changes that they associate with being sleep deprived because of their children. The ease of use and convenience of the internet-based discussion forum, *Mumsnet Talk*, allowed over 100 participants to share their experiences of these things in popular and active discussion strings. The nature of these strings invited them to discuss the impact of sleep disruption on their lives but also what strategies they used in attempting to cope. The TA, which was applied to the strings, identified 10 superordinate themes concerning living with sleep disruption and, while some progression through stages of adjustment may be implied in the following discussion, no linearity is assumed as parents must have to deal with multiple challenges day to day.

Middlemiss (2004) had claimed that 90% of parents in the USA depended on sources other than medical health professionals for advice about managing infants' sleep, so it was likely that the expectations of participants in *Mumsnet Talk* discussions about their children's sleep would be highly variable. Even if they did consult published research it would probably not give them clarity. While Hoban (2004) had quoted average sleep durations of 16-18 hours in newborns, decreasing to 11.4 hours by 5 years of age, and an expectation that by 6-months of age an infant would sleep continuously for 6 hours, Sadler (1994) reported wide individual differences such that broken sleep was a common and unpredictable experience of parents with babies up to six months old. In agreement with this, Horne (1992) highlighted wide variation in sleep patterns from birth and Anders and Weinstein (1972) reported that, while there was a general trend towards longer periods of unbroken sleep as infants matured, 10% had never slept through the night in their first year. Awareness of this variation, by whatever means, was evident amongst *Mumsnet* participants, especially in superordinate theme 3 (*Changing relationships with others*) in which they discussed other's '*perfect sleeping babies'* (3.6.2) and how they '*learnt* [a] *lesson'* (3.7.3) that even their own children did not share similar sleep patterns. For these parents, the only certainty was unpredictability.

4.4.2. Living with sleep disruption

In superordinate themes 1 - 3 parents appeared to accept that changes to their sleep patterns would occur but could not know what these, or their effects, would be. Desynchrony (superordinate theme 1) between parents' and children's sleep patterns meant that parents were obliged to respond to the child's needs, resulting in them abandoning their own preferred sleep needs and habits and replacing them with curtailed and broken sleep. Parental sleep became unpredictable, especially when children were unwell, and was further marred by the demands of more than one child. Parents' expectations that their own sleep needs could be met changed. They came to accept very early rising times and even began to feel they could function adequately, but not optimally, without sleep. In spite of this apparent acceptance, in superordinate theme 2 (Sleep need is intense) there appeared to be an underlying pre-occupation with sleep such that it was prioritised when the opportunity arose and yearned for and fantasised about when it was impossible. On occasions when good sleep was possible, the positive effects were marked but, for the remainder of the time, some parents fought sleepiness or were frustrated by being unable to sleep when given the chance. Sleep disruption, therefore, appeared to be accepted as a facet of parenting requiring perseverance through fatigue for much longer than the five weeks post-partum that Runquist (2007) had studied. Indeed, some parents described sleep disruption that had lasted as long as five months (4.3.9., 4.4.2., 4.7.2), seven months, (1.3.2), 10 months (1.1.9., 1.1.12., 1.2.2), 14 months (1.3.4) and 2 years 8 months (1.1.6) (see Appendix G).

In superordinate theme 3 (*Changing relationships with others*), disrupted sleep was responsible for negative undercurrents in social relationships that suggested increasing isolation of the affected parent. There were more arguments and greater tension between partners and private resentment of anyone who slept well. Parents actively managed their interactions with other parents and family members, especially with those who caused self-doubt. The perception that their sleep difficulties were not well understood by others led them to excuse their behaviour publicly to strangers or simply to avoid contact with anyone who might be judgemental. Although there were some opportunities for respite, in the form of holidays or assistance from relatives, living with sleep disruption was seen by some participants as an on-going personal struggle that had detrimental effects on the quality of their mothering abilities and was a deterrent to having more children.

Superordinate themes 4 (torture, hell and madness) and 5 (depression, anxiety and worry) illustrated the extreme psychological pressure under which some sleep-disrupted parents were operating, as well as the difficulties they had with controlling their emotions. Concerns about mental health tended to centre on depression, with anxiety and worry mentioned less frequently. All of these had negative affect in common. In addition, physical symptoms (superordinate theme 6) of nausea and dizziness, physical exhaustion, backache and feeling '*hung over*' troubled some participants. Taking the first six superordinate themes together therefore, participants' experience of sleep disruption took various forms but, collectively, these seemed to serve to remove them from what they considered to be normal sleep patterns, interactions with others and good mental and physical health into a situation which had to be endured for an indeterminate time.

In superordinate themes 7 to 10 participants mostly discussed ways to actively manage the problems that sleep disruption presented. In superordinate theme 7, participants focused their coping strategies on the practical problem (Lazarus and Folkman, 1984) of maximising opportunities to take compensatory sleep. Strategies involved enlisting the help of other adults, synchronising with the child's sleep patterns, facilitating rapid onset of one's own and the child's sleep and finding ways to rest while the child was occupied. With respect to managing troubling cognitions and emotions, in superordinate theme 8 there was evidence of a variety of strategies identified by coping theorists, for example '*positive cognitive restructuring*' (Skinner *et al.*, 2003: 240) and '*meaning focused coping*' including '*benefit finding*' or '*benefit reminding*' (Folkman, 2008: 7-8). Participants were experiencing a trying situation which imposed limitations that they could not easily modify. As a result, coping involved endurance of sleep disruption that appeared to be finite, but of indeterminate duration, and which could be made more tolerable by drawing on support from one's own resources, *Mumsnet Talk* and family members.

Looking after yourself in superordinate theme 9 included addressing physical needs for such things as stimulants (caffeine) and energy boosts (sugar) as well as strategies intended to build resilience (vitamin and iron supplements and exercise) so, in these respects, coping was both problem–focused and '*future oriented*' and *'pro-active'* Folkman and Moskowitz (2004: 757). In superordinate theme 10, as well as adjusting expectations about their own sleep (subtheme 1.3) some participants described accepting limitations and 'down-shifting' expectations about what and how much of their daily tasks could realistically be accomplished in the time available. Again, problem-focused strategies were suggested to help achieve daily tasks and, while some of these focused on time-management, participants referred, for the first time, to managing impaired attention and memory symptoms, both of which have been alluded to in research by Kurth *et al.* (2011).

Finally, 31% of 48 participants who contributed to superordinate theme 10 said that they felt unable to cope with their situation. Phrasing of these comments (e.g. 10.6.5 '*I can't go on*') suggested that, this was a reaction to a chronic rather than acute stressor, and that their coping resources were '*overwhelmed*' (82C). While it is uncertain to what extent sleep disruption as opposed to, or in addition to, general demands of parenthood precipitated this crisis, these participants clearly regarded it as instrumental. They also made up 14% of the total sample of 108 meaning that about 1 in 7 mothers saw sleep disruption as partly or wholly responsible for rendering them devoid of coping resources and unable to function in ways that would have been possible with adequate sleep.

4.4.3. Cognitive effects of sleep disruption

Six superordinate themes were identified that indicated cognitive effects of sleep disruption. Superordinate theme 11 (*Hallucinations and visual disturbances*) indicated that, although participants perceived things that were not present, they were well aware of this and any disconnection with reality was fleeting. There is little research evidence to link everyday sleep disruption with hallucinations in healthy people but visual disturbances have been demonstrated by Rogé *et al.* (2002, 2003) such that drowsiness and TSD seem to be associated with less attention to the peripheral visual field in simulated car-driving. *Mumsnet* participants did allude on occasion to concerns about their fitness to drive and this had also been referred to in Long and Johnson's (2001) study. This is of some concern as there was a tendency for sleep-disrupted participants to drive short distances rather than walk (10.3.1), have lapses of memory when driving (10.5.2) and feel as though they were a '*risk to others'* (16.2). One participant attributed a road traffic accident to their husband's tiredness (16.2.3). Added to the *Clumsiness* identified in superordinate theme 16, and the remaining ones still to be discussed, the possibility that sleep-deprived parents are a risk to themselves and others when they drive is clear; in the words of one participant, '*Tiredness on the road is not at all funny*' (10.5.5).

Superordinate themes 12, 14 and 15 (*Action slips, Unreliable memory, Language production problems*) collectively suggest detriments to executive functions and implicate the pre-frontal cortex (PFC), which is thought to be particularly affected by sleep loss, as originally suggested by Horne (1993) in his PFC vulnerability hypothesis. Superordinate theme 13, (*Nocturnal disorientation/reality check*) could also be seen in this light: a familiar action sequence (putting the baby to bed) was, in all cases, carried out successfully, but the memory of having done so was impaired in much the same way as one might be unable to recall having locked up when leaving the house. Together, these perceived effects of sleep disruption have a generalised effect on executive functioning during the day and at night and these effects may be amenable to measurement using established procedures such as the Wisconsin Card Sorting Test (WCST: Milner 1963), the Tower of London test (TOL: Shallice, 1982), phonemic verbal fluency tests (such as the COWAT, Benton, Hamsher and Sivan, 1994) and the Stroop Test (Stroop, 1935; Golden, 1978). Tests such as the digit span test of memory, which do not call on the same mechanisms, are less likely to be affected (e.g. Van der Linden, Frese and Meijman, 2003) as are semantic verbal fluency tests (Troyer, Moscovitch, Winocur, Alexander and Stuss, 1998).

4.4.4. Assessment of methodology

Criteria for judging the quality of quantitative research, such as objectivity, control and replicability, are well established, but they are partly or wholly unsuitable for assessing qualitative research. Attempting to find equivalents for each quantitative criterion, and then applying them to qualitative research, risks missing the point that there are important epistemological differences behind different methods. Accordingly, a number of ways of assessing the quality of qualitative research have long been debated in the research literature (e.g. Elliott, Fischer and Rennie, 1999; Fossey, Harvey, McDermott and Davidson, 2002; Stiles, 1993). While these suggest useful guidelines, Barbour (2001: 115) warns *'If we succumb to the lure of "one size fits all" solutions we risk being in a situation where the tail (the checklist) is wagging the dog (the qualitative research)'* so that the unique contribution that such research can make may be obscured or lost. She suggests that it is important to keep in mind what a qualitative research design is attempting to achieve and assess it accordingly by applying appropriate criteria for adequacy, or '*credibility checks*' (Elliott et al., 1999: 222), flexibly but not slavishly. In the spirit of Feyerabend's (1975: 175) recommendations, psychologists must not be confined by the rules of traditional, quantitative, natural sciences but instead become '...*more anarchic and more subjective'.* Barbour (2001: 1116) further stresses the importance of fluidity of the context in which qualitative research often occurs and the uncomfortable relationship this may have with relatively rigid '*technical fixes'* typically recommended to improve the rigour of qualitative analysis. These '*fixes*' are purposive sampling, grounded theory, multiple coding, triangulation and respondent validation, concepts that are echoed by Elliott *et al.* (1999), Fossey, *et al.* (2002) and Stiles (1993). Each of these will be discussed (flexibly, not slavishly) with respect to the current findings, but first it is important to consider context of this research and its possible effects on the quality of data (Speer, 2002). In this case, the main concern is the online context of the narratives drawn from *Mumsnet* discussion strings and whether they constitute naturally occurring talk that reflects objective reality in the form of measurable effects of sleep disruption on mothers.

In this chapter, the desirable effects of safe, private and anonymous participation in an online discussion forum were outlined in 4.2.1. *Mumsnet* participants contributed under pseudonyms, freed from concerns about impression management and being judged (Bane *et al*., 2010), allowing them to risk self-disclosure more intensely and rapidly (Suler, 2004). Compared to face-to-face contact however, computer mediated contact removes the influence of many variables that operate in the former (Joinson, McKenna, Postmes and Reips, 2009) such as attribution and stereotyping based on appearance as well as the proxemic, kinesic and paralanguistic aspects of communication. Barak (2009: 306) has suggested that the rapidity and intensity of online disclosure may occur because it helps to compensate for the resulting sense of '*aloneness*'. According to him, a further key difference between face-to-face and online, typed, communicative exchanges is that the latter are not necessarily synchronous. Online, typed discussions can be asynchronous and therefore thought about, planned, edited, shared, deleted, archived and revisited in a way that spoken conversations usually cannot. While this may make them different, Barak suggests that it can make online, typed communications more carefully considered and therefore of superior quality to more spontaneous types. In addition to this, a further strength of internet-based discussions is that they encourage participants to concentrate attention closely on an issue as they might do in a focus group. While they are not 'staged' in the same way, they tend to be relatively unstructured and this encourages sharing of common experiences, introduction of new ones, triggering of ideas in fellow participants and permission to express concerns in ways that might not occur in other research contexts such as an individual interview (Bane *et al*., 2010; Suler, 2004).

Given the special nature of online discussions, a more general question can be raised about whether *Mumsnet Talk* online discussions really do constitute naturally occurring talk uninfluenced by the researcher. Speer (2002) argues that the definition of naturally occurring data, as opposed to data that are '*got up'* (Potter, 2002: 539) by the researcher, is not as straightforward as it first appears. Potter (2002: 541) agrees;

for talk to be natural he suggests that it must, pass '…*a (conceptual) dead social scientist's test'*, which means asking *'…would the data be the same, or be there at all, if the researcher got run over on the way to work?*' The data used here arguably fall somewhere between occurring naturally and being elicited by a 'researcher'. Talk was triggered by the initiators of the *Mumsnet Talk* strings in much the same way that a researcher might begin an unstructured focus group or interview. However, initiators of strings A and C were relatively more active than other participants in making contributions to the discussion, something that a researcher would usually avoid doing. Nevertheless, the data existed and were the same regardless of the researcher's presence, placing them near the natural pole of the natural-contrived continuum that Speer suggests.

While naturally occurring, online talk used in the TA reported in this chapter arguably has many good qualities, there are also reasons to be cautious about whether it is reasonable to interpret it from a realist perspective. In other words, the question is whether it can be believed that what participants say about sleep disruption experiences and effects in this context accurately reflects assumed objective reality. In addition to the special nature of online communication discussed earlier in this section, there are several reasons why the *Mumsnet Talk* analysed in this chapter cannot be considered to be objective, dispassionate or neutral, chiefly that such talk is '*occasioned'* in that it '*come*[s] *naturally'* in a given situation (Gill, 1996: 142). This can affect who participants talk to, how they frame their talk, how their talk is affected by others and what they talk about. In Figure 4.1. (subtheme 3.6) for example, some mothers said they were selective about who they talked to, suggesting that the way they communicated about their experiences, if at all, changed for different audiences. In addition, the initiators of the strings framed the discussion topics in terms of 'deprivation' and the need for 'support' (Table 4.1.) implying that *Mumsnet Talk* participants would share the view that the situation was 'given', problematic and could be ameliorated with the support of others. McKenna (2008) has also suggested that, when individuals are anonymous, discussing something highly salient and concerned about making a good impression, there is a greater tendency for them to adhere to group norms. In the case of *Mumsnetters*, the effects of sleep disruption were often expressed with intensity (e.g. Fig 4.1 Superordinate theme: Torture, hell and madness).

If this intensity were perceived as the norm by the discussion groups, the level of difficulty expressed by them in their talk could have become exaggerated.

One disadvantage of using naturally occurring talk is that its completeness is not as assured as it could be in more contrived data collection methods such as face-to-face interviews. In online discussions, participants are likely to talk candidly about what matters in the moment, without the expectation that their contributions will be scrutinised, but may not reflect more deeply on their experiences or be as concerned about thoroughness as they might be in a qualitative interview. Pertinent issues may be omitted by participants for many reasons; they may not think they are important, they may not want to disclose them or acknowledge them or they may simply not think about them at the time. For example, it was noticeable that *Mumsnet* participants did not talk about the impact on disrupted sleep on their intimate relationships with their partners and no-one mentioned seeking professional help with managing its general effects on themselves. This may be because they were resigned to living with sleep disruption as a ubiquitous, but probably finite, aspect of parenting, or because they did not mention that they felt they needed, or had sought help, or because they saw discussion strings as one of the few or only sources of useful support they felt they could access. In some respects, discovering that others share a difficult experience validates and normalises it so no further action is needed. As one participant said: '*I really appreciate people not flaming me and just being understanding'* (186-7C). Potential 'missing data' issues such as these could be addressed by more direct questioning and/or more direct contact with participants.

Finally, there is also a double hermeneutic in the analysis in that the researcher did not share all participants' experiences first-hand and so made sense of their sense-making (Smith *et al*., 2009). This can be addressed in various ways, but mainly through the researcher reflecting on personal biases that may influence their approach to all aspects of their research. Such formal reflexivity does not feature prominently in TA and so it was thought to be unnecessary to incorporate it here, other than to acknowledge that the researcher's personal interest in the perceived effects of sleep disruption on parents arose from experiencing chronically disturbed sleep during the first four years of her youngest daughter's life.

When considering the extent to which *Mumsnet Talk* discussions can give a valid indication of the objective effects of sleep disruption, it is also important to take into account who provided the talk. This relates to the first of Barbour's '*fixes*', that is, the use of purposive sampling. In qualitative research such as this it is inappropriate to use probabilistic sampling for the purposes of statistical generalisation, instead sampling tends to be opportunistic. In this case, therefore, purposive sampling of participants, in an attempt to achieve sample characteristics such as homogeneity or maximum variation, has not occurred and this calls into question the transferability of findings. All that is known about the sample of participants in this study is that they were parents experiencing sleep disruption and were English speakers with internet access who had registered with *Mumsnet Talk*. Other than this there is no way of knowing participants' identities and '*life circumstances'*, i.e. how they were '*situated'*, an explicit discussion of which can be an important quality indicator in published research (Elliott *et al*., 1999: 221). An online discussion forum itself 'situates' participants but it is rarely possible to know about other attributes such as age, gender, ethnicity or social, cultural, educational, financial, family, personal or domestic circumstances. Verification of these variables is impossible and, while they could be potentially relevant and useful for determining the objective reality of the situations in which participants experience sleep disruption, it might not actually have been desirable for participants to divulge them online.

Participants who chose to take part in discussion strings were also self-selected, being attracted by the string topic, presumably because it was personally relevant and they felt they had something of value to contribute, or because they were in particular need of social support. Invitations to share accounts of the effects of sleep deprivation, without debating possible solutions, and to offer support to each other imply that participants presumed their experiences were common and could be coped with at least in part through online discussion (Skinner *et al*., 2003; Taylor and Stanton, 2007). However, this revealed nothing about the prevalence of sleep disruption and its perceived effects and there was no way of knowing how typical respondents' experiences were.

In spite of these reservations, identification of parents' perceptions of the effects of sleep disruption was the key aim and this was achieved in that an array of issues worthy of further study was discovered. An additional strength of these qualitative findings was that TA, conducted without preconceptions, is arguably grounded in the data rather than focusing entirely on examining existing research as typified in the hypothetico-deductive approach. Barbour (2001) argues that this is a hallmark of good qualitative research. TA also allows for an emphasis on discovery, even though it stops short of developing new theory, and has resulted in a breadth of description that might not otherwise have emerged. This was aided by the fact that the chosen discussions were free-flowing, naturally occurring talk. The only structure imposed was in the titles of the discussion strings, which were, themselves, chosen by participants. Within that loose framework, any issues of importance to participants were raised, unconstrained by interview schedules or topic guides devised by the researcher.

Barbour (2001) goes on to suggest multiple coding as a way of improving rigour in qualitative research. Multiple coding would normally involve cross-checking of analysis by at least one other researcher, and bears some similarity to quantitative inter-rater reliability that might be used to check findings arrived at using such devices as pre-determined coding schemes. However, in qualitative research, Barbour argues that, while agreement could be desirable, multiple coding of qualitative data is unlikely to result in exactly the same conclusions, thus its value lies more in the possibility that other researchers may raise disagreements or see gaps in analysis that can then be addressed to improve the thoroughness of the original. Multiple coding was not formally used here but informal feedback by a colleague raised the question that the perceived effects of sleep disruption might be difficult to separate from participants' attempts to cope with them and this led to examination of selected coping literature in order to enhance the analysis of themes and improve their coherence. Essentially however, multiple coding was carried out here by the lone researcher who used '*iteration'* (Stiles, 1999: 99), continually revisiting the data and analysis to check and re-check themes for clarity and consistency. This process was greatly aided by the lack of redundant material in the discussion strings. Their rich and closely focused nature gave them a very high level of '*news value'* (Gill, 1996: 144); the vast majority of their content was usable resulting in a comprehensive analysis. For Braun and Clarke (2006) good TA can be achieved by the individual researcher through attention to 15 key criteria grouped into five categories: accurate transcription, thorough coding, interpretative analysis, deep analysis and production of a written report that makes explicit and actively applies TA procedures in order to identify themes. All of these criteria have hopefully been addressed here.

Barbour's (2001: 1117) penultimate criterion for rigour is '*triangulation'* which, in this case concerns both data and theory. In this analysis evidence was deliberately sought that was both 'bottom up', data-driven and exploratory (Boyatzis, 1998) as well as 'top down' or theory driven; a combination that Fereday and Muir-Cochrane (2006) believe improves the rigour of TA. Throughout this analysis both 'bottom up' and 'top down' sources of information have been used with the intention of '*confirming, supplementing* [and] *elaborating'* each other (Stiles, 1999: 100) and of raising further research questions. No assumption has been made that existing qualitative or quantitative research used in the analysis are in competition with each other, merely that multiple viewpoints help to crystallise, or make more comprehensive, our conception of an issue even if there are apparent contradictions in it (Mays and Pope, 2000).

Finally, Barbour (2001) discusses respondent validation that chiefly concerns whether participants agree that the researcher's interpretation accurately and completely reflects their thoughts, feelings and experiences. This collaborative aspect of some qualitative research has been called '*testimonial validity'* (Stiles, 1999: 100) and this has not been directly assessed in this research other than through a relatively crude judgement that can be made by examining the frequency with which participants shared experiences clustered under different themes. Respondent validity is not without its critics however, e.g. Mays and Pope (2000) have argued that the researcher often aims to give an overview rather than deal with specific issues that may be important to an individual. Furthermore, participants and the researcher may, consciously or otherwise, collude in accepting an interpretation or a participant may, for any number of reasons, not care to challenge it. Stiles (1999: 100) continues that qualitative research may further be validated through its effects on the parties involved. Findings that empower participants have 'c*atalytic validity'* and those that challenge, change or enhance the researcher's understanding have '*reflexive validity'*. The status of the current research with respect to these different kinds of validity is currently unknown but could, at least partly, be determined retrospectively once findings are shared with *Mumsnet* and made available online.

4.4.5. Conclusions and recommendations

Sleep disruption due to parenthood takes many forms hence this analysis has revealed multi-faceted effects and coping strategies for dealing with practicalities, psychological and physical states, cognitions and emotions. Its purpose was to identify key concerns expressed by sleep disrupted parents in order to contextualise and guide further investigation of perceived and actual cognitive effects; an area that is, to date, under-researched. Sleep disruption for participants in this study was experienced as a largely inescapable, chronic stressor demanding psychological and practical adjustment and coping strategies that were only partially successful in reducing its effects if at all. Some of these effects were alluded to in the review of research into the effects on parents of infant crying by Kurth *et al.* (2011), in particular in the paper by Long and Johnson (2001), including exhaustion, changed inter-personal relationships, worry, curtailment of daily activities, the need to use practical and psychological coping strategies, low mood and resignation. While the sleep of parents in the current study was not solely affected by infant crying, they shared all of these experiences. In addition, they were pre-occupied with trying to obtain adequate sleep, felt tortured and emotionally volatile and described unpleasant physical symptoms.

The next stage in this thesis is to further investigate whether some of the cognitive effects that parents think result from sleep disruption can be measured. A range of specific, measurable, cognitive effects can be identified from the foregoing TA of the discussion strings and tested both subjectively with good quality, self-report measures and objectively using neuropsychological tests. As well as this, it is important to try to understand the role that factors identified in the current study play in these effects, for example, the nature of sleep disruption, level of fatigue, mood and physical symptoms. In addition, discussion forum participants in this study were self-selected because sleep disruption was salient to them. Their naturally occurring talk about this may not have captured all the effects of sleep disruption or variation in experience, for example, those with '*perfect sleeping babies*' (3.6.2). To address this, efforts will be made to recruit survey participants with a wide range of sleep disruption experiences with the aim of discovering what effects might be due to parenting *per se* as opposed to parenting with disrupted sleep.

Chapter 5.

COGNITIVE CORRELATES OF SLEEPINESS AND FATIGUE IN SLEEP-DISRUPTED MOTHERS OF CHILDREN AGED UNDER FIVE YEARS.

5.1. Introduction

5.1.1. Sleep disruption, sleepiness and fatigue

With very few exceptions (e.g. Long and Johnson, 2001; Kurth et al., 2011) the cognitive effects of disturbed sleep in parents are barely understood and the complex relationship between sleep disruption, sleepiness and fatigue has not been addressed. Although sleepiness and fatigue are closely related to sleep disruption, they are not inevitable consequences, and it is possible to experience any one of the three alone or in various combinations. In the research literature, sleep disruption can lead to feelings variously described as tiredness, exhaustion and sleepiness, all of which might be fairly short-term and alleviated with adequate rest, but fatigue tends to be different in nature. It has been described by Elek, Hudson and Fleck (2002) as more severe than tiredness, persistent and not relieved by rest. Aaronson *et al.* (1999: 46) offered a more elaborate definition similar to that used for stress, describing fatigue as '*the awareness of a decreased capacity for physical and/or mental activity due to an imbalance in the availability, utilisation, and/or restoration of resources needed to perform activity'*.

In the thematic analysis of *Mumsnet Talk* in Figure 4.1., while no-one used the word 'fatigue', participants alluded to the inability to sleep when the opportunity arose (sub-theme 2.7), to feeling tortured (sub-theme 4.1), experiencing the '*body screaming with tiredness'* (sub-theme 6.2), needing to rest whenever possible (superordinate theme 7) and simply being unable to cope (sub-theme 10.6). Because of the sleep-related nature of the chosen *Mumsnet* discussion strings, it would seem reasonable to assume that at least some of the participants were experiencing sleep-disruption-related fatigue. While there is little published research specifically related to parental sleep disruption and cognition, there is growing and wide-ranging research literature into parental fatigue, based particularly in Australia, that sometimes implicates them. Consideration of this literature may give further clues about possible cognitive effects that bear at least some relationship to sleep disruption.

The ubiquitous nature of fatigue and its negative effects are well-documented in the research literature, especially in the post-natal period. In a study of over 500 Australian mothers, Taylor and Johnson (2012) found that fatigue correlated negatively with maternal night-time sleep hours and, by 6 months post-natally, 38% of mothers reported that they were having 6 hours or less sleep at night, although it is not known whether this was continuous or of good quality. A survey that helps to clarify this by Bayer, Hiscock, Hampton and Wake (2007) reported that over half of the Australian mothers (N = 692) of 3-6 month-old infants in the sample said they were woken by their infant five or more times per week. Mothers of infants with sleep problems were found to be in poorer physical and mental health but controlling for maternal sleep quality greatly reduced this relationship, thus it appeared to be crucial to the health status of mothers.

Giallo, Rose, Cooklin and McCormack (2013) extended their investigation to both mothers and fathers of children aged 0-6 years and found that they experienced unrelenting physical, mental and emotional fatigue that impacted on every aspect of their lives and relationships and that needed to be actively managed. In this relatively small sample of 13 mothers and six fathers, mothers found that they had few opportunities to take a break and fathers viewed going to work as respite although, for working mothers, other research (Sinai and Tikotvsky, 2012) showed that fatigue was no different to that of mothers on maternity leave. Some of these findings were further supported in a survey of over 10,000 infant and pre-school aged Australian children's sleep which found that problems were common and associated with poorer health in both mothers and fathers, particularly the mental health of mothers (Martin, Hiscock, Hardy, Davey and Wake, 2007). Further Australian studies (Cooklin, Giallo and Rose, 2012; Dunning and Giallo, 2012, Ward and Giallo, 2008) concur that parents' sleep disruption due to their children can continue until the children are at least six years of age, and the associated fatigue predicted parental stress, reduced feelings of parental competence and satisfaction and poorer parent-child interactions. Furthermore, unrealistic expectations about young children's sleep have also been found to be associated with fatigue (Giallo, Rose and Vittorino, 2011) and shifting these expectations downwards allegedly helped parents to cope better (Giallo *et al*., 2013).

Much of the sleep disruption and fatigue research has focused on executive functioning (EF), which Miyake *et al.* (2000: 50) define as '...*general purpose control mechanisms that modulate the operation of various cognitive sub-processes and thereby regulate the dynamics of human cognition*.'' while, at the same time, acknowledging that there is much disagreement about what EF comprises and what, exactly, its sub-processes are. In general, it is agreed that EF is involved in directing and controlling behaviour, often in novel situations, while non-executive functioning is involved in more routine and familiar situations of varying complexity. Anderson (2002) has proposed that there are three, key, inter-related sub-processes underlying EF, which are cognitive flexibility, information-processing and goal-setting, and all of these are underpinned by attentional control. Miyake *et al.* (2000:) proposed an alternative trio of set '*shifting'*, information '*updating'* and '*inhibition'* of pre-potent responses as related but separable EF sub-processes.

In studies of EF, the link with parental sleep disruption and/or fatigue is tangential, being drawn from participants who are not parents or based on parents' self-reports. Van der Linden, Frese and Meijman (2003), for example, subjected 58 Dutch undergraduates to just two hours of fatigue-inducing mental planning tasks. They found consequent increases in perserverative errors on the Wisconsin Card Sorting Test (WCST: Milner 1963), and in planning time on the Tower of London test (TOL: Shallice, 1982), and took these to reflect reduced executive control, especially as performance on a digit span test of memory, which does not call on the same mechanisms, was unaffected. In university students who self-reported fatigue, Hockey, Maule, Clough and Bdzola (2000) found an increased tendency towards risky decision-making about hypothetical everyday dilemmas that was largely unaffected by anxiety and depression. In a study particularly focusing on parents, Fisher, Feekery and Rowe (2004) found that self-reported daytime functioning and clarity of thinking were significantly impaired in mothers of babies aged up to 12 months who slept poorly, but these were much improved after a five-day residential intervention programme that specifically addressed infants' sleep patterns. If such findings can be transferred to other parents, cognitive impairments may render them less able to function effectively or even to help themselves. Giallo, Rose and Vittorino (2011: 245) concluded '*given that fatigue has the potential to affect cognitive* [executive] *processes such as clarity of thought, decision-making and problem-solving, parents may have more difficulty managing parenting challenges such as children's sleep problems'.* Kienhuis, Rogers, Giallo, Matthews and Treyvaud (2010) developed these ideas further in the context of the *Optimal Parenting Development model* (Commonwealth Department of Family and Community Services, 2004), which construes sleep deprivation and fatigue as just two of a number of adverse factors that can affect parenting effectiveness and thus children's development. Kienhuis *et al.* (2010: 393) propose that fatigue impairs executive functions, such as '*selective attention, planning, decision-making and cognitive flexibility'*, all of which affect parents' ability to respond effectively to the varied demands of their role.

In summary, studies of sleep disruption in parents tend to depend on anecdotal reports of, and speculation about, its potential effects on cognition (Bayer *et al.,* 2007; Cooklin *et al*., 2012, Dunning and Giallo, 2012; Giallo *et al*., 2013; Taylor and Johnson, 2012; Ward and Giallo, 2008). In addition, potentially important distinctions between the individual or combined effects of sleep disruption, sleepiness and fatigue have not been explored and the type of cognitive functioning which is affected is often unclear. Sleep-disrupted *Mumsnetters*, however, provided specific examples of the latter when they spontaneously raised concerns about aspects of their attention, memory, mood, language production and clumsiness (Tables 3.2. and 3.3.), but the prevalence and magnitude of these are unknown, neither is it clear how sleep disturbance, sleepiness and fatigue, either singly or in combination, might be associated with them.

5.1.2. Executive functioning, the prefrontal cortex and sleep

Executive functions, alluded to by Kienhuis *et al.* (2010), are known to involve activity in the pre-frontal cortex (PFC). Horne (1993) stated that studies involving total sleep deprivation (TSD: e.g. Blagrove, Alexander and Horne, 1991; Blagrove, Alexander and Horne, 1995; Harrison and Horne, 1999; Pilcher and Walters, 1997; Van Dongen, Maislin, Mullington and Dinges, 2003; Williamson and Feyer, 2000) indicate that human PFC function is especially vulnerable to the detrimental effects of TSD and derives particular benefit from recovery sleep. This became known as the 'PFC vulnerability hypothesis' (Horne, 1993). The PFC has complex connections with other cortical areas and has many functions. The primary ones are to maintain wakefulness and non-specific arousal and to act as "…*the executive co-ordinator of many cortical events*." (Harrison and Horne, 2000a: 246). Complex divergent tasks, compared to complex convergent tasks, appear to be particularly vulnerable to sleep loss (Harrison and Horne, 2000a). These include multi-tasking, responding flexibly to novel situations, planning, communication and risk assessment. Recovery sleep, but not increased effort by participants during sleep loss studies, restores these functions to normal levels. Other roles of the PFC, according to Horne (1993) are:

> …*planning, sensory comparisons, discrimination, decisions for action, direction and maintenance of attention at a specific task, execution of associated scanning eye movements, and initiation and production of novel goal-directed behaviour, (especially with speech). Of the senses, vision makes a particular demand of the PFC*… (Horne, 1993: 413.)

The PFC has the highest cerebral metabolic rate of any cerebral region whilst we are relaxed and alert and the lowest during sleep, especially during slow wave sleep (SWS) when we are in stages 3 and 4 of the sleep cycle. The associated delta wave activity, evident from EEG, readings is the most intense of any region and it is tempting to conclude that this activity performs a restorative function. The link, however, remains controversial e.g. in an extensive study of sleep deprivation and restriction in 21-38 year olds, Van Dongen *et al.* (2003) tested vigilance, working memory and cognitive throughput during TSD over three nights and fourteen nights limited to 4, 6 or 8 hours of sleep per night. In this unusually long-lasting study, they were able to show that, while three nights of TSD produced the biggest performance decrements and the 8 hour condition showed none, the 6 hour condition matched performance decrements after one night of TSD and the 4 hour condition produced decrements equivalent to two nights of TSD. This challenges the idea that we can adapt to restricted sleep and remain fully functional and, since delta wave activity changed little in response to sleep restriction, that it is restorative. Of additional practical concern to people experiencing everyday sleep restriction was the finding that, after a modest initial increase in self-reported sleepiness, participants in the 4 and 6-hour conditions did not change their self-assessments over the 14 days. Van Dongen *et al.* (2003), in agreement with Pilcher and Walters (1997), speculate that, given deteriorating performance, it is likely that participants failed to appreciate how sleepy they were, and this lack of insight could be one reason why people in general wrongly believe they can adapt to, and function adequately on, night after night of restricted sleep. Finally, it was postulated that it is not sleep debt that is responsible for the observed effects but excess wakefulness and that, on average, 15.84 hours or more of cumulative wakefulness was the critical point at which performance decrements were evident across all conditions.

5.1.3. The prefrontal cortex and real world functioning

Beebe and Gozal (2002: 4) proposed a model to explain how sleep disruption, specifically in obstructive sleep apnoea, but with wider applicability, could lead to everyday cognitive dysfunction. They argue that sleep disruption interferes with the allegedly restorative action of sleep on the PFC and this has adverse effects on at least six aspects of functioning: '...*behavioral inhibition, set-shifting, self-regulation of affect and arousal, working memory, analysis/synthesis, and contextual memory*'. These in turn are associated with a range of effects on everyday functioning, such as:

- *'Problems in mentally manipulating information*
- *Poor planning and haphazard execution of plans*
- *Disorganization*
- *Poor judgement/decision-making*
- *Rigid thinking*
- *Difficulty in maintaining attention and motivation*
- *Emotional lability ('mood swings')*
- *Overactivity/impulsivity (especially in children)'*

(Beebe and Gozal, 2002: 3)

In researching this, Horne (2012) stressed the importance of choosing measures of sleepiness carefully so that they reflect more accurately the complexity of daily tasks. He argued that cognitive tasks commonly used in research involve convergent or divergent thinking, and it is helpful to know that divergent tasks are relatively more adversely affected by sleep loss than convergent ones, even if both are complex, since convergent tasks may be dealt with by defaulting to well-rehearsed strategies that do not necessarily involve supervisory control or substantial PFC involvement. Horne explains that others '...*are only partly executive in nature, or only assess a single dimension of executive function and are 'non-supervisory' in nature (e.g. Sternberg working memory, Stroop colour test, digit-symbol substitution and simple verbal fluency tests). Furthermore, these tests are...somewhat divorced from the real world in not being 'ecological'.'* (Horne, 2012: 2227.) Horne also suggests that a reductionist approach, which focuses on one or a few aspects of EF, risks missing measurable effects of sleep loss because of the possibility that the *'...whole is greater than the sum of its parts.'* (Horne, 2012: 2227).

In an earlier study of the effects of 36 hours of sleep loss, Harrison and Horne (1999) tested individual performance on a demanding marketing game (Masterplanner) that required flexible decision making and innovative thinking. The concern that lay behind this test was whether there could be implications for real world settings, particularly in occupations in which it might be necessary to work through the night. Some occupations may demand decision-making and the ability to revise plans on the basis of evidence as well as dealing with the unexpected. Factors that might help to counteract sleep loss in such contexts could be the motivating, novel and interesting nature of such tasks. This led Harrison and Horne to question whether performance on tasks like this, which require divergent thinking such as innovation, flexibility and planning, would or would not be adversely affected by one night's sleep loss.

Ten young adult volunteers participated in two conditions, one in which they slept normally and the other in which they were sleep deprived for one night. Harrison and Horne were able to measure profitability and production errors throughout the game sessions as well as rigidity in response style and ability to respond to new information. Results showed that, following about 36 hours of sleep loss, there was a sudden drop in profitability, even leading to bankruptcy and having to stop the game. The sleep loss group showed more rigid responding with time, made more perseverative errors and became increasingly unable to adjust decisions in accordance with guidelines. The collapse of play in the sleep loss condition was thus marked by difficulties with innovative and flexible thinking. The participants also had problems with acting upon changing information even though it would appear that they had been able to assimilate it. The authors suggest that the PFC is implicated in these findings because of its supposed role in divergent thinking and dealing with novelty, innovation and the unexpected. The PFC is not, however, strongly associated with logical and critical reasoning and the fact that the data concerning this showed no change over the course of the study once again underlines the specific vulnerabilities of the PFC to even one night of sleep loss. Harrison and Horne conclude by recommending that people engaged in occupations that feature functions in which the PFC is heavily implicated should not work beyond 36 hours of sleep loss.

More recent research has attempted to use more ecologically valid tests and bears out the vulnerability of EF to sleep deprivation. Nilsson *et al.,* (2005) chose to test goal-directed, integrative EF after 31-32 hours of TSD. They used the modified 'Six Elements Test' (SET) devised by Shallice and Burgess (1991) and incorporated it into the Behavioural Assessment of the Dysexecutive Syndrome (BADS) test battery by Wilson, Alderman, Burgess, Emslie and Evans (1996). The SET had earlier been shown to be ecologically valid, via ratings of people who knew the tested individuals well (Burgess, Alderman, Evans, Emslie and Wilson, 1998). It consists of two tests each of dictation, simple arithmetic and picture naming. Participants are required to do at least some of each test in 10 minutes by switching between them but they must not do two of a kind consecutively. Number of rule breaks (maximum three), number of tests tried (maximum six) and maximum time on one test are measured. Nilsson *et al.* also tested vigilance and visuo-spatial and verbal working memory and found that, while none of these were affected by TSD, EF was significantly impaired. They concluded that, as the SET measures supervisory control and involves multi-tasking and responding to novelty, their findings support the PFC vulnerability hypothesis in ways that have relevance to everyday cognitive functioning in the real world.

Blatter, Opwis, Münch, Wirz-Justice and Cajochen (2005) also used a test that they argued was ecologically valid (a maze planning and completion task) because of its correlation with a driving proficiency task. They varied the level of difficulty and tested performance in 57-74 year olds when rested and after 40 hours of TSD. Planning time increased significantly after TSD only for the difficult mazes and did so in accordance with circadian rhythms, being worst at 8am. This finding is at odds with those of Drummond, Brown, Salamat and Gillin (2004) which claimed that increased difficulty in logical reasoning could be compensated for by the cortex. However, Blatter *et al.* suggest this could have reflected a confounding practice effect and their own results could have been due to greater circadian sensitivity in their older sample (as they had partialled out the practice effect by using alternate forms of the mazes).

In reviewing research into the effects of working through the night, Horne (2012) concluded that sleepiness alone, or its generic effects on attention and vigilance, could not account for deleterious effects on EF. Also implicated were alterations in the functioning of the PFC such that flexible responses to changing situations and the ability to ignore distractions, assess risk and keep track of negotiations were all compromised. Of particular relevance to parents is a study by Horne and Moseley (2011) who subjected young reservists to a simulated, military emergency at either 3am or 8.30am. Although well-rehearsed, routine task performance was unimpaired, tactical decisions, assessment of information and flexibility in the face of sudden change all suffered in what Horne and Moseley (2011: 275) called '...*a worst case scenario', combining short sleep, circadian 'trough' and sleep inertia'*. This *'early morning, sudden curtailed sleep'* (Horne 2012: 2229) is a feature of parenthood and could have far-reaching effects in the moment and throughout the following day.

Finally, another aspect of sleepiness–related cognitive functioning, with implications for interactions with others, is speech. After just one night, Blagrove *et al.* (1995) found that sleep deprived individuals showed impaired prosody (aprosodia) such that their speech lacked intonation, melody and variability. Speech typically became slurred, arrhythmic, quieter and lacking in affect. Harrison and Horne (1997) later focused on further study of these changes. Horne (1993) had earlier noted that aprosodia is also present in certain PFC deficits. In TSD studies, this disappears with recovery, implying that sleep is necessary to restore certain PFC functions. To this end, Harrison and Horne compared verbal word fluency (word generation from a given letter) and word articulation in reading a children's story in a group of nine volunteers following a night of TSD and a night of normal sleep. In the story reading, 'blind', volunteer raters assessed intonation, errors, volume, fatigue and pace. Findings indicated an increasing tendency in sleep deprived participants to generate semantically similar words in the verbal word fluency tests. This suggests an increasing inability to transfer attention to new ideas. There was also a significant reduction in verbal word fluency in the reading tests with particular respect to fatigue and intonation. Harrison and Horne point to the possible practical consequences of this. Just one night of sleep loss is sufficient to impair performance in certain neuropsychological tests, especially those involving novel responses. In addition, the ability to communicate clearly is impaired. A sleep-deprived person may sound disinterested and so fail to engage the listener. This could have important consequences, especially in situations where the well-being of others is at stake.

To summarise, Harrison and Horne (2000a) highlight key areas of concern in which sleep loss might affect pre-frontal cortex functioning in sleep-deprived individuals making decisions in the real world:

- Impaired language, and therefore communication, skills
- Lack of innovation
- Inflexible thinking
- Distractibility
- Perseveration
- Unwillingness to try new strategies
- Unreliable memory for when events have occurred
- Impaired ability to self-monitor performance
- Mood changes including loss of empathy with others
- Inability to deal with the surprising or unexpected
- Impaired personal insight
- Impaired awareness of what is feasible

They concluded by highlighting several disasters or near disasters (e.g. the loss of the Space Shuttle, Challenger, 1986) in which loss of sleep on the part of important decision-makers may have had a role to play. They also make the key point that the vast majority of laboratory-based research studies have used young adults, who are usually men, and who may not be representative of the many decision-makers who do not usually reach positions of major responsibility until well after their twenties. As a consequence, here and in a review by Jones and Harrison (2001), they highlight the need for research into a wider range of real-world settings and for studies that can determine the quality and quantity of sleep that would restore a sleep-deprived, prefrontal cortex to its full working capacity. Ideally, they say, tests of prefrontal (executive) functioning should include novelty (to avoid drawing on automatic processes), effort (to maintain and focus attention) and working memory demands (involving up-dating, monitoring and inhibition).

In summing up studies of laboratory-based TSD, Harrison and Horne (2000a) reiterated that research has reliably shown that performance in simple tasks such as vigilance and reaction time are particularly diminished by sleep loss, especially when the tasks are well practised and the testing conditions are monotonous. Participants are usually able to improve on their performance with effort, reward or encouragement, at least in short-term sleep loss. Short, and even longer, complex, rule-based tasks requiring divergent thinking also appeared to be not much affected, probably because participants find them more intrinsically interesting and can, again, overcome deficits in performance with effort. On the basis of such findings, it has tended to be accepted that sleep loss will not affect performance on tasks that include high-level decision-making and hence are demanding, complex and engaging. However, Harrison and Horne (2000a) point out that, even studies using complex tasks have tended to require participants to use rule-based, convergent thinking. In contrast, the kind of lengthy, flexible, innovative and responsive thinking used in the Masterplanner study (Harrison and Horne, 1999) and with reservists (Horne and Moseley, 2011) does appear to be adversely affected by sleep loss even when participants are known to be capable of assimilating new information and to be making extra effort in interesting thinking tasks. This is the kind of thinking that might have more direct relevance to certain contexts where sleep loss is a feature of the working environment e.g. for clinicians emergency workers and parents. Such occupations might also require controlled mood, avoidance of distractions, ability to assess a range of future consequences, risk assessment, speedy decision-making, insight into one's own performance, on-going interest in outcomes and the ability to communicate well.

Harrison and Horne argue that deficits in more complex, divergent thinking are probably not due to a breakdown in underlying lower level skills (e.g. aspects of attention or memory) since performance in these can be overcome with effort. Neither are these deficits likely to be the result of a sleep deprived cortex simply slowing down since compensatory effort does not appear to help. Horne (2012) has argued that there may be PFC activity changes linked to sleep loss that involve more than just sleepiness-related basic attention and vigilance and, furthermore, that other, non-PFC brain regions known to be affected by sleep loss (e.g. insula and nucleus accumbens) may also be involved in higher level EF and decision-making. These complex interactions led him to warn against viewing components of EF as fractionable.

More recent research has attempted to refine understanding of specific regions of the PFC that are vulnerable to sleep loss (Zukerman and Fostick, 2010; Hartstra, Oldenburg, Van Leijenhorst, Rombouts and Crone, 2010) and the mechanisms by which this might occur (Muzur, Pace-Schott and Hobson, 2002). Measures of cortical activity using functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) had been carried out but, until relatively recently, tended to concentrate on memory or attention functions (Chee *et al*., 2006) of less complexity than those suggested in the PFC vulnerability hypothesis. With regard to the latter, Zukerman and Fostick (2010) tested 13 young adults' performance on a battery of cognitive tasks thought to activate different PFC regions following 24 hours of sleep deprivation. Impairments in number cancellation and trail making tasks implicated attention-related DLPFC regions and speech comprehension deficits implicated the ventrolateral PFC but gambling task performance, thought to activate the orbitofrontal PFC, was unaffected, all of which suggested differing effects on PFC regions. Telzer, Fuligni, Lieberman and Galván (2013) have recently linked lower DLPFC recruitment with increased risk-taking in adolescents reporting poor quality sleep, and Venkatraman, Chuah, Huettel and Chee (2007) linked raised responses in the right nucleus accumbens (a non-pre-frontal region) to expectation of reward, and lowered ones in the insular and orbitofrontal cortices to losses, following riskier decisions after 24 hours of sleep deprivation in young adults.

In a meta-analytic review, Alvarez and Emory (2006) considered research evidence published since 1951 suggesting diverse and complex relationships, which they describe as '*fuzzy*', between the frontal lobes and EF. They identified three main prefrontal circuits that are implicated in this. The dorso-lateral PFC (DLPFC) appears to be involved in '*...verbal and design fluency, ability to maintain and shift set (as* *measured by the WCST), planning, response inhibition, working memory, organizational skills, reasoning, problem-solving, and abstract thinking...'.* The ventromedial circuit has a role in aspects of motivation and damage to it can result in '...*apathy, decreased social interaction, and psychomotor retardation'.* Finally, the orbitofrontal circuit is implicated in '*socially appropriate behaviour'* and damage to it may result in *'...disinhibition, impulsivity, and antisocial behavior'* (Alvarez and Emory, 2006: 18). They stress that these circuits are just one aspect of the EF system and are underpinned by many other cortical, sub-cortical and brain-stem structures. Their review concerned lesion and neuroimaging studies that used three established EF tests: the WCST, the Phonemic Verbal Fluency test and the Stroop test and concluded that the WCST was the strongest indicator of frontal lobe functioning followed by Phonemic Verbal Fluency and then Stroop. They also stress however, that in their view, this does not necessarily indicate that EF is fractionable but should, instead, be seen as a '*macroconstruct'* (Alvarez and Emory, 2006: 32) involving many interacting processes and neural structures. Since not all the studies they reviewed are in agreement, such tests are, therefore, better construed as good, but not exclusive, indicators of specific executive functions which are, themselves, not exclusively confined to the frontal lobes.

Lateralisation in the DLPFC is not yet well documented but Nebel *et al.* (2005) provided evidence that right hemisphere activation, indicative of attentional processes, increased with task complexity and Cieslik *et al.* (2012: 8) say that there is growing evidence of increased right DLPFC activation in such activities as '...*monitoring operations...and resolution of conflict during motor response execution'* which they sum up as '*cognitive action control'*. Since sleepiness has been linked to greater vigilance in the right hemisphere for basic visual attention processes (Manly *et al.,* 2005; Dufour *et al*., 2007) it is feasible that DLPFC lateralisation changes could also affect performance of more complex, executive tasks.

Non-executive and EF are affected differently by sleep disruption in both laboratory and real-world settings. It is not known whether sleep disruption, sleepiness and fatigue in parents have similar, measurable effects and whether, by implication, PFC vulnerability may play a part in this (Harrison and Horne 2000a; Horne, 1993; Jones and Harrison, 2001; Van Dongen *et al*., 2003). Sleep disruption has been linked to changes in higher-level EF (Horne, 2012, Jones and Harrison, 2001). If this is the case for parents, it should be possible to measure both of them and to show that more complex executive tasks are more vulnerable to detrimental effects of disrupted sleep. As a separate but related issue, arising from work linking sleepiness and pseudoneglect (Manly *et al.,* 2005; Dufour *et al*., 2007; Casagrande and Bertini, 2008a, 2008b), the effects of sleep disruption should also be evident in changes in spatial awareness, a basic attentional process that Nicholls *et al.* (2007, 2008) linked to different 'bump' rates when navigating through doorways and which may have relevance to sleep disturbed *Mumsnetters*' complaints about *Clumsiness* (superordinate theme 16, see Table 3.3.)

While there has been some research into sleep disruption in real-world settings, little has been done to investigate either simple or complex cognitive effects of this in parents of babies and young children. The studies discussed so far involved laboratory-based TSD or sleep curtailment, or were field studies and surveys, which depended mainly on self-reports of sleep patterns, stress, mood and marital quality and largely ignored cognitive effects of sleep disruption. Laboratory-based PSD is high in control but tends to use healthy volunteers and orderly, predictable sleep curtailment (e.g. Muzur *et al.,* 2002). This does not reflect the kind of unpredictable, real-world sleep fragmentation experienced by people who could sleep well but are disturbed by other things or people. A rare exception is an experimental study into cognitive effects of parental sleep patterns carried out in Germany by Plessow, Kiesel, Petzold and Kirschbaum (2011). They recruited 106 parents of infants aged 6-18 months and divided them into two groups depending on their self-reported sleep in the previous six months (average < 7 and ≥ 7 hours per night). They employed a task switching test of executive function in which participants had to decide if a series of digits was larger or smaller than five (magnitude) or odd or even (parity). Testing order was randomised so that sometimes the task was repeated and sometimes it was switched. This was in order to see how well participants could '*flexibly implement task goals'* (Plessow *et al.*, 2011: 3) when having to change from judging parity to magnitude or *vice versa*. There were no discernible differences between the two sleep groups in mean reaction time, mood, sleepiness, stress level, night-time wakenings, daytime naps, age, gender, education level and infant age, but task-switching costs were greater in the sleep curtailed group. Furthermore, there was a negative correlation between switch costs and self-reported sleep hours in the previous six months. Chronic sleep curtailment, therefore, led to a decreased ability to respond flexibly in a fast-changing environment; a finding that could have practical implications in everyday, demanding situations such as when driving or caring for others. As there were no differences in the subjectively perceived cognitive potential of the two groups, it would appear that participants were unaware of the effects of their sleep curtailment; a finding that has featured in other studies (Van Dongen *et al*., 2003; Pilcher and Walters, 1997).

The unresolved issues in the literature reviewed so far centre on a lack of understanding about how everyday sleep disruption impacts on cognitive functioning. This gave rise to the two studies reported in this chapter. The paucity and disparity of research in the area of cognitive correlates of sleep disruption in parents meant that the Study 1 was largely exploratory, focusing on subjective, self-reports of parents' sleep disruption, daily cognitive functioning and mood, and possible distinctions between their association with sleep disruption, sleepiness and fatigue. Study 2 was designed to investiagate whether different levels of sleep disruption, sleepiness and fatigue predicted performance on simple, objective tests of cognition, acknowledging that, at this early stage of research, it was not possible to follow Horne's (2012) recommendation that measures should reflect the complexity of everyday tasks.

A number of decisions were made about which variables to measure in these two studies based on the thematic analysis of *Mumsnet Talk* as well as existing research literature. These are further elaborated in the following two sections.

5.1.4. Study 1: Rationale for measures

Study 1 comprised an online questionnaire survey of mothers using *Mumsnet Talk* and *Netmums*. The questionnaire included a range of general demographic questions and questions about sleep and incorporated a number of established scales. For most questions, participants were asked to consider the past week as it was felt that this could easily be recalled and would capture the episodic nature and range of parents' sleep disruption. A week was also likely to be long enough for effects of sleep disruption to be apparent e.g. Harrison and Horne (1998, 1999) had shown that just one night of TSD could impair test performance and, in a field setting, McCann (2008) had shown detrimental effects in parents 'sleeping in' for one night with their hospitalised children. Lee et al. (2007) had shown similar effects over three to ten days, and Horne and Moseley (2011) had shown that responses to one complex and demanding incident, when participants would have otherwise been sleeping, were similarly impaired. It was also thought that limiting time to one week would elicit more precise responses than in the study by Plessow et al. (2011) in which participants were questioned about their sleep in the previous six months.

5.1.4.1. Demographic variables and sleep patterns.

In a sample of over 5000 Swedish adults, Kronholm et al. (2009) found that the relationship between self-reported sleep factors and subjectively reported and objectively measured cognitive functioning weakened with the addition of gender, age and educational level, but Taylor and Johnson (2012) found that, for reasons that were unclear, fatigue was positively correlated with age and education level, thus it was thought to be important to account for them in this study. Wade, Giallo and Cooklin (2012) recommended asking family structure questions to help contextualise parents' experiences, even though they had themselves found little evidence to link these with fatigue and had, instead, discovered that sleep disruption was the main predictor. It was nevertheless thought to be important to ask these questions in order to make comparisons with the study by Wade et al. and to investigate possible distinctions between primiparous and multiparous women as found by Taylor and Johnson, (2012). Questions were also asked about weekly hours typically spent in employment and self-employment and the constitution of the family to give some indication of the demands placed on parents as workers and caregivers. Although Mumsnet and Netmums are British in origin, they are available to anyone with Internet access so geographical location was requested.

In accordance with recommendations by Van Dongen et al. (2005: 483) individual sleep preferences were requested including 'chronotype', 'somnotype' and 'trototype', quality and continuity of sleep, nap time, sleepability and sleepiness (using the Epworth Sleepiness Scale, Johns, 1991). Van Dongen et al. (2005: 480) also suggested that preferred sleep duration fell into four main types '…short sleepers who fall asleep early, short sleepers who fall asleep late, long sleepers who fall asleep early and long sleepers who fall asleep late', so questions about preferred sleep times were asked so that these could be calculated. Van Dongen et al. (2003) had also suggested that an individual measure of sleep debt could be calculated from preferred sleep hours, vulnerability to sleep loss and actual sleep time so questions were asked to allow for this. Parents were then asked similar questions but with regard to their actual sleep pattern and place of sleep in the previous week. They were asked to report frequency and duration of disturbances by their child(ren) aged under 5 years and, if applicable, by their child(ren) aged 5 to 17 years and by adults aged 18 years or over and say how disruptive they felt this was. Where exact values such as times, frequencies or hours could not be given, 1-10 Likert scales were used with a 'not applicable' option where appropriate.

5.1.4.2. Fatigue.

Many studies have measured fatigue in the post-partum period (e.g. Gay, Lee and Lee, 2004; Giallo, Rose and Vittorino, 2011) and Troy (2003) thought its impact at this time was poorly understood. Giallo, Rose, Cooklin and McCormack (2013) found that mothers and fathers with children aged 0-6 years saw fatigue as qualitatively different but related to the effects of sleep disruption, and Giallo, Wade, Cooklin and Rose (2011) showed that fatigue symptoms were also separate from but related to depression symptoms in 228 Australian mothers within one year post-partum, at least in the particular indicative rather than diagnostic measures that they chose. Wade, Giallo and Cooklin (2012) found that sleep quality was an important discriminator between mothers with different combinations of fatigue and depression and was worst in those who scored highly in both. For these reasons fatigue was measured using the Fatigue Assessment Scale (FAS: Michielsen, De Vries, Van Heck, Van de Vijver and Sijtsma, 2004) which has a Cronbach's alpha value of .87 based on 1893 Dutch participants aged 16-87 years and has been evaluated as appropriate for mothers in Australia (Giallo, Wade, Ward and Kienhuis, 2008).

5.1.4.3. Action slips and memory failures

TA of Mumsnet discussion strings showed that participants most frequently identified attention-related action slips and unreliable memory (Table 4.2) as consequences of sleep disturbance so, although the Cognitive Failures Questionnaire (CFQ: Broadbent, Cooper, FitzGerald and Parkes, 1982) had been used in previous studies in this thesis, it was thought that its generality and bias towards memory failures made it unsuitable for distinguishing between them. As a consequence it was decided that the Attention Related Cognitive Errors Scale (ARCES) and the Memory Failures Scale (MFS) (Cheyne, Carriere and Smilek, 2006), both later revised by Carriere, Cheyne and Smilek (2008) should be substituted. In a meta-analytic study, Smilek, Carriere and Cheyne (2010) claimed the ARCES '...is a specific and conceptually meaningful measure of attention-related errors distinct from memory related errors (MFQ) [sic]...and is thus a suitable replacement for the CFQ in studies seeking to measure everyday attention-related cognitive failures.' (Smilek et al., 2010: 2569). In addition, some of the 12 items on each of the ARCES and the MFS were derived from the original CFQ and new ones reflect action slips and memory failures identified by Mumsnet participants such as 'I have gone to the fridge to get one thing (e.g. milk) and taken something else (e.g. juice)' and 'Even though I put things in a special place I still forget where they are'. The ARCES and the MFS have high internal consistency with alpha reliability coefficients of .89 and .86 respectively (Cheyne et al., 2006: 586).

5.1.4.4. Clumsiness.

Clumsiness was a superordinate theme identified by Mumsnetters in Table 3.3 and, as this would be difficult to test directly online it was decided to ask self-report questions on bumps and collisions. Nicholls et al. (2007, 2008) attributed the tendency to bump into doorways on the right when passing through them to pseudoneglect. Furthermore, greater right-side bumping tendency predicted greater leftward bias in manual line bisection performance, a task that is also susceptible to pseudoneglect. If attentional asymmetry changes when individuals are sleepy, side of bumping should also be affected. It has been suggested by Manly et al. (2005), Dufour et al. (2007) and Casagrande and Bertini (2008a, 2008b) that a lateral shift in spatial attention occurs because the right hemisphere remains more vigilant than the left when sleepy. If this also affects navigation in peri-personal space, more right-side bumps would be expected in sleepier people. Questions were asked about this as well as when driving the family car (forward and in reverse) since a car could be considered an extension of peri-personal space (Stancey and Turner, 2010) and Mumsnetters had raised the issue of risky driving when tired. In addition, Rogé, Pébayle, Kiehn and Muzet (2002) and Rogé, Pébayle, El Hannachi and Muzet (2003) had shown that drowsiness and TSD led to less efficient central field vision and increased ‘tunnel vision’ (Rogé et al. 2002: 189) when driving in foggy conditions, such that detection of central and peripheral visual-field stimuli in general deteriorated. For these reasons, respondents were asked to report incidences of bumping or collisions when driving over the past week, but in conditions of good visibility. The possibility that cars might not necessarily be right-hand drive and driven on the left, as in the UK, was also accounted for.

5.1.4.5. Handedness

As part of the general questionnaire, and in keeping with previous studies in this thesis, handedness was assessed because Thiebaut de Schotten et al. (2011) had shown that attention pathways were lateralised to the right in 65% of the participants assessed as right-handed using the Edinburgh Handedness Inventory (EHI: Oldfield, 1971). As this could have some bearing on bumping into things and attention-related neuropsychological tests, an assessment of handedness was made. To address concerns about the reliability of two of the original EHI items (i.e. using a broom, opening a box lid) and the high correlation between writing and drawing (Dragovic, 2004) an updated version of the EHI was used (Williams, 2011). Writing alone was retained and the use of a computer mouse or touchscreen was added.

5.1.4.6. Mood

Since mood has been frequently connected with sleep patterns in the research literature, it was thought to be important to assess anxiety and depression along with some additional variables. Mumsnetters had identified depressive symptoms most often but had also mentioned anxiety and worry and sufficient physical symptoms to warrant a separate superordinate theme in the TA (Table 5.2). In addition, Giallo et al. (2011) had provided evidence that depressive and fatigue symptoms were both related to and distinct from each other and Taylor and Johnson (2012) had highlighted the importance of distinguishing depressive symptoms from anxiety in supporting mothers, as anxiety was particularly strongly associated with fatigue in multiparous women. In order to address these possible distinctions, mood measures were based on Clark and Watson's (1991: 316) 'tripartite' model which separates somatic anxiety and positive affect (its opposite being anhedonia) from general distress all of which Babson Trainor, Feldner and Blumenthal (2010) had connected with sleep deprivation. The original Mood and Anxiety Symptoms Questionnaire (MASQ-90: Watson et al., 1995a, 1995b) for measuring the three components of the tripartite model was considered to be too long for an online questionnaire so a briefer version, the Anxiety Depression Distress Inventory (ADDI-27: Osman et al., 2011), was selected. This was developed using a non-clinical sample of American men and women aged 18-47 years and each nine-item scale had an internal reliability estimate of between .85 and .92. Concurrent validity between the three subscales and established mood scales was also good and the scales were well-discriminated from each other.

5.1.4.7. Executive functioning

Self-assessment of executive functioning is possible using the Dysexecutive Questionnaire (DEX). This is a part of the Behavioural Assessment of the Dysexecutive Syndrome (BADS) test battery by Wilson et al. (1996). The BADS is intended to assess functioning in individuals with Dysexecutive Syndrome (DES; formerly 'frontal lobe syndrome') resulting from frontal lobe damage. Shallice (1982) suggested that the characteristic pattern of responses to the DEX could arise from deficits in attention-based, supervisory, executive control functions and, although the condition is complex and varied, it typically involves problems with working memory, abstract thinking, problem-solving and reasoning, set maintenance and shifting, response inhibition and verbal and design fluency and organizational skills (Alvarez and Emory, 2006). Wilson et al. (1996) opined that many tests of executive function, such as the Stroop Test (Stroop, 1935; Golden, 1978). and the Wisconsin Card Sorting Test (Grant and Berg, 1948) tend to be short, focused, closely guided and sometimes performed successfully by people with known DES and so may not be indicative of typical, everyday situations when planning and organisation of behaviour over longer time periods may be necessary.

There are six tests in the BADS purporting to assess such abilities, e.g. the 'Rule Shift Card Test' and the 'Six Elements Test', and performance on these is collated to give a BADS profile score. The DEX is an additional questionnaire and is the only component that can be self-administered. It poses 20 questions, each of which Burgess et al. (1998: 549) claim measures a different aspect of functioning. The DEX has two forms, one for the individual with DES (DEX) and one for someone who currently knows them well (DEX-R). Wilson et al. (1996), however, validated the test on the latter because they found that people with DES tended to underestimate their problems, possibly due to reduced insight, giving themselves M (SD) DEX = 27.21 (14.48) compared to others' M (SD) DEX-R = 32.85 (15.98). (Mdn = 25 and 33 respectively). Other people's DEX-R ratings also correlated with performance on other tests in the BADS while DEX self-ratings did not. Wilson et al. argue that the DEX has ecological validity (specifically, transferability to everyday settings) and the DEX-R also has 'testimonial validity' (Elliott, Fischer and Rennie, 1999: 219) i.e. confirmation by test-takers, although this is by proxy.

In reviews of the BADS by Chamberlain (2003) and Crawford and Henry (2005) it was queried to what extent the test had been validated on individuals with known frontal lobe or EF problems, as opposed to other kinds of brain injury, but it was acknowledged that the test's construct validity was comparable to that of other established tests. Norris and Tate (2000) also queried the validity of the test because, with one exception, they failed to find correlations between others' DEX-R ratings and BADS test scores, but they did acknowledge that the 'others' varied greatly in how well they knew the person they were assessing. This was borne out by Barker, Morton, Morrison and McGuire (2011) who demonstrated the influence of selection of 'others' on DEX ratings. Reliability of the DEX is not reported in the BADS manual although

Bodenburg and Dopslaff (2008) reported split-half reliability at r = .85 and concluded that self-ratings, at least, show high reliability. With regard to the validity of the DEX in non-clinical groups, Burgess et al. (1998) found that self-ratings of healthy participants were typically higher than 'others'' ratings whereas 'others' rated clinical cases higher than these cases rated themselves. Assuming that dysexecutive symptoms operate on a continuum, and can be meaningfully measured in non-clinical groups, Chan (2001) administered the DEX and DEX-R to 93 healthy Chinese adults and found that DEX-R ratings by 'others' tended to be lower than self-rated DEX. On a 0-80 point scale, Chan found M (SD) DEX scores = 22.13 (8.86) and M (SD) DEX-R scores = 20.61 (10.52). In comparison with the figures given by Wilson et al. (1996) for their clinical group, healthy M DEX is 5.08 points lower and healthy M DEX-R is 12.24 points lower but, without formal clinical assessment of individuals, the accuracy of these assessments is unknown. Burgess et al. (1998) gave slightly lower (graphical only) figures for 216 healthy UK residents that follow a similar pattern (M DEX ≈ 21 and M DEX-R ≈ 17).

The underlying factor structure of the DEX and DEX-R is still open to debate. Using DEX-R scores, based on ratings of their UK patient group by 'others', Wilson et al. (1996) proposed behaviour, cognition and emotion factors all of which were predictive of the total BADS profile score. Bodenburg and Dopslaff (2008: 76), however, used DEX self-ratings from brain-injured individuals and, having dropped two statistically troublesome questions, found four factors that they named '...initiating and sustaining actions, impulse control and sequencing, psychophysical and mental excitability and observance of social conventions'. They recommended further checking of the factor structure of the DEX-R (ratings by 'others'), but it should also be borne in mind that the original DEX had been translated into German. Using DEX-R scores for non-clinical, Chinese participants, Chan (2001) found a five factor solution: inhibition, intentionality, knowing-doing dissociation, in-resistance (e.g. perseveration) and social regulation that compared well with the three of the five factors (inhibition, intentionality, and executive memory) found in UK clinical samples by Burgess et al. (1998), who had also added positive and negative affect.

5.1.5. Study 2: Rationale for measures

In Study 2 participants responded to the same online survey as Study 1 participants and completed a series of neuropsychological tests chosen for the following reasons.

Superordinate theme 11 identified hallucinations, visual disturbances and nocturnal disorientation attributed to sleep deprivation or disturbance (Table 3.3) in roughly 20% of 108 Mumsnet Talk participants posting between February 2010 and December 2011. Sixty per cent (12/20) of these described visual hallucinations. Spontaneous postings about hallucinations from October 2004 to May 2012 confirmed that, of all hallucinations reported, visual ones were the most frequent (35/48 = 73%). While interesting and apparently common, such experiences are not easily testable and were not pursued further. Similarly, superordinate theme 13 (Nocturnal disorientation/reality check) was not followed up although both themes could be potentially informative in future research. The remaining superordinate themes, however, were more amenable to testing and these were (12) Action slips, (14) Unreliable memory and (15) Language production problems. Superordinate theme 16 (Clumsiness) was assessed by the ’bumping’ questions in the general questionnaire.

Horne (2012) advised that divergent and complex tasks assessing everyday functioning are more likely to show vulnerability to sleep loss. He warned that fractionation of executive functions could ignore the argument that the ‘whole is greater than the sum of its parts’ and Alvarez and Emory (2006) talked of EF as a ‘macroconstruct’. For these reasons, the Dysexecutive Questionnaire (DEX: Wilson, et al., 1996: 20) was chosen in study 1 as a measure of functioning in everyday life, which the authors say indicates ‘ecological validity’. Others, such as Jackson et al. (2013: 222) however, think that it is important to ‘deconstruct’ executive tasks to ‘...help to bridge the gap between laboratory research and field application’. Following a long tradition of examining separate aspects of EF, Burgess et al. (1998) argued that, if EF is fractionable, executive and dysexecutive tests should tap different functions and so it makes sense to choose carefully from the available options, at least those that reflect inhibition, executive memory and intentionality.

Harrison and Horne (2000a) say that, ideally, tests of EF should include novelty (to avoid drawing on automatic processes), effort (to maintain and focus attention) and working memory demands (involving up-dating, monitoring and inhibition). Three tests that would appear to involve these, and a variety of other facets of EF, are the Wisconsin Card Sorting Test (WCST), the Tower of Hanoi (TOH) and a test of phonemic verbal fluency. While all these tests demand non-executive encoding and attention and executive working memory, the WCST requires divergent thinking, the Tower of Hanoi is essentially a convergent thinking test and verbal fluency, especially if it is phonemic, can be considered a divergent test. Whitney and Hinson (2010: 38) debate the ‘task impurity problem’ due to overlapping of test demands. They say that the WCST involves mental flexibility via set-shifting, the TOH involves planning and phonemic verbal fluency requires cognitive flexibility while all three demand inhibition. Together, these tests, all of which are considered next, address facets of EF involving behavioural action sequences, memory malfunctions and language problems, as identified by Mumsnet Talk participants, and cover both divergent and convergent thinking, the latter of which, according to Horne (2012), should be relatively less associated with sleep disruption.

5.1.5.1. Wisconsin Card Sorting Test

The Wisconsin Card Sorting test (WCST) is thought to involve many aspects of executive functioning (EF) including problem-solving, cognitive flexibility, sustained and selective attention, working memory, inhibition and response maintenance and shifting (Alvarez and Emory, 2006). In the original WCST (Grant and Berg, 1948) participants are shown an array of four cards displaying symbols that differ by colour, number and shape. They are given a pack of 128 more cards that they have to match, one at a time, to one of the four cards. They are not told whether the matching rule is colour, number or shape, and have to discover it by trial and error using feedback from the test administrator who states whether they are right or wrong after each attempt. After 10 correct matches the rule is changed without notice and participants are required to respond accordingly. The test is not timed but ends when six category matches have been made or all the cards have been sorted. Measures taken are the number of categories identified, number of conceptually correct responses, total perseverative errors and total non-perseverative errors. Milner (1963) later used the WCST in assessment of prefrontal lobe dysfunction and a shortened version was developed by Heaton (1981) and Heaton, Chelune, Talley, Kay and Curtis (1993). Nelson (1976) developed a modified version (the MCST) for clinical groups in which participants are told when the category has changed. Obonsawin et al., (1999) established norms for the MCST using a sample of 146 healthy British participants. They found that category identification was negatively skewed with 57% achieving six category matches. Perseverative and non-perseverative errors were both positively skewed with Mdn = 14 and 6 respectively.

With regard to the ecological validity of the WCST, evidence is mixed and sometimes combines brain-injured and non-brain injured groups. Using a sample of 216 healthy and 92 brain injured individuals, Wilson et al. (1996) found that WCST scores did not predict any of the three DEX-R factors (behaviour, cognition and emotion) indicating, as they had suggested, that the WCST assesses executive functions differently. Burgess et al. (1998) used the MCST (Nelson, 1976) and found a highly significant correlation between the categories measure and total DEX-R scores in a clinical group (N = 78). However, when the DEX-R was broken down by their three factors of inhibition, intentionality and working memory, all three of the MCST measures correlated with working memory alone. Chaytor, Schmitter-Edgecombe and Burr (2006) found that total DEX-R scores did not correlate with MCST perseverative errors (chosen as the most purely executive measure) in a clinical group of 46 Americans. Norris and Tate (2000) also compared the DEX-R with the WCST and found no correlation between them in 36 healthy and 37 brain injured Australians.

Crawford and Henry (2005: 235) describe the WCST as ‘an old warhorse’ with an ‘extensive research base, good norms, moderate sensitivity’ and ‘ecological validity’ but ‘potentially confusing for clients’ and with ‘poor specificity’. In a review of clinical and neuro-imaging studies Nyhus and Barceló (2009) stated that, although the WCST is implicated in many facets of EF, it lacks specificity as it does not distinguish well between frontal and non-frontal lesions and activates widespread cortical areas. Nyhus and Barceló debated how to improve the construct validity of the WCST with respect to executive prefrontal functions by suggesting refinement of such things as perseveration measures, improved scoring and using technological advances to define more precisely which networks of brain regions are involved in various components of WCST performance. This is currently ‘a work in progress’. Meanwhile, Alvarez and Emory, (2006) concluded that, reservations aside, the WCST is currently the strongest predictor of frontal lobe functioning followed by verbal fluency then the Stroop Test.

5.1.5.2. Tower of Hanoi

The Tower of Hanoi (TOH: Humes, Welsh, Retzlaff and Cookson, 1997; Newell and Simon, 1972) was used as a convergent test of executive functions including supervisory attention (Chan, Shum, Toulopoulou and Chen, 2008) and planning and inhibition (Whitney and Hinson, 2010). In its simplest form, the TOH consists of a row of three vertical posts. On the left post there is a stack of disks that increase regularly in size from top to bottom. The participant’s task is to transfer all the disks from the left to the right post so that the arrangement remains the same. To do this they must use one hand only to move the disks, one at a time from post to post, and never place a larger disk on top of a smaller one. There are a minimum number of moves required for different numbers of disks e.g. a three disk problem can be solved in seven moves and a four disk problem in 15 moves. The number of moves and time to completion are commonly used performance measures. Other versions of the TOH involve asking participants to reproduce a variety of arrangements and the internal reliability of such tests can thus be contested e.g. Humes et al. (1997) claimed a reliability coefficient of $r = .90$ whereas Welsh and Huizinga (2001) claimed that $r = .40$ was more likely and, in their revised version, $r = .77$. There is a trade-off to be considered between a one-off TOH test, which is relatively less demanding of participants, as opposed to a more demanding multiple-problem version such as that used by Welsh and Huizinga. In this case, a single, three disks test was used mainly for familiarisation followed by a single four disks test that was deemed to be appropriate and of sufficient difficulty for the participants. There was thus a small element of practice but a novelty element, said to be important in tests of EF (Harrison and Horne, 2000a), was retained.

There is some debate about what executive functions are involved in completing the TOH. In a sample of American college students, Zook, Davalos, Delosh and Davis (2004) found that a working memory test (pair-finding in a set of cards) and an inhibition test (a card-sorting, perserverative measure) were significant predictors of the number of TOH moves in a computerised, four-trial, five-disk test, but Welsh, Satterlee-Cartmell and Stine (1999) found an association with inhibition alone on 12 three- and four-disk tests also in college students. Differing measures of executive functions, versions of the TOH and ways of administering tests may account for some of these discrepancies in results and explain why they are only partly supportive of each other. In addition neither paper reported the handedness of participants. Wright et al. (2004) found that sinistrals took longer than dextrals to initiate a TOH task but completed it with fewer errors and in similar times, with males being faster than females. This underlines the importance of screening participants' handedness prior to testing.

5.1.5.3. Phonemic verbal fluency test.

A number of studies (e.g. Troyer, Moscovitch, Winocur, Alexander and Stuss, 1998) have suggested that phonemic fluency is impaired more than semantic fluency by frontal lobe lesions. A meta-analytic review of focal, cortical lesion research by Henry and Crawford (2004) partially concurred in that, although the weight of the evidence was in favour of consequent deficits in both phonemic and semantic fluency, left, frontal lobe damage tended to impair phonemic fluency in particular and semantic fluency was more vulnerable to temporal lobe damage. The decision was therefore made to use a phonemic fluency test in this study as it was judged to be at least as sensitive as a semantic test and possibly more so. Alvarez and Emory (2006) stated that verbal fluency tests are amongst the most commonly used EF tests and Crawford and Henry (2005: 236). The chosen test was similar to the Controlled Oral Word Association Test (COWAT: Benton, de Hamsher and Sivan, 1994; Borkowski, Benton and Spreen, 1967) described by Crawford and Henry (2005: 236) as 'another old warhorse' with an 'extensive research base' and 'good norms', 'high reliability', 'moderate sensitivity' and 'moderate ecological validity'. The phonemic version of the COWAT asks participants to generate as many words as possible in one minute beginning with a given letter, most commonly, F, A and S, with alternatives of P, R and W or C, F and L. Proper names and the same word with different endings are not permissible. The phonemic fluency test is thought to be a relatively novel task which is highly demanding of executive functions although Crawford and Henry (2005: 236) say 'the literature is full of contradictions' as to why this might be. Henry and Crawford (2004) suggest that it '...requires efficient organization of verbal retrieval and recall as well as self-monitoring aspects of cognition (the participant must keep track of responses already given), effortful self-initiation, and inhibition of responses when appropriate' all of which are executive processes. In addition, phonemic verbal fluency performance has been shown to have some ecological validity as it correlated positively with DEX-R scores (Burgess et al., 1998; Chaytor et al., 2006; Norris and Tate, 2000) and appeared to be a better indicator of frontal lobe dysfunction than the WCST (Henry and Crawford, 2004). Furthermore, Ross, Furr, Carter and Weinberg (2006) and Pace-Schott et al. (2009) showed that internal, inter-rater and alternate forms reliability of the test were high at $r \geq 0.70$, and Ruff, Light, Parker and Levin (1996) found a test-retest reliability over 6 months of $r = .74$. Norms for the FAS and CFL versions of the test are provided by Troyer (2000) and for CFL and PRW by Ruff et al. (1996) and metanorms for the FAS are given by Loonstra, Tarlow and Sellers (2001). Finally, there are a number of ways in which verbal fluency can be scored in order to reveal different cognitive processes. Total number of words can be broken down into size of phonemic clusters and general errors, both thought to indicate non-executive functioning. It is also possible to count switching between clusters and perseverative errors indicating cognitive (in)flexibility and 'set shifting', which are both aspects of EF (Ross et al., 2006; Troyer, Moscovitch and Winocur, 1997) and particularly vulnerable to frontal lobe damage (Troyer, et al. 1998).

5.1.5.4. Working memory test.

Working memory is a facet of cognitive functioning that features in executive tasks in general so a simple convergent test was chosen to assess it while acknowledging that even a simple task such as this demands up-dating, monitoring and inhibition (Harrison and Horne 2000a). Dorrian, Rogers and Dinges (2005) say that working memory is dependent on both the functioning of dopamine receptors in the dorso-lateral PFC and executive attention. They say it is fundamental to any goal-directed task and predictive of performance in a range of other commonly used tests of cognitive function. In a simple test of working memory, Zook et al. (2004) used a computerised card game in which participants were presented with an array of 24 cards bearing 12 matching pairs of abstract shapes. The cards were presented face down and participants were required to turn over two cards at a time to find matching pairs in as few moves and as quickly as possible. After each unsuccessful attempt, cards were turned back over and after each successful attempt they were removed. A similar online test, from the freely available website 'Games for the Brain', consisting of 18 image pairs was used here. It recorded the number of attempts made, percent success-rate and time taken to completion.

5.1.5.5. Line bisection test

The line bisection (LB) test from the Behavioural Inattention Test Battery (Halligan, Cockburn and Wilson, 1991) was used as a test of pseudoneglect in peri-personal space. It consisted of landscape-oriented, A4 sheets of white paper on which there were three, staggered, black, 0.75 point horizontal lines each 206mm long, one being centrally placed and the other two in the top right or bottom left of the page beginning 15mm from side edge and positioned at 40mm from the top or bottom edge. Since left bisection errors tend to increase with the length of the line to be bisected and may even 'cross over' to a right bias with very short lines, (Heber, Siebertz, Wolter, Kuhlen and Fimm, 2010; Jewell and McCourt, 2000; McCourt and Jewell, 1999), 206mm was chosen as middle of the range of typically tested lengths. Lines placed to the left and right of centre modify the leftward bias effect and any differences between sleepy and rested individuals should become apparent. Participants are asked to make a vertical pencil-mark on each line to indicate where they think its centre point is. Normal judgement of the midpoint of the centrally placed line is slightly to the left of centre and is indicative of pseudo-neglect (Bowers and Heilman, 1980). A mirror image version of this test was also made so that five page positions were covered. Participants were unlikely to have encountered the LB test before and so their responses would arguably be a more objective test of cognitive function and less likely to be influenced by expectations about their own sleep-related performance.

5.1.6. Research predictions

The following predictions were made for studies 1 and 2:

- Study 1: Parents' self-reported everyday attention, memory and mood will be associated with sleep disturbance, sleepiness and fatigue.
- Study 2: Detrimental effects of sleep disturbance, sleepiness and fatigue will be greater in cognitive tasks demanding higher levels of executive processing, including language production.
- Study 2: Sleep disturbance, sleepiness and fatigue will be associated with changes in spatial attention and with clumsiness in the form of bumps and accidents.

5.2. Study 1: Method

5.2.1. Study 1: Design

An online questionnaire, using *Bristol Online Surveys* (Copyright © University of Bristol) software, was devised to survey sleep patterns and experiences in parents of babies and young children the content of which was informed by, and refined on the basis of, findings in chapter 4 and the rationale given in section 5.1.3. This allowed for direct comparison with findings from *Mumsnet Talk* participants. The survey link was posted online throughout July and August 2013 on *Mumsnet* (www.mumsnet.com) and *Netmums* (www.netmums.com), both of which were founded in 2000 and are active, UK-based, social networking, advice and support websites for parents attracting millions of views per day.

The questionnaire and procedures for Study 1 were approved by the Bath Spa University School of Society, Enterprise and Environment Ethics Committee. (See Appendix E.) The British Psychological Society's (BPS) *Code of Human Research Ethics* (2011) was followed in the conduct of this research and, as the questionnaire was online, it was supplemented with the BPS's *Guidelines for Ethical Practice in Psychological Research Online* (2007). The online questionnaire was also approved by *Mumsnet* and *Netmums* following the researcher's agreement to register with both websites, credit them in any publications and protect the identity of discussion participants. (See Appendix H.) According to the BPS, internet mediated research (IMR) can be classified on two dimensions with regard to participants who are either identifiable or anonymous and either recruited or unaware. Study 1 participants were anonymous and recruited via an advertisement (see Appendix I) that explained the researcher’s university affiliation, academic status, data protection procedures and purpose of the proposed research. Anonymity enabled participants to express themselves freely, but their identities could not be verified and they could not withdraw data once they had completed the survey. Debriefing in the form of a research summary (Appendix K) was given to *Mumsnet* and *Netmums,* at which point protection of participants was paramount. It would have been unacceptable to cause them undue anxiety about the negative effects of sleep disruption so it was vital to word the research summary sensitively and equivocally.

5.2.2. Study 1: Participants

To provide continuity with findings from *Mumsnet Talk* participants (Chapter 4), on which this study was based, mothers alone were selected. The decision was made to recruit parents with at least one child aged under five years because children were still likely to be disrupting parents’ sleep at that age (Crowe, Clark and Qualls, 1996; Rona, Gulliford and Chinn, 1998; Kahn *et al.* 1989). It was stipulated that participants must:

- be aged 18 years or over.
- have no formally diagnosed mental or physical health problems.
- not be taking medication that affects sleep or mood.
- have no sleep disorders such as insomnia, sleep apnoea, restless legs syndrome, night terrors or sleep walking.
- have parental responsibility for and live with at least one child aged under five years.
- have child(ren) who were in good health with no formally diagnosed sleep problems and not on medication that affects sleep.
- have spent nights during the week prior to completing the questionnaire with their child(ren) in their usual home (i.e. not on holiday, staying with friends or relatives, on night-shifts or in any other atypical situation).

N = 126 self-selected, volunteer, participants responded to online invitations to complete the survey in the *Media Requests* section of *Mumsnet* and the *Coffee House Chat* section of *Netmums*. For Study 2, 37 participants also completed the online survey making a total of N = 163 for Study 1. In both studies, participants were asked to recruit another adult who knew them well, such as a spouse, partner, parent or friend, to answer a brief questionnaire about the respondent's everyday functioning. If such a person was unavailable, those questions remained unanswered. These 'other adults' were informed of, and protected by, the same ethical safeguards as the respondents themselves. Participant characteristics are shown in Table 5.1.

5.2.3. Study 1: Materials

A questionnaire survey comprising general demographic questions, questions about sleep and a number of scales was constructed (see Appendix I). Where relevant, participants were asked to consider the preceding week as the time period over which to judge their functioning.

5.2.3.1. Demographic and sleep questions

Demographic questions were asked about participants' age, gender and educational level. Further questions were asked about family structure, parity, weekly hours typically spent in employment and self-employment. Geographical location was also requested.

Information about individual sleep preferences was requested including '*chronotype'*, *'somnotype'* and '*trototype'*, quality and continuity of sleep, nap time, sleepability and sleepiness (using the Epworth Sleepiness Scale, Johns, 1991, as described in chapters 2 and 3). Parents were then asked similar questions but with regard to their actual sleep pattern and place of sleep in the previous week. They were asked to report frequency and duration of disturbances by their child(ren) aged under 5 years and, if applicable, by their child(ren) aged 5 to 17 years and by adults aged 18 years or over and say how disruptive they felt this was. Where exact values such as times, frequencies or hours could not be given, 1-10 Likert scales were used with a 'not applicable' option where appropriate.

5.2.3.2. Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS: Johns, 1991) was used twice to measure sleepiness as part of an individual's normal sleep patterns and to measure current sleepiness. Respondents rate their chances of dozing or sleeping in eight common situations such as sitting and reading or watching TV. Each item is scored on a four point scale ranging from 0 to 3 so totals cores on this scale range from 0 to 24 with ≥ 11 being the criterion for sleepiness.

5.2.3.3. Fatigue Assessment Scale

A 10-item Fatigue Assessment Scale (FAS: Michielsen *et al.,* 2004) was incorporated into the questionnaire. Responses are made on a scale ranging from 1 to 5 (never to always) to items such a 'I am bothered by fatigue'.This scale is thought to measure a single fatigue factor (Giallo, Wade, Ward and Kienhuis, 2008).

5.2.3.4. Attention Related Cognitive Errors Scale and Memory Failures Scale

The Attention Related Cognitive Errors Scale (ARCES) and the Memory Failures Scale (MFS) (Cheyne, Carriere and Smilek, 2006), both later revised by Carriere, Cheyne and Smilek (2008) were included in the questionnaire. The ARCES consists of 12 statements such as 'I make mistakes because I am doing one thing and thinking about another'. The MFS consists of 12 statements such as 'I forget what I went to the supermarket to buy'. On both scales, participants respond to each item on a five point scale ranging from 1 (never) to 5 (very often).

5.2.3.5. Clumsiness

To measure clumsiness, questions were asked about frequency of bumps to one's head or left or right side whilst moving around independently as well as when pushing something such as a baby buggy or shopping trolley. Questions were also asked about frequency of bumps and near misses when driving the family car (forward and in reverse) over the past week and in conditions of good visibility. The geographical location of the respondent was recorded to ensure that drivers were in the UK and therefore almost certainly driving on the left in right-hand drive cars.

5.2.3.6. Edinburgh Handedness Inventory (revised)

An updated version of the EHI was used (Williams, 2011). Participants are asked to consider which hand they use to perform eight activities such as 'throwing' and describe how they do each one using a five-point scale ranging from 'always left' to always right'. Responses are scored as -50 (always left), -25 (usually left), 0 (no preference), 25 (usually right) and 50 (always right). The eight scores are added together and divided by 100 to give a score ranging from -100 (complete left handedness) to +100 (complete right handedness).

5.2.3.7. Anxiety Depression Distress Inventory

The Anxiety Depression Distress Inventory (ADDI-27: Osman *et al.*, 2011) consists of a mixture of 27 items describing feelings, sensations, experiences and problems, each of which is responded to on a five point scale ranging from 1 (not at all) to 5 (extremely). The scale yields three sub-scale scores for positive affect (ADDIpa, e.g. 'Felt really good about myself') somatic anxiety (ADDIsa, e.g. 'Was trembling or shaking' and general distress (ADDIgd, e.g. Was disappointed in myself'.

5.2.3.8. Dysexecutive Questionnaire for self and other

The Dysexecutive Questionnaire (DEX: Burgess, 1998) consists of 20 questions, each measuring a different aspect of functioning. Participants respond to each question on a

0 to 4 point scale ranging from 'never' to 'very often', e.g. 'I lose my temper at the slightest thing'; 'I have trouble making decisions or deciding what I want to do'. The DEX-R poses the same questions about the respondent but is completed by someone who knows them well, such as a spouse or partner, good friend or adult family member.

5.2.4. Study 1: Procedure

Permission was gained from *Mumsnet* and *Netmums* to recruit participants via their websites (Appendix H). The invitation to participate was located under a link headed 'Mothers of under 5s, how do you sleep? How do you feel?' and was live from July to December 2013 inclusive. From this link, participants accessed the detailed invitation, consent form, questionnaire and debrief shown in Appendix I and completed it on a desktop or laptop computer. At the end of the questionnaire, participants were asked, if possible, to recruit a suitable adult to answer the DEX-R. These individuals were also asked to consent to taking part and were informed of the ethical procedures that had been followed in order to protect them.

5.3. Study 1: Results

5.3.1. Demographic data

Survey participant characteristics are summarised in Table 5.1. Study 2 data are also presented for ease of comparison. The vast majority of the 163 mothers who took part were living in the UK with their partner and young children. Work hours per week were positively skewed around Mdn = 12 and educational qualifications were negatively skewed with over half of participants possessing post-graduate qualifications.

5.3.2. Preferred and actual sleep patterns

Participants were asked to describe their preferred, normal sleep pattern and their current sleep experiences over the past week and these were compared in t-tests (see Table 5.2.). With the exception of bedtime and somnotype (ability to fall asleep easily) these showed highly significant differences. Participants were getting up earlier and experiencing shorter periods of unbroken sleep, night-time sleep, daytime naps and overall sleep than they thought was normal for themselves. They also judged their current sleep to be of poorer quality and felt they could resist sleep (trototype) less easily than normal ($p \leq .001$, one-tailed). The same pattern occurred in the sub-sample in Study 2 ($p \leq .05$, one-tailed).

Table 5.1.
Participant Characteristics in Studies 1 and 2

Demographic variables	Study 1 (N = 163)	Study 2 (N = 37)
Age in years: M (SD) and Range	34.47 (5.27) Range = 20-49	33.92 (4.02) Range = 24-46
Number of children: (M, % under 5 years of age) and family size Range	287 (1.76, 73%) Range = 1-5	56 (1.51, 86%) Range = 1-3
Age of children in years: Mdn and Range	3 Range = 0-15	2 Range = 0-11
Weekly employment hours: M (SD) and Range	14.65 (14.93) Range = 0-50	11.49 (11.92) Range = 0-40
Highest educational level (n, %)		
GCSE	9 (6%)	2 (5.5%)
A level	12 (7%)	2 (5.5%)
Up to first degree *	55 (34%)	10 (27%)
Postgraduate (e.g. Masters, PhD) and higher	87 (53%)	23 (62%)

Note: Study 2 N is a sub-set of Study 1 N. * Includes qualifications such as DipHE, nursing and non-postgraduate teaching.

In the sample as a whole, and during the preceding week, 16% reported no sleep disturbance, 55% reported being disturbed by their under 5s alone and 80% by their under 5s as well as other family members. Sleep disturbance by under 5s on four to seven nights was experienced by 66% of mothers. On a scale of 1-10, under 5s were the greatest source of sleep disturbance for mothers (Mdn = 7) compared to both other cohabiting children and adults (Mdn = 1 for both, $Z \geq 2.60$, $p < .001$, two-tailed).

Adults, however, were statistically the second greatest source of disturbance, an effect which is likely to be due to a small number of individuals who may have had sleep problems of their own. With a few exceptions, children aged 5 and over disturbed their mothers' sleep very little. Mothers' Mdn estimate for lost sleep in the past week due to under 5s was 2.5 hours but in this skewed data, 50% were losing considerably more.

Table 5.2.

Normal (Preferred) and Current Sleep Patterns: M (SD) and Reported Range

	Study 1		Study 2	
Sleep variable	Normal	Current	Normal	Current
Bed time (24 hour clock)	22.45 20.00-02.00	22.40 20.50-02.00	22.35 21.30-01.00	22.30 20.30-24.00
Rise time (24 hour clock)	08.00 06.00-10.30	06.25 04.50-09.00	08.00 06.30-10.30	06.20 04.30-08.00
Longest unbroken sleep (hrs.)	7.78 (1.74) 1.30-12.00	5.43 (1.91) 0.50-9.75	7.97 (1.73) 4.00-12.00	5.92 (1.71) 3.00-9.00
Sleep duration per night (hrs.)	9.32 (0.97) 7.00-12.50	7.78 (1.02) 5.00-10.25	9.44 (0.90) 7.50-11.50	7.80 (0.77) 6.50-9.50
Daytime naps (hrs.)	0.36 (0.57) 0-2.00	0.17 (0.32) 0-2.00	0.34 (0.55) 0-1.75	0.19 (0.35) 0-1.43
Total sleep in 24 hours (hrs.)	9.67 (1.15) 8.00-14.00	7.96 (1.11) 5.00-11.11	9.77 (0.97) 8.50-12.50	8.00 (0.84) 6.75-10.21
Sleep quality	8.48 (1.54) 4-10	5.12 (2.21) 1-10	8.84 (1.09) 5-10	5.92 (2.01) 2-10
Somnotype	7.34 (2.20) 1-10	7.07 (2.90) 1-10	7.51 (2.20) 2-10	7.70 (2.40) 1-10
Trototype	6.52 (2.54) 1-10	5.77 (2.92) 1-10	6.76 (2.65) 1-10	5.86 (3.09) 1-10
Chronotype	5.34 (2.54) 1-10		5.27 (2.73) 1-9	

Note: Study 1 N = 163. Study 2 N = 37.

5.3.3. Sleep disturbance, fatigue, sleepiness and mood as prdictors of self-rated cognitive and everyday functioning

Results from scales used in Study 1 are presented in Table 5.3. As would be expected in a non-clinical group, distributions of scores for DEX and DEX-R, ADDI General Distress (ADDIgd) and Somatic Anxiety (ADDIsa) tended to be positively skewed. Taylor and Johnson (2012) had suggested that parity was relevant to the well-being of mothers, but there were negligible differences on these scales between primiparous and multiparous mothers. Exceptions were for ESS and ARCES suggesting that multiparous mothers were slightly more sleepy (by 2.5 scale points) and reported slightly more attention-related errors (by 3 scale points) than primiparous mothers ($p = .05$). Correlations between fatigue, age and education level, also suggested by Taylor and Johnson (2012), were not evident.

Parenting under 5s is strongly associated with sleep disturbance, sleepiness and fatigue. These have variance in common, being positively correlated with each other ($r_s \geq .35$, $N = 163$, $p < .001$, two-tailed), but they have been distinguished in the literature (e.g. Bayer *et al*., 2007; Cooklin *et al.*, 2012; Giallo *et al*., 2013; Sinai and Tikotvsky, 2012) often enough to merit separate consideration. Of these 163 mothers, 34 (21%) were categorised as neither fatigued, sleepy nor disturbed and 35 (22%) were all three. Only three mothers (2%) were classified as just sleepy or sleepy and disturbed so these were excluded from Table 5.3. There is an upward trend in ESS, FAS, disturbance, ARCES, MFS and DEX and a downward trend in ADDIpa discernible from comparing means from conditions 1 through 6 in Table 5.3.

Harrison and Horne (2000a) stressed the importance of taking mood into account in sleep research and this has been borne out by others (e.g. Giallo et al., 2011; Taylor and Johnson, 2012). Linear regressions were therefore conducted to explore how combinations of factors might work together to predict each of the cognition scales. Results are shown in Table 5.4. As suggested by the upward trend in Table 5.3, fatigue is strongly predictive of ARCES and MFS and the addition of sleepiness further strengthened this relationship. ADDIgd and ADDIsa, along with FAS, were highly significant predictors of DEX scores with ADDIpa making a slightly weaker but still significant contribution,

Table 5.3

Scale Ranges, Cronbach's Alpha and M (SD) for ESS, FAS, MFS, ARCES, ADDI, DEX and DEX-R Scale by Disturbance, Sleepiness and Fatigue

Scale	Scale range	Alpha	1.Not disturbed fatigued or sleepy	2. Disturbed only	3. Fatigued only	4. Fatigued and disturbed	5. Fatigued and sleepy	6. Disturbed, fatigued and sleepy
ESS	0-24	.80	3.41 (3.18)	6.00 (2.25)	5.27 (3.33)	5.71 (3.78)	13.33 (1.41)	13.83 (2.57)
FAS	10-50	.90	16.03 (2.32)	17.17 (6.07)	24.15 (3.91)	26.97 (7.05)	24.22 (2.53)	26.83 (5.79)
DIST	1-10	—	2.82 (0.99)	7.83 (1.34)	3.46 (1.53)	8.05 (1.29)	2.89 (1.05)	8.34 (1.47)
ARCES	12-60	.86	27.18 (7.55)	29.94 (7.73)	31.73 (7.78)	36.76 (7.40)	35.44 (5.61)	38.40 (8.89)
MFS	12-60	.90	23.47 (5.87)	26.72 (7.99)	31.85 (8.50)	32.89 (7.59)	33.00 (4.58)	34.69 (8.01)
DEX	0-80	.87	12.12 (7.86)	14.06 (9.98)	17.32 (6.06)	20.29 (11.65)	23.78 (9.79)	20.46 (10.40)
ADDIpa	9-45	.90	28.21 (5.98)	29.88 (9.15)	22.52 (6.35)	20.95 (5.28)	21.22 (6.55)	21.57 (6.34)
ADDIgd	9-45	.90	14.76 (4.33)	14.65 (5.12)	19.16 (7.01)	21.39 (7.67)	20.22 (4.89)	20.66 (7.53)
ADDIsa	9-45	.77	11.09 (2.96)	12.47 (4.63)	12.80 (3.86)	13.92 (5.33)	14.89 (4.22)	13.91 (4.58)
N (%)	—	—	34 (21%)	18 (11%)	26 (16%)	38 (23%)	9 (6%)	35 (22%)
DEX-R	0-80	.90	11.92 (6.65)	15.25 (16.46)	13.80 (9.65)	13.75 (8.74)	21.40 (9.76)	18.52 (13.83)
N DEX-R	—	—	13	8	10	12	5	25

Note: Total N = 160 and N DEX-R = 73. ESS: Epworth Sleepiness Scale; FAS: Fatigue Assessment Scale; DIST: Sleep disturbance by under 5s; FAS: Fatigue Assessment Scale; MFS: Memory Failures Scale; ARCES: Attention Related Cognitive Errors Scale; ADDIpa, ADDIgd and ADDIsa: Anxiety Depression Distress Inventory positive affect, general distress and somatic anxiety; DEX and DEX-R: Dysexecutive Questionnaire for self and independent rater.

indicating that increases in emotional tone of any kind were predictive of increases in DEX. DEX-R was not predicted by sleep disturbance, FAS, ESS or any of the mood scales. (Adjusted R^2 = .04, p = .21, N = 74). Sleep disturbance was excluded from the models for all of the scales but it was predictive of ARCES, MFS and DEX, in combination with ADDIgd in particular, when FAS and ESS were not included (Beta = .22 to .38; Adjusted R^2 = .18 to .37, p ≤ .004).

Table 5.4

Fatigue, Sleepiness and Mood as Predictors of Self-reported Cognitive Functioning

Scale: predictor	*Beta*	*Sig.*
ARCES: FAS	.45	< .001
ARCES: ESS	.24	= .001
MFS: FAS	.49	< .001
MFS: ESS	.22	= .001
DEX: FAS	.31	<.001
DEX: ADDIgd	.30	< .001
DEX: ADDIsa	.25	=. 001
DEX: ADDIpa	.17	=.02
Scale, final model predictors	*Adjusted R^2*	*Sig.*
ARCES: FAS, ESS	.32	= .001
MFS: FAS, ESS	.34	< .001
DEX: ADDIgd, ADDIsa, FAS, ADDIpa	.42	<.001

Note: N = 160. ADDIgd, ADDIsa and ADDIpa: Anxiety Depression Distress Inventory general distress, somatic anxiety and positive affect; ARCES: Attention Related Cognitive Errors Scale; DEX: Dysexecutive Questionnaire; MFS: Memory Failures Scale.

5.3.4. Bumps, driving incidents and accidents

Accurate recall of bumps to self, or collisions while pushing something forwards, such as a baby buggy or shopping trolley, in the past week was difficult for some mothers. However, out of the whole sample (N = 163), 36% reported bumps to their right or left side or head and 25% said they had had bumps while pushing something. Side of bumps was investigated as Nicholls *et al.* (2007, 2008) had suggested that this might become more lateralised with sleepiness. Right-handed participants who scored 80% or more on the handedness scale only were included in the following analyses. Numbers of right and left-side bumps to self differed significantly from zero ($p < .001$, one-tailed) and did not differ between groups divided according to whether they were more vs. less sleepy, fatigued or disturbed by under 5s ($p \geq .50$). Numbers of bumps when pushing something also differed significantly from zero ($p \leq .002$, one-tailed). When participants were both sleepy and fatigued they reported more lateralised than head-on bumps in general. Compared to head-on bumps there were more right-side bumps ($Z = 2.38$, $N = 10$, $p = .02$, two tailed) and only a marginal tendency towards more left side bumps ($Z = 1.72$, $N = 15$, $p = .09$, two-tailed) but numbers of left and right bumps did not differ. No such pattern was observed in people who were just fatigued or neither sleepy nor fatigued and there were insufficient numbers of 'just sleepy' participants for meaningful analysis. When participants were divided into groups on the basis of whether they were more or less disturbed by their under 5s, no patterns were observed in the less disturbed group. In the more disturbed group, however, there were more right-side bumps than head-on bumps ($Z = 2.46$, $N = 20$, $p = .01$, two tailed) and a slightly lesser tendency towards more left-side bumps than head-on bumps ($Z = 2.10$, $N = 30$, $p = .04$, two-tailed) but numbers of left and right bumps were generally low ($Mdn \leq 2.5$ per week) and did not differ.

The association between disturbance by under 5s group (yes/no) and fatigued and/or sleepy (yes/no) with regard to occurrence of any kind of bump to self was highly significant ($X^2_{(1)} = 17.56$, $N = 59$, $p < .001$, two-tailed); the disturbed group was 25 times more likely than the undisturbed group to report bumps to self when sleepy/fatigued than when they were neither (OR = 25.00). With regard to occurrence of any kind of bump when pushing something, although numbers were too low for reliable testing for association ($N = 40$), the disturbed group was more than twice as likely as the undisturbed group to report bumps when sleepy/fatigued than when they were neither (OR = 2.44).

Of the 134 drivers, 22 (16%) reported a total of 15 bumps or near misses while driving forward and 13 while reversing during the past week. Eighty-two per cent of these incidents were reported by participants who were fatigued, sleepy or both. When split by level of sleep disturbance due to under 5s, 57% of incidents were reported by the more disturbed group. There was a significant association between fatigue/sleepiness and disturbance by under 5s such that the more disturbed group was over nine times more likely than the less disturbed group to report bumps and near misses when sleepy/fatigued than when they were neither ($X^2_{(1)} = 6.47$, $N = 22$, $p = .01$, two-tailed); ($OR = 9.17$). Lateralisation effects could not be tested due to the limited data sample.

Finally, accidents during the past week, which included minor bumps, cuts, bruises, burns and falls due entirely to oneself were reported by 26 (16%) of participants. It was notable that 7 (27%) of them happened to mothers who were neither sleepy nor fatigued and 19 (73%) to those who were fatigued or both fatigued and sleepy. A roughly even 12/14 (46/54%) split was observed for accidents recalled by mothers who were less or more disturbed by their under 5s respectively. When the association between disturbance group (yes/no) and fatigue and/or sleepiness (yes/no) with regard to frequency of accidents was explored, it was found that the disturbed group was nearly twice as likely as the undisturbed group to report an accident when also sleepy/fatigued than when they were neither ($OR = 1.88$) although, again, numbers were low. Nevertheless, there is some support for an association between sleepiness and superordinate theme (16) *Clumsiness*, identified by *Mumsnet Talk* participants.

5.4. Study 1: Discussion

In Study 1, 163 participants described a current sleep pattern that differed from their normal, pre-parental pattern in every respect and to their detriment. During the preceding week, only one in 10 mothers had slept undisturbed by others and this was largely due to their under 5s' sleep patterns, to a lesser extent to that of their partners and hardly at all to older children.

Fatigue, sleepiness and sleep disturbance are correlated with each other but also have unique variance so assessment of their relative contributions was attempted. Self-reported levels of fatigue, sleepiness and sleep disturbance with respect to everyday attention, memory and EF indicated that the presence of fatigue significantly increased

ARCES and MFS scores and the addition of sleepiness further strengthened the relationship. Increases in DEX scores were positively correlated with ADDIgd and ADDIsa and to a lesser extent with ADDIpa. The presence of fatigue further strengthened this model. These findings offer some quantitative support for the suggestions made by Fisher, Feekery and Rowe, (2004), Giallo et al. (2011) and Kienhuis et al. (2010) in their studies of Australian parents. Analyses confirmed the importance of fatigue, followed by sleepiness, in predicting ARCES and MFS. Disturbance and ADDIgd predicted ARCES, MFS and DEX when sleepiness and fatigue were not included in the calculations. The prediction of DEX by fatigue, as well as by all three ADDI mood scales, suggested that executive functions were strongly associated with emotional elements although the direction of cause is unknown since heightened emotions could be as distracting as EF problems are emotive. ARCES and MFS were not associated with emotion scales, possibly because everyday action and memory slips may be at best amusing and at worst irritating but rarely worrying in the same way that problems with DEX factors, such as reduced inhibition and intentionality (Burgess et al., 1998; Chan, 2001), might be. In a meta-analysis, Pilcher and Huffcutt (1996) suggested that sleep deprivation affected mood more than cognitive functions but, in this case, negative mood was the strongest predictor of DEX alone but with the causal direction unclear.

In summary, superordinate themes identified in Table 3.3: (12) Action slips and (14) Unreliable memory, which Mumsnet participants had attributed to being ‘sleep deprived’, were corroborated using ARCES and MFS, which are high-quality, valid and reliable measures. In addition to this, measures on the three ADDI scales supported superordinate themes in Table 5.2 (5) Depression, anxiety and worry and (6) Physical symptoms associated with fatigue and linked these with everyday EF through the DEX.

5.5. Study 2: Method

5.5.1. Study 2: Design

For Study 2, participants completed the same online questionnaire as in Study 1 followed by a battery of neuropsychological tests that could only be administered face-to-face. The questionnaire and procedures were approved by the Bath Spa University School of Society, Enterprise and Environment Ethics Committee. (See Appendix E.) The British Psychological Society's (BPS) Code of Human Research Ethics (2011) was followed in the conduct of this research. Debriefing in the form of a research summary (Appendix K) was given to participants in Study 2 who had expressed an interest in knowing the results. The summary was carefully worded with due consideration for protection of participants.

5.5.2. Study 2: Participants

For Study 2, 37 participants were recruited by advertisement from amongst the researcher's university colleagues and by snowball sampling thereafter. Inclusion criteria were the same as for Study 1. Participant characteristics are shown in Table 5.1.

5.5.3. Study 2: Materials

In Study 2, participants completed the same online questionnaire survey as in Study 1. They also completed the WCST, TOH, phonemic verbal fluency test, working memory test and the line bisection test described in section 5.1.5.

5.5.4. Procedure

Immediately prior to taking these tests participants were asked about previous intake of caffeinated or energy drinks since waking as this had the potential to affect performance. Participants were also asked to state how long they had been awake for in order to measure cumulative wakefulness. Time of testing was recorded and current sleepiness was assessed in the general questionnaire. (Van Dongen et al., 2003). Lee (1998) and Lee and Kryger (2008) had stressed the importance of hormonal influences in pregnancy, childbirth and early motherhood and womanhood in general as potential influences in sleep research but female participants were not asked about these things as it was felt to be too intrusive.

In Study 2, the online questionnaire was completed within two hours of testing by the majority of participants, although some elected to complete it at the time of the researcher's visit. The WCST, TOH and working memory tests were presented on a Lenovo Thinkpad T520 laptop with a 15.6 inch screen, 1366 x 768 pixel resolution and screen refresh rate of 50Hz. Participants were asked to position themselves directly in front of the computer, so that their gaze was directed to the centre of the screen, and to sit at their usual comfortable viewing distance from it. The LB tests were completed with paper and pencil, and the participants gave oral responses to the verbal fluency test which were timed and written down by the researcher. The five elements of the test battery were presented to participants in random order.

5.5.4.1. Wisconsin Card Sorting Test

A computerised, 128 card version of the Wisconsin Card Sorting Test (WCST: CV4; © Hogrefe Ltd., 2013) was used. The instructions for administering this are as follows, with the researcher indicating cards on screen as appropriate:

'This test is a little unusual because I am not allowed to tell you very much about how to do it. You will be asked to match each of the cards that appear here [lower central screen] to one of these four key cards [across top of screen]. Using the mouse, point to the key card that you believe matches this card. Once you have made your choice, press the left mouse button to make your selection. The computer will place your card under the key card that you select, and a new card will appear at the bottom of the screen. If you wish to change your answer before the card stops moving, immediately click anywhere on the screen. You will then be permitted to select again. However you may not change your answer after the card stops moving.

I cannot tell you how to match the cards, but the computer screen will tell you each time whether you are right or wrong. If you were wrong, simply try to match the next card correctly and then continue matching the cards correctly until the test is over. There is no time limit on this test. Are you ready? Let's begin.' (Heaton et al., 1993).

The WCST: CV4 automatically calculates scores for the total number of cards administered, correctly sorted cards, trials to complete the first category, categories completed and failures to maintain set. It also gives totals and percentages for errors (E), perseverative responses (PR), perseverative errors (PE), non-perseverative errors (NPE) and conceptual level responses (CLR).

5.5.4.2. Tower of Hanoi.

An online version of the TOH was chosen from the website 'Games for the Brain'. Participants were presented with an image of the TOH showing a row of three posts (towers) with disks stacked on the left one (Tower 1) and are instructed on screen thus: 'The objective of the game is to move the entire stack of disks from Tower 1 to Tower 3. You can only move one disk at a time. No disk may be placed on top of a smaller disk. A disk is moved between towers by drag and drop'. They were asked to complete the game in as few moves as possible and as quickly as possible bearing in mind that there was a speed-accuracy trade-off (Alhola and Polo-Kantola, 2007). All participants were presented with a three-disk problem first followed by a four disk problem. Timing began as soon as participants engaged with the task so that planning time in seconds was recorded manually. The number of moves made to reach the solution and execution time in seconds was recorded automatically. If the four-disk problem had not been completed in six minutes participants were asked to stop.

5.5.4.3 Phonemic verbal fluency test.

Standardised instructions for the phonemic verbal fluency test were based on those given by Ruff et al. (1996) for the COWAT. Participants were told that they would be given a letter of the alphabet and they should say as many words as possible, of any length and beginning with that letter, in one minute. They were asked not to use proper names such as 'Bristol' or 'Barbara', or the same word with different endings, such as 'cruise' and 'cruising', and to persevere for the whole minute even if they made a mistake or had a mental blank. The letters chosen were F, A and S and were presented to participants one at a time in randomised order. Digital timing began as soon as this instruction had been stated: ‘Please say as many words as you can think of that begin with the letter F for foxtrot’ (or ‘A for alpha’ or ‘S for sierra.’) and continued until the timer signalled that a minute had passed. The total number of allowable words was then calculated as well as the total number of switches, mean word-cluster size and percentage of errors (non-allowable words). A word-cluster was defined as recommended by Troyer et al. (1997) as two or more consecutive words which:

- began with the same two letters (e.g. ‘sing’ and ‘simple’
- differed only by vowel sound (e.g. ‘flop’ and ‘flip’)
- were homophones (e.g. ‘sear’ and ‘seer’)
- were rhymes (e.g. ‘slip’ and ‘skip’)

A switch was counted each time a participant made a transition between un-clustered words, from one cluster to another, from a clustered to an un-clustered word and vice versa. Cluster size was determined as the number of words in a cluster minus one.

5.5.4.4. Working memory test.

An online ‘Memory Pairs’ game similar to the card-matching test used by Zook et al. (2004) was chosen from the website ‘Games for the Brain’. ‘Image set 2’ was selected which consisted of 18 matching pairs of pictures of animals, scenery and everyday objects. Participants were presented with an on-screen array of 36 blank ‘tiles’ arranged in a six by six grid. They were instructed to ‘Find pairs of images under the following tiles. Click on two tiles to find two matching pictures’. The images were randomly distributed in the grid. After the participant had mouse-clicked two ‘tiles’, non-matching pairs reverted to being blank after one second and matching pairs disappeared from the screen. Timing began on the first click and then participants had unlimited time in which to think about their first and second choice of card. They were asked to complete the game in as few moves as possible and as quickly as possible bearing in mind that there was a speed-accuracy trade-off (Alhola and Polo-Kantola, 2007). Time taken to complete the test, the number of attempts and the percentage of these that were correct were recorded automatically.

5.5.4.5. Line bisection.

Participants completed four manual LB tasks, two in the original form and two in its mirror image. Test papers were presented to seated participants at desk-top height and placed mid-sagitally by the experimenter. Verbal instructions were given, indicating which starting position to use and asking participants to use their right hand to place a short, vertical, pencil stroke where the perceived exact mid-point of each line was. Starting position (left or right) was equalised on both versions of the test and while this does not control for where scanning is initiated, or how it progresses across line positions (Jewell and McCourt, 2000; Brodie and Dunn, 2005), it does allow some control over which cerebral hemisphere is favoured at the outset of the task. Participants were left to find their own strategies for completing this task and these would inevitably vary (Varnava and Halligan, 2009). Use of the right hand, however, was required in order to control it as a possible source of bias, since exclusive use of the left hand has been shown to exaggerate pseudoneglect (McCourt, Freeman, Tahmahkera-Stevens and Chaussee, 2001). All paper and pencil tests were completed in glare-free, daylight conditions using daylight simulating lighting when necessary. The deviation of bisection marks from the mid-point of each line was measured in mm such that negative values indicated leftward drift, positive values indicated rightward drift and zero indicated exact mid-point.

5.6. Study 2: Results

5.6.1. Fatigue, sleepiness and sleep disturbance and test battery performance

Greve *et al.* (2005) found that particular measures in the WCST, specifically total correct, PEs, CLRs and categories achieved were the strongest predictors of general EF and that this factor was clearest when success rate by participants was controlled.

Mothers in study 2 were generally highly successful in achieving six categories in the WCST so they were selected for further analysis. In addition, lateralisation associated with sleepiness has been shown to be influential in basic attention-based tasks (Manly *et al.,* 2005; Dufour *et al*., 2000; Casagrande and Bertini, 2008a, 2008b) and there is growing evidence for right lateralisation in DLPFC-related, executive, cognitive action control (Cieslik *et al.*, 2012; Nebel *et al.*, 2005). For these reasons, 100% right-handed participants were further selected leaving 20 closely matched individuals with 28 children between them.

Data in Table 5.3 (Study 1) suggested that different combinations of disturbance, sleepiness and fatigue were associated with changes in self-reported ARCES, FAS, ADDI and DEX scales in intuitively predictable ways. In Study 2, (Table 5.5.) a similar pattern is shown. In linear regression analyses (Table 5.6.), increasing fatigue became a significant predictor of decreasing performance in verbal fluency and TOH4 tests but did not predict the relatively simple Memory Pairs test performance. With increasing fatigue, participants produced fewer words and fewer cluster switches and took more time and moves to complete TOH4. When the executive demands of the test were the most complex (WCST), sleepiness became the only significant predictor, specifically of PEs which correlated positively with sleepiness, and CLRs which correlated negatively with sleepiness. One final check was necessary at this point. In other parts of this thesis, inherent sleepiness, with no obvious explanation, could have accounted for some of the observed differences in cognitive functioning and it was possible that some of the effects observed in mothers in this study were due to this. The disturbed group, however, did not perceive sleepiness as a constant trait and rated themselves as significantly more sleepy now than they had been before having children ($Z = 2.23$, $p = .02$, two-tailed) but the undisturbed group did not ($Z = 1.58$, $p = .11$, two-tailed).

Mothers' self-assessed sleepiness and sleep-disturbance predicted WCST performance ($p \leq .03$, two-tailed) but self-assessed problems, measured by the DEX intention factor (Burgess, 1998), did not. The DEX-R intention factor, however, correlated with all of the WCST dimensions ($p \leq .02$, two-tailed). This suggested that partners' best predictor of mothers' WCST performance was judgement of mothers' intentionality problems while mothers' best predictor was how sleepy or sleep-disturbed they felt.

Table 5.5.

M (SD) Test Battery Results by Sleep Disturbance by Under 5s, Sleepiness and Fatigue

Test	Disturbed by under 5s		Sleepy (ESS)		Fatigued (FAS)	
WCST	No	Yes	No	Yes	No	Yes
Total correct*	67.82 (7.26)	71.78 (7.78)	68.07 (7.15)	73.17 (7.94)	68.86 (8.49)	70.00 (7.36)
% perseverative errors	7.18 (2.27)	10.11 (2.21)	7.50 (2.47)	10.83 (1.17)	9.00 (2.64)	8.23 (2.71)
% conceptual level responses	85 (6.39)	76.78 (9.63)	83.93 (6.46)	75.17 (11.12)	81.29 (7.41)	81.31 (9.81)
Verbal fluency						
Allowable words	39.82 (10.73)	41.11 (12.44)	42.07 (10.38)	36.50 (13.17)	44.86 (12.98)	38.00 (9.89)
Non-allowable words (errors)	2.27 (1.56)	2.22 (1.30)	2.64 (1.39)	1.33 (1.03)	2.29 (1.70)	2.23 (1.30)
Switches	31.91 (7.73)	32.22 (9.40)	33.43 (8.27)	28.83 (8.09)	37.00 (9.73)	29.38 (6.28)
Cluster size	1.45 (0.49)	1.51 (0.39)	1.48 (0.43)	1.45 (0.49)	1.41 (0.59)	1.51 (0.36)
Tower of Hanoi (4 disks)						
Planning and execution (secs)	112.45 (83.66)	136.33 (93.98)	121.36 (81.62)	127.50 (106.49)	72.71 (33.52)	150.38 (95.43)
Moves to completion	27.45 (21.75)	33.56 (23.16)	29.00 (20.07)	33.00 (27.94)	20.00 (6.63)	35.69 (25.54)
Memory Pairs (18 pairs)						
Time to completion (secs)	150.00 (31.90)	189.11 (67.49)	147.57 (38.68)	214.33 (56.60)	150.00 (42.72)	177.08 (57.66)
Tries	44.91 (8.99)	52.56 (13.47)	43.79 (8.43)	59.00 (11.44)	48.14 (9.62)	48.46 (12.90)
% correct	41.82 (7.83)	36.22 (8.60)	42.64 (7.07)	31.50 (6.16)	38.57 (6.80)	39.69 (9.47)
N	11	9	14	6	7	13

Note: Total N =20. ESS: Epworth Sleepiness Scale; FAS: Fatigue Assessment Scale; WCST: Wisconsin Card Sorting Test; Tower of Hanoi: minimum possible moves = 15. * against predicted trend.

Table 5.6

Fatigue, Sleepiness and Disturbance as Predictors of Test Battery Scores.

Scale: predictor	*Beta*	*Adjusted R^2*	*Sig.**
WCST total correct	—	—	—
WCST % perseverative errors: ESS	.61	.34	.004
WCST % conceptual level responses: ESS	-.43	.14	.06
Verbal fluency total allowable words: FAS	-.54	.25	.02
Verbal fluency switches: FAS	-.67	.41	.001
Verbal fluency cluster size	—	—	—
TOH4 planning and execution time: FAS	.52	.23	.02
TOH4 moves to completion: FAS	.54	.25	.01
Memory Pairs time to completion	—	—	—
Memory Pairs tries	—	—	—
Memory Pairs % correct	—	—	—

Note: N = 20 right-handed participants who completed 6 categories in the WCST: Wisconsin Card Sorting Test. F = FAS, S = ESS and DIS = Disturbance. * for both Beta and Adjusted R^2.

5.6.2. Line bisection

The effect of sleepiness on line bisection is sensitive to handedness (Thiebaut de Schotten *et al.*, 2011) so, for this part of the analysis, 100% right-handed participants who successfully completed the WCST were selected leaving 20 closely matched individuals. Assuming a medium effect size of f = 0.30 (Cohen, 1992, 1988), alpha = .05, and power = .80, the online power analysis programme *G*Power 3* (Buchner, Erdfelder and Faul, 1997) confirmed that N = 20 was the minimum requirement for ANOVA but, as samples were small and unequal, Friedman's tests were applied separately to sleepy and not sleepy groups. For the sleepy group there was no effect of line position, indicating a consistent leftward bias (X^2 = 1.33, p = .51, two-tailed). Post hoc Wilcoxon tests confirmed that there were no differences between pairs of conditions ($p \geq .25$, two-tailed). For the not sleepy group, however, the line position effect was significant ($X^2 = 7.31$, $p = .03$, two-tailed). Post hoc Wilcoxon tests showed significant differences such that left line bisections were more leftward than both the centre condition ($p = .02$, two-tailed) and the right condition ($p = .07$, two-tailed) but the centre and right conditions did not differ ($p = .86$).

Table 5.7.

Mean (SD) Deviations from Centre in mm on the Line Bisection Task in ESS Groups.

	Line position		
ESS group	Left	Centre	Right
Sleepy	0.79	-0.71	-1.48
Not sleepy	-2.86	-1.55	-1.53

Note: N = 20; not sleepy n = 14, sleepy n = 6. Negative values indicate left of centre deviations.

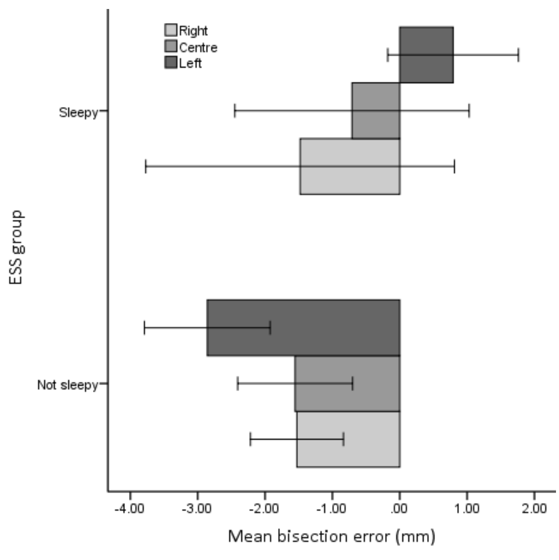


Figure 5.1. Line Bisection Error means ± 1 SE by Position and ESS Group.
Note: Not sleepy n = 14, Sleepy n = 6; negative values indicate left errors, positive values indicate right errors.

5.7. Study 2: Discussion

5.7.1. Neuropsychological tests

Study 1 showed that self-reports of ARCES, MFS and DEX were predicted particularly by fatigue, to a slightly lesser extent by sleepiness and to some extent by sleep disturbance by under 5s. In Study 2, an attempt was made to assess the extent of the putative effects of these predictors by using a battery of tests to measure some of the facets of cognitive functioning that Mumsnet participants attributed to being 'sleep deprived'. All of the tests involved degrees of sustained attention, working memory, and executive inhibition. Memory Pairs was arguably the least demanding of the tests and required non-verbal, working memory and some inhibition. The Tower of Hanoi demanded a greater element of problem-solving and strategic forward planning, although like the Memory Pairs task, it was also a convergent thinking task with a time-accuracy trade-off. Executive and non-executive functioning was assessed, using phonemic, verbal fluency switching (searching) and cluster quantity (storage) respectively (Troyer et al., 1997), and the WCST, which measured perseveration and set maintenance. Finally, line bisection (considered with 'bumps, driving incidents and accidents' in section 4.3.4.) was a simple test of allegedly sleepiness-sensitive, visual attention in the form of pseudoneglect.

Study 1 participants clearly perceived a correspondence between their sleep-related experiences and impaired everyday cognition. This was supported in Study 2, especially, at first, in the association between fatigue and performance in a series of increasingly demanding tests. As a simple test of working memory, Memory Pairs was not associated with fatigue, sleepiness or sleep disturbance. In the more demanding tasks, TOH4, speed and efficiency deteriorated as fatigue increased. In the verbal fluency tests, non-executive functioning in terms of cluster size (storage) was not predicted by disturbance, sleepiness or fatigue but reduced executive switching (searching) and total fluency were associated with increasing fatigue (Troyer et al., 1997). It was not possible to distinguish between perseverative and non-perseverative errors, as recommended by Tucker et al. (2010), because the number of errors was negligible. To the surprise of the highly educated participants, the verbal fluency test proved more difficult than expected and yet they performed well. It is possible that this high-functioning, dextral group produced a ceiling effect in verbal fluency in that they generated a significantly higher number of words (M, SD = 40.40, 11.24) than the meta-norm mean for women (M, SD = 35.14, 12.59) calculated by Loonstra et al. (2001), based on over 17,600 Controlled Oral Word Association Test (COWAT) tests and using the same letters as in Study 2 (t (19) = 2.09, p = .05, two tailed). They also produced average cluster-sizes above the 99th percentile and switches above the 55th percentile according to age- and education-adjusted norms provided by Troyer (2000). Nevertheless, verbal fluency performance revealed differences in executive and non-executive functioning which were most strongly related to fatigue thus providing some support for Mumsnet Talk participants and Harrison and Horne (2000a) who linked being 'sleep-deprived' with Language production problems (superordinate theme 15).

Henry and Crawford (2004) found that phonemic verbal fluency performance was a better predictor of the presence of frontal cortex lesions than the WCST, but here, while acknowledging that the participants were not a clinical group, both were predicted but in different ways. Patterns of deficit in WCST performance were most clearly predicted by sleepiness or sleep disturbance in mothers. Mumsnet participants had linked (12) Action slips with being 'sleep deprived' and the sub-theme (12.1) Failures of intended action and (14) Unreliable memory corresponded particularly well with WCST PEs and CLRs. Of all the measures in Study 2, the WCST was the only one that corresponded to a self-report measure of EF, specifically the DEX-R intentionality factor (Burgess et al., 1998). It was, therefore, the only one with the potential to bridge the gap between real-life functioning and elements of executive function tests (Jackson et al., 2013). This stood in contrast to the conclusion drawn by Wilson et al. (1996) that the DEX-R and WCST tapped qualitatively different functions, because they did not correlate, and underlines the disagreement over the factor structure of the DEX tests.

Unfortunately, it was not possible to compare Study 2 participants' WCST performance to an appropriate reference group. Norms are currently unavailable for the WCST CV4, which is considered to be a research, rather than a clinical assessment, version of the test. Furthermore, Feldstein et al. (1999) reported that the manual and computerised versions of the WCST give different results, and Steinmetz, Brunner, Loarer and Houssemand (2010) also gave evidence questioning their equivalence. The occurrence of more PEs and fewer CLRs in the sleepy group, however, is still a good, but not necessarily exclusive, indication of sleep-associated changes in pre-frontal functioning (Alvarez and Emory, 2006).

Prior to the main analysis, (unreported) data exploration was carried out. In spite of concerns about 'task impurity' (Whitney and Hinson, 2010: 38), no patterns of correlation were found between TOH4, Memory Pairs and verbal fluency, suggesting they were all calling on different underlying cognitive processes (Anderson, 2002; Miyake et al., 2000). Furthermore, they did not correlate with any of the self-report scales (ARCES, MFS, ADDI scales, DEX and DEX-R). Performance in basic cognitive tasks, with both convergent and divergent solutions, requiring relatively short bursts of attention, working memory, planning and inhibition was not, therefore, associated with variations in mood and everyday cognitive functioning. Henry and Crawford (2004) had suggested that educational level should be taken into account but no effects of this were found in either study. In both of them however, over 84% of participants had at least an undergraduate degree, and in Study 2, most of the participants had post-graduate qualifications and so formed relatively homogenous groups in this respect. In Study 2, parity, which was suggested to be important in studies of fatigue (Taylor and Johnson, 2012) was found to be unimportant in test performance. General wakefulness and alertness were also considered to be potentially influential in self-reports of functioning and in test performance, but time since waking was measured and checked at all stages and no discernible effects were found. Caffeine intake was negligible among participants, many of whom had given it up during pregnancy and breast-feeding and never returned to it, so its potential to affect responses (Killgore et al., 2009) was virtually non-existent. Likewise, effects of individual sleep patterns and preferences (Van Dongen et al., 2003, 2005) could not be discerned in test performance and were not predictive of other measures in either study.

5.7.2. Pseudoneglect

As in other parts of this thesis, manual LB in peri-personal space was expected to show leftward bias characteristic of pseudoneglect (Gamberini et al., 2008; Heber et al. 2010; Longo and Lourenco, 2006; Varnava et al., 2002) and, according to the hemispheric activation/orientation hypothesis (Kinsbourne, 1987, 1970), this effect should become more pronounced as a line moves from the right visual field to the left, leading to greater leftward drift on lines in the right visual field and vice versa. It has also been suggested that attentional asymmetry changes when individuals are sleepy and a lateral shift in spatial attention occurs because the right hemisphere remains more vigilant (Manly et al., 2005, Dufour et al., 2007; Casagrande and Bertini, 2008a, 2008b). The combination of a vigilant right hemisphere with increased asymmetry in cerebral activation should lead to an exaggerated tendency to drift leftward in LB, especially when the stimulus is shifted rightwards (Cavézian et al., 2012). Evidence for this was mixed. In sleepy people, there was a consistent tendency to drift left on average across all line positions which would be expected if the right hemisphere remains more vigilant. In the non-sleepy group, however, there was a line position effect but in the opposite way to that predicted by Kinsbourne (1987, 1970) and shown in other parts of this thesis, so the unexpected responses of this group are not explained by the hemispheric activation hypothesis. The reason for this is unclear, especially as participants had been carefully selected for right-hand dominance and high-level cognitive functioning, hopefully ruling these out as potential sources of bias.

Repeating the analysis dividing participants by level of disturbance produced similar results and, possibly, a clearer explanation. Sleep disturbance is qualitatively different from sleepiness and, although they correlated positively in this group (rho = .59, p = .007, two-tailed), disturbance alone correlated negatively with ADDIpa (rho = -.60, p = .005. two-tailed). ADDI scales were a significant predictor of DEX in Study 1 and other measures of anxiety and depression predicted cognitive failures in older participants in both Chapters 1 and 2, implicating the action of neurochemicals such as dopamine that are known to affect sleep, attention allocation and mood (Fellous and Suri, 2002; Gonzalez et al., 2012; Monti and Jantos, 2008; Monti and Monti, 2007; Nieoullon, 2002). In addition, the participants were young women at an early stage of childrearing. Lee and Kryger (2008) stressed the importance of understanding the role of hormonal influences in motherhood and womanhood in sleep research, and this may be one indication that they were correct.

5.7.3. Clumsiness

There was some evidence of increased laterality in bumps in general when sleepy/fatigued or disturbed by under 5s, with a suggestion that right-sided bumps while pushing something were slightly more common. This offers some support for the idea that the right hemisphere is more vigilant when sleepy (Manly et al., 2005; Dufour et al., 2007; Casagrande and Bertini, 2008a, 2008b) and for Nicholls et al. (2007, 2008) who suggested a tendency towards more right-sided bumps, although the latter focused on the association between bumps and pseudoneglect, the role of which could not be determined in an online survey. Reported incidences of bumps, driving mishaps and accidents were low; 64% of all participants could not recall bumps to self, 75% could not recall bumps while pushing something, 84% of drivers reported no bumps or near misses and 84% of participants said they had not had any accidents or injuries. Amongst those that did report incidents, in many cases reported frequencies were in single figures so, although the increased risks posed by a combination of disturbance by under 5s and sleepiness/fatigue looked statistically compelling, low numbers of responses and a lack of norms to compare any these findings against make it difficult to link any of them convincingly with mothers’ sleep experiences. Furthermore, 75% of driving incidents involved the front or left side of the car, which is more likely to reflect driving on the left in a right-hand drive car than sleepiness or pseudoneglect. Studies by Rogé et al. (2002, 2003) had suggested a deterioration in central vision and a reduction in peripheral vision (lateralisation effects not analysed) in drowsy and sleep-deprived drivers and, while this could be associated with increased risk of accidents in real driving conditions, comparisons with the current findings cannot easily be made as their procedures involved simulated driving in France, which is on the right, rather than the left, side of the road.

5.8. General Discussion

5.8.1. Limitations

Since the identity of participants in Study 1 is unverified, their identity as mothers of under 5s is a matter of trust, but it was hoped that visitors to *Netmums* and *Mumsnet* research sites would not have been able to complete such a detailed questionnaire without first-hand experience of its subject area. In Study 2, participants were verifiably mothers of under 5s, united with Study 1 participants in their interest in sleep experiences as a parent. In Study 2 in particular however, it was apparent that participants' educational level was high and the recommendations they made, as the sample snow-balled, tended to be to other mothers who valued the research process. It is also likely that their intellectual confidence would have encouraged them to take part without anxiety about assessment of their capabilities, which may have accounted for their uniform performance in the verbal fluency test in spite of the difficulties they experienced with it. The decision was also made at an early stage to analyse TOH4 data because the ease with which participants completed TOH3 made differentiation between them impractical. It is also possible that they had good levels of cognitive reserve that protected their performance in simpler tests. More challenging tests, possibly with longer time-limits may, therefore, have distinguished more effectively between participants but, as Pilcher and Walters (1997) acknowledged, tests with a PFC focus may simply be more difficult than other kinds of test not focused on the PFC and that this may be responsible for any differences found. Furthermore, the WCST was the only test in Study 2 requiring sustained concentration, so both difficulty and demand could have been uncontrolled.

Although the scales in Study 1 and tests in Study 2 were carefully selected for validity and reliability, Horne suggested that a reductionist approach, which focuses on one or a few aspects of EF, risks missing measurable effects of sleep loss because of the possibility that the *'...whole is greater than the sum of its parts.'* (Horne, 2012: 2227). He stressed the importance of choosing measures of sleepiness carefully so that they reflect more accurately the complexity of daily tasks as '[some of] *these tests are...somewhat divorced from the real world in not being 'ecological'.'* (Horne, 2012:

2227). The use of tools such as the 'Six Elements Test' from the BADS test battery, which reflect real-world multi-tasking, is something to be aspired to in field research with busy mothers, so the best assessment of the measures used in Study 2 is their ability to predict everyday functioning. Wilson *et al.* (1996) claimed that DEX-R ratings were good predictors of BADS total and sub-test scores, and DEX-R intentionality did predict WCST scores in Study 2, but it has also been queried whether the DEX really does assess mild executive difficulties given that it typically produces very low scores (Chamberlain, 2003). Furthermore it has recently been argued that the WCST is more a test of general EF than a specifically pre-frontal test (Nyhus and Barceló, 2009) and so, in Study 2, it was more likely to have revealed the effects of sleepiness in general than evidence for the PFC vulnerability hypothesis.

Associations between sleep-disturbance, fatigue and sleepiness and, in some cases mood, on self-reported measures of attention, memory and everyday EF were subjectively clear to participants. However, while measurable effects on some aspects of cognitive functioning were found, a direct link with sleep disturbance by under 5s *per se* was difficult to demonstrate because of its associations with sleepiness and fatigue. Indeed, the one existing experimental study of cognitive impairments in parents with curtailed sleep (Plessow *et al.*, 2011) concentrated on long-term sleep curtailment and may have unwittingly tested the effects of fatigue, especially as participants did not differ in sleepiness. Parental experiences of sleep loss change constantly, so asking mothers to recall events for the previous week in Studies 1 and 2 potentially differentiated more clearly between sleepiness and longer–term fatigue although it was rather less successful with sleep disturbance. Statistically, sleep disturbance had common variance with sleepiness, and participants in general reported much less personally adequate sleep than they would have liked, so at least some of the observed effects would appear to be associated with these things. Fatigue may be qualitatively different; it is a stronger predictor than sleepiness of self-reported variables and reduced performance in both simple and more complex tests employed here, but sleepiness in mothers and disruption to their sleep, is at least partly responsible. Finally, some of the parents in Study 2 suggested that they had adapted to the changes from their preferred sleep pattern, but fatigued and/or sleepy participants still performed less well suggesting that they may have been unaware that they were affected (Van Dongen et al., 2003; Pilcher and Walters, 1997; Plessow *et al.*, 2011).

5.8.2. Conclusion

Sleep disruption due to parenting babies and young children seems to be an occupational hazard (e.g. Gay, Lee and Lee, 2004; Kahn *et al*., 1989; Troy, 2003). Its possible connection with everyday cognitive functioning, however, has rarely been addressed although some tangential evidence of its detrimental effects have emerged in qualitative studies (Kurth *et al*., 2011; Long and Johnson, 2001) and in a rare laboratory-based study by Plessow *et al.* (2011). In Study 1, significant associations were found between self-reported fatigue and sleepiness and attention, memory, everyday EF, mood, clumsiness and accidents in ways that corroborated thematic analysis of *Mumsnet Talk* discussion strings. In the case of simple visual attention, clumsiness and EF, effects of sleepiness and sleep disturbance, which could be linked with sleep-related changes in hemispheric activity, and possibly pre-frontal functioning, were demonstrable. While attention, memory and EF problems identified in Study 1 were not directly measurable, neuropsychological test performance in similar domains in Study 2 deteriorated with fatigue in less demanding, non-executive and executive tasks and with sleepiness in particularly demanding executive tasks. Self-reported sleepiness and 'other'-reported dysexecutive intentionality problems predicted this performance. Some evidence was also found for a lack of lateralisation effect in a simple test of pseudoneglect indicative of sleepiness and hence an alteration in visual attention. Detrimental effects of sleepiness in mothers of under 5s were thus demonstrable in spatial attention as well as in EF, both of which could underpin deficits in everyday cognitive functioning.

Chapter 6

SUMMARY, CONCLUSIONS AND IMPLICATIONS

6.1. Summary

In chapter 1, it was claimed that the effects of everyday sleepiness, fatigue and sleep disruption in domestic settings are assumed rather than empirically supported or are generally poorly understood (Middlemiss, 2004). It was argued that the importance of these effects is overlooked and was thus worthy of attention. In chapters 2 to 5, studies involving different levels of sleep disruption were reported. In these studies, detrimental effects of sleepiness, fatigue and sleep disruption in everyday domestic situations were identified, measured and clearly demonstrated in five groups of healthy adults comprising a total of 445 participants.

In chapter 2, healthy adults with apparently, inherent sleepiness and no sleep disruption had a measurably greater tendency to show pseudoneglect in peri-personal space and greater accuracy in spatial perception in extra-personal space. Effects of sleepiness were also evident in increased lateralised perception of threatening emotions. Participants in this group also associated greater anxiety, but not sleepiness, with more everyday cognitive failures. In chapter 3, partners of people with PD showed similar patterns of sleepiness-associated changes in that self-reported cognitive failures were associated with both anxiety and sleepiness and increased pseudoneglect. In the absence of underlying pathology or evidence of sleep disturbance, the inherent sleepiness in these two participant groups remains unexplained but its presence is reliably associated with changes in cognition and mood.

In chapters 4 and 5, the experiences of sleep disruption in mothers of babies and young children were explored. The grounded approach used in chapter 4 resulted in findings that demonstrated that sleep disruption has complex effects on mothers' cognitive, social and affective functioning as well as impacting upon their physical and psychological health. In Study 1 in chapter 5, in which mothers were surveyed, sleepiness and fatigue were strongly implicated in subjectively measured cognitive functioning and subjectively reported mood was strongly associated with executive functioning. In Study 2, direct assessment of mothers' cognitive functioning using neuropsychological tests showed that sleepiness and fatigue were strongly associated with poorer performance on increasingly demanding executive functioning tests. There was also some evidence of increased clumsiness.

6.2. Conclusions and implications

In all of the groups studied, participants' current sleep patterns differed from those that they considered to be right and normal for themselves, lending credibility to the view that inadequate sleep is common (Ferrara and De Gennaro, 2001) and potentially poses a substantial public health risk (Dement, 2000). The studies reported in this thesis have demonstrated that sleep that is less than ideal does, indeed, pose a risk to several aspects of healthy psychological functioning, specifically cognition and mood. The effects were evident in changed lateralisation of visual attention involved in pseudoneglect and emotion perception, and in subjectively and objectively measured aspects of attention, memory and executive functioning. Throughout this thesis, subjectively reported mood has also been associated with everyday cognitive failures and, in chapter 5, with executive functioning. Many studies of parental sleep experiences have incorporated mood measures (e.g. Byars *et al.,* 2011; Chu and Richdale, 2008; Lee *et al.*, 2007; Lee, 1998; Crowe *et al.*, 1996) and reported that they showed predictable relationships with disrupted sleep. However, this thesis is the first to show relationships between sleep disruption, cognition and mood and to suggest their interdependence.

The effects found in chapters 2 to 5 were generally small but were clearly associated with sleep patterns ranging from unexplained, everyday sleepiness to chronic sleep disruption. Changes in visual attention, emotion perception and executive functioning were demonstrated, but their possible connection with practical aspects of daily living was not. Further research should, therefore, test for effects on types of functioning that Horne (2012) says reflect the complexity of everyday tasks. With regard to visual attention, these could include such things as navigating through doorways (Nicholls *et al.*, 2007, 2008) and driving simulations (Rogé, Pébayle, Kiehn and Muzet, 2002; Rogé, Pébayle, El Hannachi and Muzet, 2003) which, respectively, have been shown to be associated with pseudoneglect and sleepiness. Tests of emotion perception might be extended to more realistic tests of interpersonal sensitivity, in contexts involving interaction with children or other adults, and executive functioning might be better measured using such devices as the 'Six Elements Test' (Shallice and Burgess, 1991) and simulations of real-life, decision-making situations (Horne and Moseley, 2011). Subjective reports of sleep patterns might also be corroborated with daily diary records and objective measures such as wrist actigraphy. Judgements by others of a sleep-disrupted person's daily performance, in more respects than in executive functioning, would also lend '*testimonial validity*' (Stiles, 1999: 100) by proxy to findings.

The study of the effects on cognition of sleep disruption in naturalistic settings is challenging and, in groups such as parents, is particularly so because it can be unpredictable and its effects complicated by differences between individuals and domestic circumstances. In an ideal situation, one would conduct longitudinal research in a similar way to Mannering *et al.* (2011), who studied marital instability alongside infants' sleep patterns, and extend the time span to include pre-pregnancy and post natal periods. Even this, however, presupposes that individuals would remain relatively stable over time and this is particularly unlikely for women. As Lee and Kryger (2008) have pointed out, hormonal influences in the menstrual cycle, pregnancy, childbirth, motherhood and womanhood in general have the potential to be greatly influential in sleep research and attempts should be made to account for them. A further challenge is in gaining access to potential research participants. Participants with disrupted sleep and over-stretched personal resources may, understandably, be unwilling to give their limited free time to a researcher. It was noticeable, for example, in the latter stages of this thesis that the mothers who took part were largely highly educated, valued the research process and were particularly motivated to take part because they understood the difficulties of recruitment. While their contribution was invaluable, they did fall into a particular demographic group leaving others under-represented, so future studies should incorporate more demographically diverse participants to try to capture cultural variation (Mindell *et al.*, 2010). Fathers also tend to be under-represented in research such as this, so attempts should also be made to include them.

Practical implications may be drawn from the findings reported in chapters 2 to 5. In chapters 2 and 3, the effects of sleepiness on lateralisation of spatial attention, shown using a test of pseudoneglect in healthy adults, were small but consistent as were the effects on emotion perception. The former may have practical significance for navigating through peri-personal space as has been suggested by Nicholls *et al*. (2008) and Nicholls *et al.* (2007). The exaggeration of the over-perception of the left visual field (or under-perception of the right visual field) when sleepy could lead to greater clumsiness in the form of damage to oneself or to self and others when driving (as shown in chapter 5, Study 1 and by Rogé *et al*., 2002, 2003). Perception of threatening emotions may also be heightened when sleepy and this could have implications for social interactions with others. People for whom sleepiness is a common experience could potentially benefit from acknowledging these risks and taking steps to minimise the harm they may cause, such as improving sleep (if possible) or being more mindful of them and strategic about their management.

With regard to sleep-disrupted mothers, findings in chapters 4 and 5 indicate that many of the effects that they discussed informally online are measurable using self-report scales and objectively verifiable in neuropsychological test performance. These findings help to clarify what have hitherto been poorly understood effects and could be of practical value to sleep-disrupted parents and the health professionals who try to support them. As Middlemiss (2004) showed, mothers depend largely on unqualified others for advice about managing disrupted sleep and much of it focuses on how to manage their babies' and children's sleep rather than helping them directly. While health professionals and self-help resources can offer techniques for improving babies' and children's troublesome sleep, there is wide variation in infants' and children's sleep patterns (Sadler, 1994; Horne, 1992) and, even when these are as good as can be expected, some parents' sleep may still be inadequate.

Findings in chapters 4 and 5 inform parents and health professionals alike that the negative effects of everyday fatigue, sleepiness and sleep disruption should not be under-estimated. They can become a preoccupation for parents and have far-reaching effects on many aspects of everyday lives including their physical and psychological well-being and their relationships with others. What was missing from the research literature until now was clear information about the likely effects of sleep disruption on parents' cognition, for example, in terms of the type and extent of the difficulties they may encounter, and whether deficits are noticeable to others. In Studies 1 and 2 in chapter 5 it became apparent that mothers who are fatigued, sleepy and sleep disrupted are at particular risk of cognitive impairment compared to mothers who are none of these things.

Based on these findings, it would be safe for health professionals to assume that the more a parent complains of fatigue, sleepiness and sleep disruption the more likely they are to be experiencing deficits in everyday attention and memory. The additional presence of heightened emotional tone is likely to be associated with reported difficulties in executive functioning. Furthermore, reports of increased clumsiness and concerns about safe driving are likely to be legitimate. With regard to specific cognitive functioning, fatigue, sleepiness and sleep disruption are unlikely to be associated with simple, short-term memory deficits but are associated with deficits in cognitive functioning such as logical problem solving, verbal fluency and executive task performance. Moreover, higher fatigue, sleepiness and sleep disruption indicate poorer performance on tasks that are both particularly demanding of executive functioning and divergent in character. In most of these effects, fatigue plays a particularly important part and, although some parents in chapter 4 believed that they could function without sleep (subtheme 1.4) and some mothers expressed the view to me in Study 2 (chapter 5) that they had adapted to fatigue, the findings presented in Study 2 in particular suggest otherwise. Parents and health professionals should, therefore, be aware of the particular risk to mothers posed by fatigue and be prepared to recognise its presence and association with impaired cognitive and affective functioning.

As demonstrated by *Mumsnetters* in chapter 4 and by Runquist (2007), parents can be extremely resourceful in coping with fatigue, sleepiness and sleep disruption but, if the difficulties associated with them were better understood by parents and health professionals, it could help them to implement more focused support and, with time, potentially effective interventions. Managing babies and young children's sleep as well as possible is an important aspect of this support, but identifying parents' needs is equally so. Helping them to recognise the nature of sleep-disruption-related difficulties, and when they are most vulnerable to experiencing them, could enable them to manage the situation more effectively, for example, by putting compensatory measures in place to counter cognitive functioning deficits and by utilising coping strategies that mothers find helpful such as '*positive cognitive restructuring'* (Skinner, *et al*., 2003: 240), '*meaning focused coping'* (Folkman, 2008: 7-8) and '*future-oriented pro-active coping*' (Folkman and Moskowitz, 2004: 757). In addition to interventions such as these, health professionals might also cautiously suggest that sleep-disrupted parents engage in online support groups such as *Mumsnet*. Pennebaker (1997) for example, claims that writing about experiences and emotions can be therapeutic in itself. Tanis (2009: 150) however claims that '…*robust evidence that online support groups increase health'* is currently lacking. He argues that online support groups tend to attract people who feel that aspects of their situation are beyond their control and that finding the same in others may foster feelings of helplessness. 'Virtual' support may, therefore, help some parents, but only as long as they do not become dependent upon it at the expense of other sources of support in the real world and real time.

In conclusion, the findings in this thesis have contributed towards showing that a variety of potentially detrimental changes in cognitive processes are associated with everyday, domestic sleep disruption and has thus made a contribution towards helping us to understand its effects. If strategies could eventually be developed to help to ameliorate these effects, the current findings would have 'c*atalytic validity'* (Stiles, 1999: 100) in the sense that sleep-disrupted, healthy adults, and the health professionals who support them, could understand more clearly what was happening to them and be empowered to make changes for the better.

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Appendix A. NHS: Bath Research Ethics Committee approval of surveys of people with Parkinson's disease, their partners and healthy adults

NHS

Bath Research Ethics Committee
Forbes Fraser Building
Research Ethics Office
Royal United Hospital
Combe Park
Bath
BA1 3NG

Telephone: 01225 825725
Facsimile: 01225 825725

22 December 2005

Dr Alison Lee
Senior Lecturer in Psychology
Bath Spa University
School of Social Sciences
Newton St Loe
Bath
BA2 9BN

Dear Dr Lee

Full title of study: **The impact of sleep fragmentation on carers and families of people with Parkinson's Disease.**
REC reference number: **05/Q2001/258**

Thank you for your letter of 13 December 2005, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair. I am happy for Miss Wadeley to use 30 minutes as the time taken for the questionnaire (20 minutes plus 10 minutes thinking time), given the results of the pilot.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Ethical review of research sites

The Committee has designated this study as exempt from site-specific assessment (SSA). There is no requirement for other Local Research Ethics Committees to be informed or for site-specific assessment to be carried out at each site.

Conditions of approval

The favourable opinion is given provided that you comply with the conditions set out in the attached document. You are advised to study the conditions carefully.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Application	5.0	26 October 2005

An advisory committee to Avon, Gloucestershire and Wiltshire Strategic Health Authority

05/Q2001/258 Page 2

Investigator CV Dr Alison Lee		06 October 2005
Protocol	1	06 October 2005
Covering Letter		06 October 2005
Summary/Synopsis	1	06 October 2005
Letter from Sponsor and funder		05 October 2005
Compensation Arrangements Bath Spa University Employers, Public and Professional Liability insurance		22 July 2005
Questionnaire Partners of patients with PD	2	13 December 2005
Questionnaire PD patients	3	13 December 2005
Participant Information Sheet combined PD and partner information	1	13 December 2005
Participant Consent Form PD patients and partners	1	06 October 2005
Response to Request for Further Information		13 December 2005
CV PhD student Ms Alison Wadeley		06 October 2005

Research governance approval

The study should not commence at any NHS site until the local Principal Investigator has obtained final research governance approval from the R&D Department for the relevant NHS care organisation.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

05/Q2001/258	**Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project

Yours sincerely

Anna Jenkins

pp **Dr Andrew Taylor**
Chair

Email: anna.jenkins@ruh-bath.swest.nhs.uk

Enclosures: *Standard approval conditions*

Copy to: Professor Robert Mears
Bath Spa University, School of Social Sciences
Bath Spa University
Newton Park
Newton St Loe, Bath
BA2 9BN

Miss Alison Wadeley
Bath Spa University
Newton Park
Newton St Loe
Bath, BA2 9BN

Appendix B. Invitation to participate in sleep and everyday functioning study: healthy adults

BATH SPA UNIVERSITY Research into sleep patterns and everyday functioning

We would like to invite you to take part in a study which is being carried out as part of a PhD project by Mrs Alison Wadeley under the supervision of Dr Alison Lee, both at Bath Spa University. The aim of this study is to explore ways in which sleep patterns, everyday functioning and mood might be associated. We are looking for people who:

- are right-handed
- in good health
- have normal vision (uncorrected or corrected)
- have no diagnosed sleep problems and do not take medication to aid sleep

If this describes you would like you to ask you to complete a questionnaire and a series of simple visual tasks. All procedures have been approved by the Bath Royal United Hospital NHS Research Ethics Committee and by Bath Spa University.

This questionnaire is divided into five sections:

A. The first section asks for some general information about you
B. The second section asks questions about your sleep patterns
C. The third section asks about the kind of everyday minor mistakes that everyone makes
D. The fourth section asks questions about your everyday mood
E. The final section asks questions about left and right handedness

To answer the questions all you need to do is to make a choice or enter some brief information. Any questions you may prefer not to answer can be left blank. Most people find that the questionnaire takes about 10 - 15 minutes to complete.

The visual tasks are presented on a projection and computer screen and you are asked to make a response to each image. This part of the study takes about 35 minutes. There are four further visual paper and pencil tasks which will take no more than 5 minutes. The questionnaire and all of the tasks can be completed in about an hour.

You do not have to take part in this study if you do not want to. If you do decide to take part you may withdraw at any time without having to give a reason. At all stages, procedures are in place to ensure your anonymity. Because of these, it would not be possible for you to withdraw consent at a later date as we would not be able to identify you from your test or questionnaire results.

If you have any questions, or would like to find out our results, please contact us. The final publication of the results will take some time as this research could take until 2014 to complete.

Thank you for considering taking part in this study.

Contact details: Dr Alison Lee and Ms Alison Wadeley are in the School of Society, Enterprise and Environment, Bath Spa University, Newton Park, Newton St Loe, Bath, BA2 9BN. Telephone during the working day: (Dr Lee: 01225 875 726; Mrs Wadeley: 01225 875 793). e-mail at any time: a.c.lee@bathspa.ac.uk or a.wadeley@bathspa.ac.uk

Appendix C. Invitation to participate in postal survey: people with Parkinson's disease and their partners

Bath Spa University

Research into sleep patterns in people with Parkinson's disease and their partners.

This study is being carried out as part of a PhD project by Ms Alison Wadeley under the supervision of Dr Alison Lee, both at Bath Spa University and is supported by Bath Spa University.

We would like to invite couples, in which one person has Parkinson's disease (PD), to take part in a questionnaire study about their sleep. It is well known that PD can have an effect on sleep but little is known about what this is like for both the person with PD and their partner. You may feel that your sleep is not changed by living with PD, or you may feel that there have been mild, moderate or great changes. We would like to question couples with different experiences so, whatever your situation, your participation in this research will be valuable. Eventually, we hope that what we find out will help those, whose sleep patterns are changing, to manage the situation in the best way.

The aim of this study is to explore the possibility that sleep patterns, everyday functioning and mood are in some way associated. Two questionnaires have been designed, one for the person with PD and one for their partner. Most of the questions are the same but there are some extra questions for each of you. You will be asked to complete the questionnaires separately but you will both have the same personal identification number so that couples' responses can be kept together. There are no personal questions about your relationship and we do not ask for your names so your responses will be anonymous.

This questionnaire is divided into four sections:

A. The first section asks for some general information about you
B. The second section asks questions about your sleep patterns
C. The third section asks about the kind of everyday minor
mistakes that everyone makes and includes a simple visual judgement test
D. The final section asks questions about your mood

To answer each question all you need to do is to make a choice or enter some brief information. Most people have found that the questionnaire takes about 20 minutes to complete but you may like to allow up to 10 minutes extra for 'thinking time'. We will provide you with a private room in clinic if you would like to complete your questionnaire there and will help you with it if you wish. If you would prefer to complete the questionnaire at home and/or are taking one home for your partner, please post them to us in the envelope provided. Please do not feel that you must complete your questionnaire because your partner has completed his or hers. Simply return the unused questionnaire to us.

You do not have to take part in this study if you don't want to. If you do decide to take part you may withdraw at any time without having to give a reason. However, it will not be possible for you to withdraw consent at a later date as the questionnaires are completed anonymously. The treatment one of you is receiving for PD will be unaffected whether or not you take part.

If you have any questions, or would like to help in our research or to find out our results, please contact us. Once we have something to report we will produce a newsletter to tell you about what we have found. The final publication of the results will be in some years' time as this research could take until 2010 to complete.

If completion of the questionnaire raises any issues for you that you feel we cannot address, the Parkinson's Disease Society in the UK has a free phone help line for all people with PD, their friends, families and carers. The number is 0808 800 0303

Thank you for considering taking part in this study.

Contact details:

Dr Alison Lee and Ms Alison Wadeley are in the School of Social Sciences and can be contacted at the Newton Park address given below or by telephone during the working day: (Dr Lee: 01225 875 726; Ms Wadeley: 01225 875793) or by e-mail at any time: a.c.lee@bathspa.ac.uk or a.wadeley@bathspa.ac.uk

Appendix D: Survey questionnaire for people with Parkinson's disease, their partners and healthy adults

Sleep patterns in people with Parkinson's disease and their partners.

Instructions:

Most of these questions require you to enter some brief information in a box or to make a choice from a number of alternatives by circling a number or ticking a box. There is space at the end of each section if you would like to add further comments about any of the issues raised by the questions.

It is important that your answers are not influenced by others so please do not discuss them with anyone while completing the questionnaire (although you might want to discuss them afterwards). You may want to request assistance in writing down your answers, in which case the person assisting you will be asked not to influence you in any way.

Please do not feel that you must complete your questionnaire because your partner has completed his or hers. In any event it would be much appreciated if you would return both questionnaires, completed or not, in the envelope provided. Thank you.

Ms Alison Wadeley
School of Society, Enterprise and Environment
Bath Spa University
Newton Park
Newton St Loe
Bath
BA2 9BN
Tel 01225 875793

Participant identity number (same as partner's) _____________

Section A - General questions

Note: For non-PD respondents, PD-specific questions shown in italics were removed. **Names of published scales use with permissions are indicated in bold.**

1. Please state your age to the nearest year
2. Please state your gender: Male, Female
3. When did you first notice symptoms of Parkinson's disease (if known): Year
4. Please indicate on which side of your body you first noticed motor (movement) symptoms of PD? Left, Right, Both
5. When was your Parkinson's Disease formally diagnosed (if known): Year
6. Which hand do you write with? Left, Right, Either
7. Do you take any medication to help you sleep? Yes, No
If yes: Please state what it is and, if possible, how long you have been taking it. Name, Weeks, Years, Months
8. Please indicate whether you take any other prescribed medication, and if possible, how long for. Name, Dose, Weeks, Months, Years

9. Thinking about when you are at your best, perhaps when your PD medication is helping you the most, please indicate best describes your symptoms:

Symptom	*Absent*	*Mild*	*Moderate*	*Severe*
Right hand side tremor				
Right hand side rigidity				
Right hand side freezing, slowness or loss of movement				
Left hand side tremor				
Left hand side rigidity				
Left hand side freezing, slowness or loss of movement				

10. How would you describe your PD?
Freezing, slowness or loss of movement dominant, Tremor dominant, Mixed
11. Do you experience any of the following? Falls (more than two per year), 'On-off' fluctuations, Other PD related symptoms - please give a brief description here:

12. Now we are interested in how you occupy a typical week. Please estimate how many hours in a typical week, you spend doing the following.

Full time paid employment
Part time paid employment
Full time self employed
Part time self employed
Other (e.g. voluntary work).
Carrying out activities related to managing PD e.g. clinic visits, obtaining medication.
Carrying out PD related activities e.g. involvement in support groups, reading about PD.
Doing other general tasks necessary to run your home e.g. childcare, housework, shopping, cooking, paperwork
Taking time to do things that you enjoy and that are not duties e.g. socialising, relaxing, watching TV, leisure activities
Any other regular activity or activities not listed above.

13. If you have any further comments, or think there are any other general questions we should be asking about you, please write them on the back of this page.

<u>Section B - Questions for people with PD about sleep. (For non-PD respondents PD specific questions, shown in italics, were removed).</u>

1. First of all, we are interested in what your normal, adult sleep pattern is like. Think back to when you had no noticeable PD symptoms and were able to sleep undisturbed. Please fill in the gaps or circle a number:

a. I would sleep for ______ hours per night
b. I would typically wake up ______ time(s) a night
c. The quality of my sleep would be: Awful (1) to Excellent (10)
d. If I were not particularly tired but had the chance to take a nap in the day, I would fall asleep With great difficulty (1 to (10) Very easily
e. I would nap in the day for a total of ______hours and _____minutes

2. Some people regard themselves as 'larks' (prefer early getting up and bedtime, more alert in the morning) and some see themselves as owls' (prefer later getting up and bedtime, more alert in the afternoon/evening). How you would describe yourself? Very much a lark (1) to Very much an owl (10)

Now, please look back over THE LAST WEEK.
PDSS questions: 3-20. Questions 4-10 Never (1) to Always (10)

3. The overall quality of my night's sleep is Awful (1) to Excellent (10)
4. Do you have difficulty falling asleep each night?
5. Do you have difficulty staying asleep?
6. Do you have restlessness of legs or arms at night or in the evening causing disruption to sleep?
7. Do you fidget in bed?
8. Do you suffer from distressing dreams at night?
9. Do you suffer from distressing hallucinations at night (seeing or hearing things that you are told do not exist?
10. Do you get up at night three or more times to pass urine?
11. Do you have incontinence of urine at night because you are unable to move due to "off" symptoms?
12. Do you experience numbness or tingling of your arms or legs which wakes you from sleep at night?
13. Do you have painful muscle cramps in your arms or legs which wake you from sleep at night?
14. Do you wake early in the morning with painful posturing of arms or legs?
15. On waking, do you experience tremor?
16. Do you feel tired and sleepy after waking in the morning?
17. Have you unexpectedly fallen asleep during the day?
18. Do you wake earlier than you would like and cannot get back to sleep?
19. Do you oversleep?
20. Are you late for things such as appointments or work?

---

21. How important is it to you to get a good night's sleep? Not at all (1) to Extremely important (1)

22. Thinking about your current situation, please indicate which one of the following best describes your sleeping arrangements: Same bed as partner, Same room separate bed, Same room would *sometimes* choose not to if had an alternative, Same room would *always* choose not to if had alternative, Sometimes same room sometimes not, Different room, Other

23. Thinking about the time before your PD symptoms appeared and now, did/do you have any of the following sleep problems yourself? Please estimate how long any current problem has lasted (Present before PD? Yes, No. Present now? Years, Months):
Insomnia - difficulty getting to sleep, Insomnia - difficulty staying asleep, 'Restless legs' Nightmares, Snoring, Sleep apnoea (Interrupted breathing during sleep), Sleep walking, Talking in your sleep, Disturbed by partner for non PD reasons, Other,No sleep problems

Now we would like to ask you about how your nights have been over THE LAST WEEK.

24. On average, how many times per night do you think the following events occurred? (Use zero if appropriate) I got out of bed for PD related reasons, I got out of bed for other reasons, I woke for PD related reasons but didn't get out of bed, I woke for non PD reasons of my own but didn't get out of bed, My partner woke me but I did not have to get out of bed

25. On average, during the last week, at what time did you tend to: Go to bed at night? Get up in the morning? Hours, Minutes

26. We would like to know when in the night you are most likely to have disturbed sleep (if at all). Disturbed during the first third of my night's sleep, Disturbed during the middle third of my night's sleep, Disturbed during the final third of my night's sleep Nota at all (1) to A great deal (10)

27. During the night, how much time in total do you think you spend attending to your PD related needs? Hours, minutes

28. How much time in total do you nap during the day? Hours, minutes

29. Is disturbance to your sleep (if any) distressing to you? Not at all (1) to Extremely distressing (10)

30. **ESS**. How likely are you to doze off or fall asleep in the following situations, in contrast to just feeling tired? Please use the following scale and circle the most appropriate number for each situation:
0 = would never doze or sleep.
1 = slight chance of dozing or sleeping
2 = moderate chance of dozing or sleeping
3 = high chance of dozing or sleeping
na = does not apply to you
Sitting and reading, Watching TV, Sitting inactive in a public place, Being a passenger in a motor vehicle for an hour or more, Lying down in the afternoon, Sitting and talking to someone, Sitting quietly after lunch (no alcohol),Stopped for a few minutes in traffic while driving

31. If you have any further comments, or think there are any other questions we should be asking you about your sleep, please write them on the back of this page.

Section C. **CFQ** (except for Question 26)

The following questions are about minor mistakes which everyone makes from time to time, but some of which happen more often than others. We want to know how often these things have happened to you IN THE PAST WEEK. 4. Very often, 3. Quite often, 2. Occasionally, 1. Very rarely, 0. Never

1. Do you read something and find you haven't been thinking about it and must read it again?
2. Do you find you forget why you went from one part of the house to the other?
3. Do you fail to notice signposts on the road?
4. Do you find you confuse right and left when giving directions?
5. Do you bump into people?
6. Do you find you forget whether you've turned off a light or a fire or locked the door?
7. Do you fail to listen to people's names when you are meeting them?
8. Do you say something and realize afterwards that it might be taken as insulting?
9. Do you fail to hear people speaking to you when you are doing something else?
10. Do you lose your temper and regret it?
11. Do you leave important letters unanswered for days?
12. Do you find you forget which way to turn on a road you know well but rarely use?
13. Do you fail to see what you want in a supermarket (although it's there)?
14. Do you find yourself suddenly wondering whether you've used a word correctly?
15. Do you have trouble making up your mind?
16. Do you find you forget appointments?
17. Do you forget where you put something like a newspaper or a book?
18. Do you find you accidentally throw away the thing you want and keep what you meant to throw away – as in the example of throwing away the matchbox and putting the used match in your pocket?
19. Do you daydream when you ought to be listening to something?
20. Do you find you forget people's names?
21. Do you start doing one thing at home and get distracted into doing something else (unintentionally)?
22. Do you find you can't quite remember something although it's "on the tip of your tongue"?
23. Do you find you forget what you came to the shops to buy?
24. Do you drop things?
25. Do you find you can't think of anything to say?
26. Are you accident prone (irrespective of any medical condition you may have)?

27. Line bisection instructions. On the following page is a simple judgement test. Please turn the page so that the three lines are horizontal to you and the arrow is pointing away. Centre the page in front of you on a flat surface. Use the arrow to help you. On each line, mark a short vertical line to show where you think the exact centre of the line is, for example:
____________________________|_______________________________

Please don't use a ruler. It is your judgement that counts.

(The manual line bisection (LB) test appeared on the next page.)

Section D. **HADS**

Here are some questions about how you feel. In each case, please underline the answer that applies to you.

1. I feel tense or "wound up."
   a. Most of the time
   b. A lot of the time
   c. From time to time, occasionally
   d. Not at all

2. I still enjoy the things I used to enjoy.
   a. Definitely as much
   b. Not quite as much
   c. Only a little
   d. Hardly at all

3. I get a sort of frightened feeling as if something awful is about to happen.
   a. Very definitely and quite badly
   b. Yes, but not too badly
   c. A little, but it doesn't worry me
   d. Not at all

4. I can laugh and see the funny side of things.
   a. As much as I always could
   b. Not quite so much now
   c. Definitely not so much now
   d. Not at all

5. Worrying thoughts go through my mind.
   a. A great deal of the time
   b. A lot of the time
   c. From time to time but not too often
   d. Only occasionally

6. I feel cheerful.
   a. Not at all
   b. Not often
   c. Sometimes
   d. Most of the time

7. I can sit at ease and feel relaxed.
   a. Definitely
   b. Usually
   c. Not often
   d. Not at all

8. I feel as if I am slowed down.
   a. Nearly all the time
   b. Very often
   c. Sometimes
   d. Not at all

9. I get a sort of frightened feeling like "butterflies" in the stomach.
   a. Not at all
   b. Occasionally
   c. Quite often
   d. Very often

10. I have lost interest in my appearance.
    a. Definitely
    b. I don't take so much care as I should
    c. I may not take quite as much care
    d. I take just as much care as ever

11. I feel restless as if I have to be on the move.
    a. Very much indeed
    b. Quite a lot
    c. Not very much
    d. Not at all

12. I look forward with enjoyment to things.
    a. As much as I ever did
    b. Rather less than I used to
    c. Definitely less than I used to
    d. Hardly at all

13. I get sudden feelings of panic.
    a. Very often indeed
    b. Quite often
    c. Not very often
    d. Not at all

14. I can enjoy a good book or radio or TV program.
    a. Often
    b. Sometimes
    c. Not often
    d. Very seldom

We are grateful for your time. Thank you for completing this questionnaire.

Please put it with your partner's questionnaire and return it in the envelope provided.

<u>Supplementary questions for partners: Not at all (1) to Very much so (10)</u>

Do you feel you cope well emotionally with your caregiving role?

Do you feel you cope well physically with your caregiving role?

Do you feel emotionally detached from your care-giving role?

Do you regard yourself as a competent caregiver to your PD partner?

Appendix E: Approval by the Bath Spa University School of Society, Enterprise and Environment Ethics Committee for online survey and face to face testing of mothers of children aged under five years

Psychology Ethics Committee Report
School of Society, Enterprise and Environment

Researcher's name: Alison Wadeley
Project title: Sleep/PhD
Supervisor (if applicable): Alison Lee
Undergraduate Postgraduate Staff X

Summary of Ethics Committee meeting dated 20th July 2013:

Ethics Committee Decision

1. Pass X – Your proposal satisfies the ethical principles detailed in the BPS Code of Conduct.

2. Conditional pass ☐ – This proposal satisfies the ethical principles detailed in the BPS Code of Conduct, but requires some changes of a procedural or technical nature before the research can proceed. Your supervisor has agreed to supervise these changes, and will let you know when your research can proceed.

3. Resubmit ☐ - This proposal does not satisfy all of the ethical principles as laid down in the BPS Code of Conduct. Discuss changes with your supervisor and resubmit the proposal to the Ethics Committee.

4. Fail ☐ - Approval denied on ethical grounds. Consult your supervisor about writing a new proposal or consider using secondary data.

If you have not been awarded a clear 'pass' (category 1) you cannot begin collecting data until your supervisor has agreed the necessary changes to your paperwork (category 2). In the case of a request for resubmission (category 3) you must liaise with your supervisor to negotiate the necessary changes, and s/he will bring your proposal back to the Committee for reconsideration. Proposals which are failed by the Committee (category 4) will not be reconsidered unless they have been radically rewritten – proposals which fall into this category will often necessitate a complete change of project and/or use of secondary data. Any queries should be referred to the Committee via its chair, Dr. Diane Stevens (d.stevens @bathspa.ac.uk).

Signed ___________________________________(Chair of Ethics Committee)

Signed ___________________________________(Committee member)

Appendix F: *Mumsnet* - permission to analyse discussion forum contents

Re: (Case 89831) Sleepy parents

Mumsnet Towers contactus@mumsnet.com to me
14 November 2011 16:52

Hi Alison

Yes, that would be fine - although we would appreciate a mention of *Mumsnet* in anything you publish. And of course, we'd assume you'd delete any real-life details (names of children, geographical locations) that could identify the posters whose quotes you're making use of.

Best
Helen
MNHQ

-----Original Message-----
From: "Alison Wadeley" <a.wadeley@bathspa.ac.uk>
Reply-To: "Alison Wadeley" <a.wadeley@bathspa.ac.uk>
Date: Fri, 11 Nov 2011 17:01:02 +0000
To: "*Mumsnet* Towers" <contactus@mumsnet.com>
Subject: Re: (Case 89831) Sleepy parents

Thank you very much for your prompt reply. Before I ask for volunteers I was wondering about the acceptability of analysing existing discussion strings on sleep in order to clarify the kinds of experiences parents are having before I start to ask more specific questions. Do you think this would be OK? It would be written up as preliminary information in general terms using a selection of statements as evidence. I would not use people's online names.

Many thanks

On 9 November 2011 23:06, *Mumsnet* Towers <contactus@mumsnet.com> wrote:

Thanks for contacting us about this.
We're sure there are Mumsnetters out there who would consider being case studies for you.
You are very welcome to start a thread asking for volunteers.

Please put your request in the Media Requests section
here: http://www.mumsnet.com/Talk/media_nonmember_requests

There is a £30 charge for this, as a contribution to our running costs.
(Just click on the link and follow the instructions and you'll automatically be taken to the payment page.) Good luck with finding the people you need!

Best,
Catherine
MNHQ

Appendix G: *Mumsnet Talk* Thematic Analysis

Living with sleep disruption

1. Parents' and children's sleep needs are desynchronised.

    1.1. Frequent waking.

        1.1.1. 40-1A My problem now is that both dc are waking at different times in the night, two or three times each.

        1.1.2. 89A guess who was up with the teething baby every hour of last night...

        1.1.3. 195-8A ...your friend with the same age baby texts you at 2am saying "you awake?" and you reply every night. average wakings per night 10-20. hv [health visitor] gave up on us.

        1.1.4. 177-84A My local baby group is rather dominated by one woman who rails loudly and incoherently about her baby's (lack of) sleep patterns in great detail - "She had a feed at seven, then woke at SEVEN THIRTY and what do you know, she was up for forty seven minutes and I did shush pat for forty of those and then at twenty past eight I was just tiptoeing out when would you believe it but she was crying again, well that went on until ten to nine and then...", while other mums weakly interject with "Yes, I know" or "Me too..." If any of us could summon the energy we would tell her that yes, we are all knackered and you are not helping.

        1.1.5. 116-7C She has the past slept through the night but this is very rare and is usually followed with hourly waking the next night.

        1.1.6. 141-4C DD1 [daughter 1] is 2.8 and has only slept through a couple of times. DD2 [daughter 2] has now joined the conspiracy to deprive us of sleep and times her night-wakings around DD1. Last night...wake ups at 22.30 DD2, 01.30 DD1, 02.30 DD2, 04.30 DD2, 05.30 DD1 (when she came into our bed and disturbed everyone).

        1.1.7. 222-3C none my kids slept through til 8mnths plus. all woke ev 2hrs in nite for feeds.

        1.1.8. 230C Dd2 [daughetr2] has cried solidly for past two hours- as is normal most nights

        1.1.9. 346-9C My DS2 [son 2] was up for 2 hrs at his second waking last night from 2.45-4.45. He is 10 months and has never been a great sleeper. The best we have has is a few weeks of only one waking

1.1.10. 995-6C DD2 [daughter 2] has slept really badly all week now - between the 2 of them I've been up every hour tonight.

1.1.11. 1108-9C I'm averaging 3 hours sleep a night, all in snatches of about an hour/ 45 minutes

1.1.12. 1014-5C Worst was ages 4 - 10 months I don't think she ever slept more than 2 hours without waking.

1.2. Curtailed parental sleep.

1.2.1. 7-8A A bad night last night - 4 hours sleep in total.

1.2.2. 146-7A Haven't had more than three hours unbroken sleep since dd2 [daughter 2] was born 10 months ago.

1.2.3. 166-7A I go to a children's centre drop in on a Friday and there are a bunch of us with new babies and older children (ie no chance to nap in the day!)

1.2.4. 65-6A 6 month old has just started weaning and seems to be wanting all night feedathons.

1.2.5. 167-9C She currently has a cold and has her 2 back teeth coming through so I havent actually being to bed for 2 nights (that is not an exaggeration, I really havent)

1.2.6. 169-70C I got 1hrs sleep and am totally f-ed! Hoping for a nap later.

1.2.7. 249-51C Oh no, not illness! You just know there is no point in hoping for sleep then. My two are just recovering and ds2 [son 2] actually went from 1ish to 8am today! Ds1 [son 1] however was up from 5.45 but you can't have it all.

1.3. Altered expectations about sleep

1.3.1. 27A anything less than 4 night wakings is a "good night"

1.3.2. 46-7A Wow, tell me about it. Only 4 night wakings would be living the dream for me! Ds [son] is 7 months and showing no signs of reducing his ravenous feeding all night long!

1.3.3. 134-5 You tell everyone how pleased you are that your baby woke up at 3am instead of 2am.

1.3.4. 216-7A ...four wakings would be an ok night here too.Bad night includes 2 awake for an hour spells, he's nearly 14mo and I am quite sick of it frankly.

1.3.5. 241-2B You are jealous of parents whose babies sleep until 5.30am as you consider 5.30am to be a lie in.

1.3.6. 321-2A I'm at the stage now where 3 wakings a night is considered a blessing - 4-5 is more normal

1.3.7. 42B Its only 6.30 and you're on your second load of washing

1.3.8. 527-528B Being pleased that your baby managed 2 hours in a row during the night, when for months it was 1.5 at the most.

1.4. Can ‘function’ without sleep.

1.4.1. 392-4B You wonder why you wasted so much partying time in your twenties not staying out all night when you can so clearly "function" without any sleep now

1.4.2. 1908-11C makes me realise how tough I am too;10 years ago I might have bragged about going to bed at 2 or 3am ocasionally, then being in work at 9 next day. Nowadays I never get that much sleep and still function and look after 2 children!

2. Sleep need is intense

2.1. Grasping the opportunity to sleep

2.1.1. 245-7B And on your first child free night you forget a night out or cracking open a bottle of wine but instead go to bed at 9pm and enjoy 10 hours of blissful uninturrupted sleep.

2.1.2. 319-20B I'm going to Ibiza without baby for 2 days soon and I fully intend to sleep for 48 hours.

2.1.3. 491-2B Thought i was being amazingly clever leaving work at lunchtime and keeping ds in nursery so i could go home and sleep for the afternoon

2.1.4. 822-4 C Why can't the jehovah witnesses knock on the door when I want them to, I swear if they had at 2.30pm when DD woke from her nap, I would have welcomed them in and paid them a LOT of money to just watch her for an hour while I continued my nap

2.1.5. 915-6C My biggest bit of advice is dont worry about what the books say or the HV says, do whatever u can to get some sleep.

2.2. Any sleep will do

2.2.1. 174-5A ...they [the children's centre] should provide beanbags and gym mats to give you all some "quiet time!"

2.2.2. 46B The bathroom floor looks to be an inviting place for a nap.

2.2.3. 425-30B (A few days later while listening to the news on the radio about the sleep-deprivation torture technique being used on prisoners at guantanomo bay I realised that they were getting a better quality & amount of sleep than me. I then seriously started to think about ways that I could get to spend a few nights in a nice, cushty prison cell!).

2.2.4. 209-10B You put your head down on the kitchen table for a 20 second nap at lunch time and feel better for it.

2.2.5. 450-2B A friend text to let me know she was in hospital for investigations. Instead of thinking sympathetic thoughts for my friend, my first thoughts were of jealousy that she'd get an uninterrupted night's sleep.

2.2.6. 708-10C I feel insanely jealous of anyone who is sleeping-even my depressed mother who has been prescribed big fat sleeping pills. I know-unreasonable in the extreme but I just want some sleep.

2.2.7. 1037-9C Broke down last night and told DH I actually longed to have a semi serious accident eg broken leg just because if in hospital I would at least have some unbroken sleep. In the cold light if day I think that was melodramatic, but last night I meant it

2.2.8. 1820-1C I want to also be put in hospital**...**because then I'd sleep.

2.2.9. 753C Right now I might voluntarily section myself just so i can get some sleep.

2.3. Longing for sleep

2.3.1. 249-50B You wish it was winter so you could go to bed at 7pm and pretend it is much later because it is dark.

2.3.2. 279-81B You are so desperate to sleep you ignore the fact that you only have until midnight to edit your auto-order of online shopping and hide under the duvet. Anyone need any size 2 nappies and avocados?

2.3.3. 501-2C am trying not to wish away the newborn stage because this is our last time but PLEASE baby - can we have at least 1 three hour stretch at night?

2.3.4. 504C Been praying to the sleep god for one and all.

2.3.5. 620-1C Have tries to get rid of expectations but keep thinking that one night or one nap time he'll surprise the hell out of me by sleeping like he used to.

2.3.6. 720-4C I am starting to fantasise about sleep in the way I used to fantasise about boys when I was a teenager... You know, obsessively.

2.3.7. 997-1001C I've had to clean the house my parents just bought before they arrive from France today. It's taken 14 hours this week when all I wanted to do is sleep...They had said they'd pay me for doing it but right now I'd rather have some sleep!

2.3.8. 1194-5C go to bed every night thinking "maybe, just maybe this is the night they will magically sleep through?!"

2.3.9. 1219 Yes I do go to bed EVERY night thinking I might not be woken til say, 5am.

2.3.10. 1337-8C I just want the quickest route back to sleep.

2.3.11. 1860-1 At least I have now got 1 reasonable night under my belt, hopefully it will (please, please) happen again.

2.4. Sleep pressure

2.4.1. 169-70A...we sit there [with friend] setting each other off yawning.

2.4.2. 170-1A They play soft classical music there [at the children’s centre] too and it makes us all feel really sleepy.

2.4.3. 256-7A ...you are pushing the pram, note that it's a straight bit, and there is no poo on pavement to dodge, so maybe you could just walk with your eyes closed for a bit.

2.4.4. 1109-10C Yesterday I could feel myself falling asleep as I sat of the sofa with DC [children] and I had to literally slap myself to come round....

2.4.5. 795-6C I nearly fell asleep in the corner of a playgroup this afternoon while another mum was rescuing DD from escaping into the cold outside as I hadn't even noticed

2.5. Nodding off

2.5.1. 219-21A I remember falling asleep on the settee, upright, for a few mins. When I woke up/came round I realised I still had food in my mouth and fallen asleep before I could swallow it

2.5.2. 37B You nod off in the time it takes facebook to load a page.

2.5.3. 207-210B You fall asleep while reading bedtime stories but your children are still awake.

2.6. Sleep makes me more human

2.6.1. 144-5C Last night was a good night...I feel decidedly human today!

2.6.2. 927-8C Had a good night this week and it was *weird* being able to think clearly the next morning.

2.6.3. 1223C Woohoo! I've had some sleep!

2.6.4. 1431-2C I'm feeling like a different person today from having had sleep.

2.6.5. 1573-7C DS woke at 7, so sleep for me a bit interrupted then...but otherwise was the best night in AGES!!! ...feel more human. Going out for coffee with a friend today and hopefully will look less like a zombie from the planet sleep deprivation.

2.7. Inability to sleep

2.7.1. 83C i can't just command sleep instantly!

2.7.2. 513-5C I think it was the reason it clicked that I had PND, the really not being able to sleep between the 2 hourly feeding through the night despite being exhausted.

2.7.3. 756-9C My dear pils [parents-in-law] came today and took the boys out for an hour for me to get some rest. Couldn't bloody sleep! Laid in bed feeling anxious, stressed and depressed but not tired. I never would have seen that one coming. Sorry, feel I have let the side down by having the chance to nap and failing!

2.7.4. 777-8C I think you get too tired to sleep bizarrely. Or to sleep easily. I have gone past feeling sleepy

2.7.5. 989-90C Had such a busy day today & a nice relaxing evening so I was sure I would sleep but 4 hrs & I'm awake.

2.7.6. 1045-6C I can't sleep any more with him in the bed, I just lie there looking at him waiting for the next call.

2.7.7. 1964-5C Sadly I can't sleep at all tonight even though DD [daughter] is quiet, so I'm lying here waiting for the boot to drop.

2.8. Sleeplessness is a wind-up

2.8.1. 41-3A I am knackered and have that dread of going to bed as I know I will finally fall asleep only to be woken and it will be foul and cold and moan moan moan...

2.8.2. 185-6C Had the chance to sleep between 4 and 7 this morning, (a lie in!) and laid awake fuming instead.

2.8.3. 226-7C ironic bloody kids sleep now and i cant!

2.8.4. 765-6C Snap! My dad took oldest, baby was (for once) sleeping like a baby and I couldn't sleep! Grrrrr!

2.8.5. 1237-9C Grr! Bloody insomnia has meant that despite DD continuing to sleep, I've been awake ever since. So instead of a wonderful extra 3 hours sleep on top of the 3.5 I'd already had I've just been lying here getting wound up. Great!

3. Changing relationships with others

3.1. Falling out with husband/partner

3.1.1. 1309C I'm snappy at partner

3.1.2. 1884-5C Fell out with DP [partner] this morning, I'm not actually sure what it was about. But we weren't speaking when he left for work.

3.1.3. 1963C biggest row with DH [husband] last night, I stormed off to bed

3.1.4. 1984-6C I also had a big row with DP [partner] this morning - maybe it was just the day for it? Was livid when he left for work but realised he only said what he did because he loves me and worries about me.

3.1.5. 2027-8C Also had a big row with DH [husband] yesterday. THINK it was something to do with him passing me a book incorrectly...

3.1.6. 2071-2C DP [partner] and I have started doing that competitive who's the most tired thing which really is a stupid thing to argue about.

3.1.7. 2072-3C We seem to spend a lot of our time bickering and then apologising for arguing over nothing.

3.2. Appreciation of partner's support

3.2.1. 710-11C Dh [husband] is understanding, even gets my irrational response to his snoring.

3.2.2. 1261-2C I am thankful to have a very supportive DP [partner] who reguarly helps with the night wakings - without him, I think I'd have probably cracked a long time ago.

3.3. Resentfulness about husband/partner's and others' sleep

3.3.1. 158-9C very resentful of snory dh [husband]...

3.3.2. 195-7C I'm cosleeping with him in the spare room, but now DP is complaining that he's not sleeping well because he's lonely by himself... he's still getting 8hrs+ a night so I'm not feeling very sympathetic towards him!

3.3.3. 715-6C Husband is fast asleep beside me snoring away. Would it be wrong to push him off the bed and pretend he fell off?

3.3.4. 866C And my husband is rubbish too, never got up with her once.

3.3.5. 587-9C Everyone is now up looking happily hungover, reminiscing about fun evening... I am feeling grumpy and jealous. Does anyone else find themselves feeling really unfairly resentful of those that get sleep?

3.3.6. 1022-3C... just wish DH [husband] and I could spend an uninterrupted evening and sleep in the same bed!!

3.4. Interactions with others

3.4.1 184-7B then going up to the attendant to complain that I had to 'seek assistance' when it had plenty of money on it. He gave me a sympathetic/pitying look, kindly managing to refrain from laughing.

3.4.2. 509-11B Preceding every sentence to another adult human with: "You'll have to excuse me but I'm terribly sleep-deprived" in the hope that it'll stop them from thinking I'm a complete lunatic.

3.5. People make you feel bad

3.5.1. 1640-1C People are making me feel bad for constantly feeding, like I am causing the problem.

3.5.2. 2131-5C All those people with their comments about how wonderfully x baby sleeps/eats/crawls/poops make my blood curdle, joking or not! I know lots of people mean well but they are not the ones waking up every hour or whenever to a crying child who cannot be calmed or can only be soothed by constant feeding.

3.6. Choosing who to talk to

3.6.1. 830-1C...choosing who I talk about with it to. Someone who hasn't been through it won't understand.

3.6.2. 108 -9C I also try to avoid speaking to those that are smug with perfect sleeping babies, I'm definitely past the newborn pity stage and into the "what are you doing wrong" stage.

3.6.3. 2117-9C You do have to be careful what you say to who. I wouldn't dream of going to my sisters for help, one of them in particular likes to say things like well if you'd been doing x since she was born ect, like that helps me now!

3.7. Not smug now

3.7.1. 31-2C I was a smug bastard with ds1 [son 1] who was a good sleeper. Not smug now!

3.7.2. 75-8C I too was a smug bastard with ds1 and regret it now! A friend has just had first child and is horribly smug about amount she sleeps. I have twice excused myself from seeing her as can't bear it, will fall out with her!

3.7.3. 967-8C I was sooooo smug with DS, [son] I really thought it was people making problems by not being firm, but I have well and truly learnt my lesson.

3.8. Impaired ability to be a mother

3.8.1. 589-92C One thing that really bothers me is that I don't have enough energy to be fun with toddler... Then I watch him playing happily with others and feel so guilty for not having those levels of energy a lot of the time. He must think I'm so boring and grumpy

3.8.2. 770-1C Am so knackered that I'm a bad mummy when she's awake - too tired for fun and games

3.8.3. 1048-51C I love my children but tiredness is impacting on my abilities to be a mother... I keep bursting into tears and I know it is effecting my toddler seeing me like this. Also feel like my tiredness is spoiling what should be a really happy time....

3.8.4. 1540-2C it was beginning to impact on my health and my relationship with my older child and DP [partner], so I did have to do something.

3.9. Deterrent to having more children

3.9.1. 324A how does anyone cope with more than 1 child? how?!!

3.9.2. 344-5B If DS [son] had been my first, he'd have been an only because of the sleep deprivation alone...

3.9.3. 132C Is anyone who wanted more dc put off by the dreadful current sleep situation?

3.9.4. 135-8C I'm put off wanting more dc, I'm sure we still will but I think at least three years gap is needed. I can't imagine being pregnancy tired on top of this. Last week DH [husband] was away with work and DD [daughter] was sick, I remember thinking about 3am "I can never do this again"

3.9.5. 153-5C I have always wanted 3 and every night I urge myself to write a stern letter to my future self, urging myself not to and reminding myself how it feels!

3.9.6. 224-6C didnt stop me having more kids. once you get half decent sleep you forget (like childbirth) how hard it can be.

3.9.7. 1141-2C I had been waking every 45 minutes for a year and I was considering not having any more children!!

4. Torture, hell and madness

4.1. Pure torture

4.1.1. 314C pattern of torture

4.1.2. 714-5C Am tortured by the constant interruptions every time I start to fall asleep

4.1.3. 751-3C am seriously sleep deprived. The UN convention on human rights should have a section on parenting children under the age of 5.

4.1.4. 1309C I'm seriously losing the will to live

4.1.5. 1584-5C its just the unbroken [sic] sleep that's killing me.

4.1.6. 2011-2C waiting up to avoid the torture that is being disturbed just ad you drift off again!

4.1.7. 1120C It is pure torture being so sleep deprived

4.2. A living hell

4.2.1. 168C We had a hellish night last night

4.2.2. 193-4C we're currently in 4 month sleep regression hell

4.2.3. 200-1C I guess for whatever reason a person gets no rest, the results are the same. It's all so stressful and horrible.

4.2.4. 231C sleep deprivation is awful

4.2.5. 264-5C I know this will pass, but my god why can't it be over now?

4.2.6. 358-9C had 1 hour of sleep last night and feel like utter shit today.

4.2.7. 812-3C I won't die from tiredness though, this is what I keep telling myself --even though I wish I would some mornings

4.2.8. 1302C just hell for both of us.

4.2.9. 1376... so desparate...

4.3. Going mad

4.3.1. 706C I am going slowly mad from sleep deprivation.

4.3.2. 714C Have gone mad.

4.3.3. 830-1C I am broken, I am also 8 weeks pregnant, how we had the energy, I still don't know!

4.3.4. 985-6C I no longer make sense. My brain that was has vacated my body and been replaced by a soggy flannel.

4.3.5. 1183-4C I know that driven to the edge thing all too well

4.3.6. 1299C I'm in bits, no sleep since my girl was born 5months ago.

4.4. Crying with laughter

4.4.1 86-8A your OP [posting] has just made me cry with laughter...think poss evidence of sleep deprivation in itself I just read it out to dh [husband] whilst wiping away the tears and he just looked at me blankly

4.4.2. 279-80A I have just borrowed the edge of DS's blanket to wipe the laughing tears away. He's only been around for 5 months as well

4.4.3. 416-7B You find yourself laughing manically at pointless things that really aren't **that** funny.

4.4.4. 456-7B Hilarious, thank you - sat here crying with laughter (makes a change from crying from lack of sleep!).

4.5. Crying with despair

4.5.1. 105-6A crying no stomach wrenching sobbing while making my bed longinf to crawl into it and not get out of it for a week.

4.5.2. 1710-2C I just got off the phone from another friend with a younger baby that just started sleeping through by itself this week and burst into tears cos I felt like such a failure at having yet another non sleeper.

4.6. Crying with exhaustion

4.6.1. 24A I burst into tears a lot when over tired.

4.6.2. 1412C We've both [self and daughter] been crying quite a lot today as we're both so tired

4.6.3. 838-9C In my sleep deprived emotional state I could cry

4.6.4. 1225-6C a day of completely losing it having been woken hourly Thursday night! Suffice to say I had lots of tears yesterday

4.7. Emotional volatility

4.7.1 308-10A [in supermarket]... burst into tears because I didn't know why I was there or what I needed to buy. Phoned my DP [partner] and blubbed down the phone at him, asking what I needed to buy...

4.7.2. 200-1B The swimming instructor tells you your DS [son] will have to repeat Stage One and you feel close to tears. Your DS is 5 months old.

4.7.3. 23-4B You feel like getting out the bubbly because DC has let you sleep till 430am.

4.7.4. 244-5B You cry real tears of joy and relief when your DM [mother] offers to have the baby ALL NIGHT.

4.7.5. 343B Then you cry for ages convinced you've damaged your baby!

4.7.6. 475-6B also tripped over the pram wheel landed on my face laughing manically which very quickly turned to tears

4.7.7. 89-90C I will actually weep if i try and do anything without caffeine

4.7.8. 805-6C had to laugh breezily and brush it off when I felt like laying on the floor crying when they told me I had wrong day [for an appointment].

4.7.9. 1239C About ready to cry again

4.7.10. 1567-8C Then had a bit of silly screaming (totally overtired), her I mean, not me, although it was a close run thing.

4.7.11. 2102-4C Well meaning but smug people who asked if I'd tried a bedtime routine incite violent rage in me and inward screaming of 'WTF DO YOU THINK I'VE BEEN DOING FOR MONTHS? DO I LOOK LIKE AN IDIOT??!!''

5. Depression, anxiety and worry

5.1. Feeling depressed

5.1.1 4C exhaustion and misery of the long or short term effects of lack of sleep.

5.1.2. 16C I am having a very down day

5.1.3. 35C One day lasted about 6 years to me when i was getting no sleep

5.1.4. 1667C turning into a pissed off Mum

5.1.5. 329-30C I go through these phases of hating it and being very grumpy indeed

5.1.6. 664C its so depressing when you wake up and see how little time you've been asleep

5.1.7. 803C I am bloody fed up.

5.1.8. 854C im fed up, tired

5.1.9. 999C Just feel thoroughly miserable and extremely achey and basically sorry for myself.

5.1.10. 1309-10C I'm sick of feeling and looking shit every day.

5.1.11. 135C can feel depression slipping in.

5.1.12. 1432-3C Starting to realise I think it was tipping me int depression being so tired

5.2. Feeling anxious

5.2.1. 181C lack of sleep makes us all tetchy

5.2.2. 367-9C Anyone else developed panic attacks? I'm normally a fairly chilled person but I had a stressful pregnancy (PE) [pre-eclampsia] and now with the sleep deprivation I seem to be having them regularly and they are scary as hell.

5.2.3. 778-9C get anxious more

5.2.4. 808-10C I get so much more anxious these days too, I think the constant sleep interruptions mean your nerves become sensitised. I am jumpy and reactive about the smallest things.

5.2.5. 370-81C have had many tears but no panic attacks recently...have had them in the past and it sucks.

5.2.6. 390-5C I definitely think sleep deprivation and anxiety go hNd in hand. Your reserves for coping are utterly depleted so the most minor thing can cause you to feel anxious and jittery and unBle to cope. One your adrenal glands become used to being aroused they seem to become overactive and lead to feeling jittery and often panic attacks. Remember they are just the physical manifestation if adrenaline being released inappropriately. Horrific though

5.3. Worry

5.3.1. 265-7C Am worried that am reinforcing behaviour when go in or co-sleep or feed to sleep, yet simultaneously worry am harming him if I don't do those things.

5.3.2. 532C Am driving myself insane worrying about what to do, what not to do

5.3.3. 1648-9C The thing that gets me down the most about it is the feeling that I'm must be doing everything wrong and it's all my fault

5.3.4. 1668-71C I am afraid I am not a calm/good enough person not to get annoyed with the situation and want to scream at him to shut up and go to sleep. (Which I have to admit, in my worst moments I have done). Then I play the guilt trip on myself and try to get him to sleep again.

6. Physical symptoms

6.1. Sick and dizzy

6.1.1. 200-1A Actually feeling sick and dizzy with exhaustion, holding onto the side in the kitchen for fear of falling over.

6.1.2. 158C I had such a bad night last night. Feeling dizzy and sick today,

6.1.3. 186-8C ds1 [son 1] woke so pleased that his gro clock was telling him it was ok to get up and could he have a sticker etc. Had to act thrilled through the dizzy haze of inside my head.

6.2. Body screaming with tiredness

6.2.1. 460, 471C Does anybody else feel as if their insides are screaming?... Screaming due to lack of sleep, that is.

6.2.2. 958-60C body screaming with tiredness. I get that if I've only been asleep a short time and have to do a feed and even though I'm lying down it's not how I like to sleep and it's like every fibre of my being is SCREAMING to lie on my front and pass out!

6.2.3. 1001C I totally get the body screaming thing right now!

6.3. Backache

6.3.1. 1585-6C she ended up in our bed last night again so my back is aching.

6.3.2. 1591C I've had the worst backache since DD [daughter] did the every hour marathon!

6.3.3. 1623-4C I know what you mean about backache, I feel about 100 since this baby with lower back and/or shoulders aching all the time!

6.4. Hung-over

6.4.1. 387-390B You realise that being hungover has more to do with being very tired and sleeping badly than the alcohol consumed when you get up after yet another night awake all night feeling like you have drunk 10 pints and smoked 20 Marlborough Lights!!

6.4.2. 2228-9C Had 2 cups of coffee already and instead of feeling more awake have that cotton-wool head but jittery feeling...

7. Do whatever you can to get some rest or sleep

7.1. Enlist the help of others

7.1.1. 59-61C If people offer to take your precious one off your hands for a few hours or even just an hour...snatch their hands off...then lie on the sofa for an hour, close your eyes and sleeeeeep.

7.1.2. 29-30 A...I am promised a lie-in tomorrow.

7.1.3. 28C...a nap or lie in at the weekend helps, if your partner/dh [husband] /passing stranger can help out with childcare.

7.2. Sleep when your child sleeps

7.2.1. 211-2B When your DS/DD falls asleep in the car, you pull over somewhere safe and join them...

7.2.2. 56-7C When ds [son] went to bed at 7pm, by 7.15pm,i too would be in bed, not every night but at least two nights a week.

7.3. Get to sleep quickly

7.3.1. 9-11C Make sure you are warm enough when you have to get up in the night. Have dressing gown and slippers by your bed if necessary. This also helps you get back to sleep quickly, should you be fortunate enough to have the opportunity!

7.3.2. 424C tesco sleep aid things are quite good

7.3.3. 969-70C I have a very warm dressing gown and wear that when I get up to DD [daughter], and then cover my bottom half with a duvet.

7.4. Collapse

7.4.1. 2205-6C if toddler won't sleep this afternoon, I'm putting on toy story and dozing on the couch with them both

7.4.2. 103-5C I take DD to gymboree 2 or 3 days a week now she's crawling so I don't have to chase her around the living room saying "no". Soft play is a blessing - at least I can collapse in one place and know she won't hurt herself!

7.5. Facilitate child's sleep

7.5.1. 105-6C Also it [Gymboree] normally exhausts her so I can grab a cheeky starbucks or do some shopping on the way home while she naps in the pram.

7.5.2. 2202C spend as long as possible in the park this morning to wear out toddler

7.5.3. 990-2C Must be quiet as dd is a light sleeper & if she hears me she will be up & chattering away & that will be the end of sleep for the night (she is almost 9, not a baby but needs very little sleep)

8. Deal with cognitions and emotions

8.1. Retain a sense of humour

8.1.1. 29A Retained my sense of humour though...

8.1.2. 72A Laughing at the situation helps a lot.

8.2. Accept the situation

8.2.1. 292-3C I'm not - not sure I'd describe it as philosophical, more just acceptance that this is how it will be.

8.2.2. 329C I most of the time accept the situation...

8.2.3. 447C I have found accepting the situation an enormous help to me, psychologically.

8.2.4. 2043-4C none of this is our fault, lots of people do the same as us and have beautifully sleeping babies.

8.2.5. 793C...only half hour naps but I guess that's better than nothing.

8.3. Be realistic (and deluded)

8.3.1. 68-72A With my first I used to get very flouncey and do lots of "Oh my God I can't believe it I am so tiiiiirrrrrred." A thread on here about what you wanted to do differently with your second included a comment from someone who said she was going to be "less melodramatic" about sleep, and it's really stuck with me.

8.3.2. 448-50C I feel we expect a good night's sleep and think of it as a right or a necessity. It isn't. The 8hrs uninterupted thing is a fake, airbrushed ideal, probably promoted by matress sales people.

8.3.3. 952-3C I have convinced myself that all these mums with magical all-night-sleeping babies are LIARS.

8.3.4. 701C I delude myself I sleep less but sleep more deeply when I do.

8.4. Survive

8.4.1. 120-1C I have no advice, as I actually wonder how on earth we manage

8.4.2. 337-8C Just survive however you need to, anything else can be sorted later once she had mastered sleeping

8.4.3. 458C It is possible to survive, but, by god, it is hard.

8.4.4. 545C you will survive

8.5. This will pass

8.5.1. 212-3A Only thing keeping me going is that it won't last forever (it just seems like it when you're in the middle of it)...

8.5.2. 450-1C I know ds [son] wil grow up and, like his big brother will go off to sleep and not wake till the morning, save for bad dreams, or illness.

8.5.3. 543-5C Keep telling yourself that this will pass, that at some point they (and you) will sleep better again.

8.5.4. 815-6C I know, it's really hard. There is no answer, I hang onto the fact that, even if we do nothing, they will sleep through at some point!

8.5.5. 1686-8C When I'm feeling really crap and bad about it, I remind myself that when DS [son] is 5 he will not be like this... that hopefully in a few more weeks he will not be like this. This too shall pass

8.6. Remind yourself of the plus points

8.6.1. 181-2C it is so, so bloody difficult to bear this in mind, I know but: try to remember millions worse off for whatever reasons.

8.6.2. 296-7C It won't be long till they won't want cuddles all the time, and much less to sleep with us so I'm just making the most of this precious time while I can!

8.6.3. 546-7C Tell them you love them, because, bizarrely, despite the sleep regressions etc. you really really do.

8.6.4. 702-3C Remembering regardless of how little sleep I've had, what I went through to conceive, ds2 [daughter 2] is a total miracle

8.6.5. 736-8C A close relative of mine has been trying for a baby since before I had ds1 [son 1] and I remind myself of that when I am losing the will to live.

8.6.6. 1079-80C I try and remind myself of the plus points of having a high need baby whenever I'm feeling really down.

8.6.7. 1558-64C it's a lovely problem to have in a way, it's fucking haaaaaaard sometimes, but I wouldn't be without DD [daughter]. After a really shit night, when i go in to feed her in the morning she keeps pulling off to look up at me and beam at me with total love, it's lovely, even after the crappest of no-sleeping nights. Sometimes once I've managed to rock her to sleep and she's in my arms all peaceful...I look at her and think how lucky I am.

8.7. Use *Mumsnet* Talk support

8.7.1. 86C Sorry others are feeling my pain, but it is good to have the company.

8.7.2. 355C Anyway, misery loves company, so here I am!

8.7.3. 372-3C she's my first and all my friends have better sleepers/feeders so its really reassuring to find out I'm not the only one struggling.

8.7.4. 429C All tales of survival are music to my ears.

8.7.4. 186-7C I really appreciate people not flaming me and just being understanding.

8.7.5. 1156C Thanks for all the support, it really helps coming from people who truly understand.

8.7.6. 838-9C I am so happy to find this group, please can I join too?...finally somewhere to moan to to people who really understand.

8.8. Use family support when you can

8.8.1. 64C So far I am buoyed by having seen my family so am relatively patient.

8.8.2. 903-4C When he came back [husband returned after two weeks working away]...he ng] stayed [sleeping] on the sofa for two more weeks bless him.

8.8.3. 973-4C I do all night wakings as DD [daughter] is ebf, [exclusively breast fed] and then I can get DH [husband] (unemployed) to do the lionshare of stuff during the day if I've had a bad night.

8.8.4. 1039-41C Doesn't help that DH [husband] is having a mental week, leaving house at 6 am and home at 11pm. Just don't feel I can ask him to help at the moment.

8.8.5. 949-50C... frequently venting to my mum (she understands: my sister only needs about 4 to 5 hrs sleep a night, and sadly for my mum it was already the case as a newborn).

8.8.6. 1889-92C It's good to have somewhere to rant everyone in rl either thinks its my fault or they don't understand. Apart from my mum, I was a really difficult sleeper until I was about 5 so my mum understands but when I talk to her she sort of fills me with dread that things are going to be like this for a long time.

9. Look after yourself

9.1. Exercise and fresh air

9.1.1. 30C Getting out in the fresh air helps me

9.1.2. 80C I have dogs so they get us out daily which always helps.

9.1.3. 800C Yoga in the evening

9.1.4. 948C ...daily walks...

9.1.5. 226C fresh air

9.1.6. 698C Walk ds1 [son 1] to school with baby in buggy even in the rain.

9.1.7. 731-2C A sunny day here so about to take dogs and children out for a walk which may help my head

9.1.8. 176C Getting out in fresh air helps.

9.2. Caffeine, drinks and sugar

9.2.1. 122-3A would not have been able to walk home without the caffeine

9.2.2. 90-4A You know you're sleep deprived when all you want to eat is something sugary with coffee. ALL DAY. And then another one.

9.2.3. 212-3B... or find the nearest drive through McDonalds because you know they do coffee.

9.2.4. 27C Good coffee is a help in the morning.

9.2.5. 177C Drinking lots and lots of water.

9.2.6. 304C A big coffee is a must.

9.2.7. 697C Caffine, sugar, protein at breakfast. Fruit and yoghurt dont cut it.

9.2.8. 699C Mid morning snack. More caffine.

9.2.9. 948C...a LOT of tea and coffee...

9.2.10. 2200C coffee, good stuff only, to be employed judiciously.

9.3. Comfort eat

9.3.1. 96-8A I must try to break my custard cream habit. They are cheap though, so I like to kid myself that I am helping the pursestrings by having a fistful of them instead of some fruit...

9.3.2. 32-3B It's breakfast time and you've already eaten 4 cereal bars from the snack-stash.

9.3.3. 13-14C Have lovely breakfast things in. I always have expensive cereal in the cupboards Just For Me.

9.3.4. 226C lots chocolate got me through it.

9.3.5. 340-1C My mil made some flapjacks, should have lasted about 4 days. Would have done for ds [son's] lunchbox. I ate The Lot in One Sitting. That is tiredness. About to stuff my face with chocolate now

9.3.6. 365-6C I'm sitting here...stuffing chocolate

9.3.7. 785C I ate 4 yum yums for breakfast yesterday and that definitely helped!!

9.3.8. 834-5C its such a comfort to see that it is not just me who eats junk and just has to get through the day, half an hour at a time!

9.3.9. 853-5C I eat crap non stop all day because im so knakered...getting fatter!

9.3.10. 956-7C treating myself with a nice breakfast (and food in general...I'm going to be the size of a house at this rate)

9.3.11. 136-7B You eat an obscene amount of chocolate, mainly between the hours of 1 and 5am.

9.4. Use diet supplements

9.4.1. 605-6C I bought some iron supplements as dh [husband] pointed out that I feel just like I do when anaemic, so hoping they will help.

9.4.2. 948C I cope with Berocca [a multivitamin]...

10. Accept and live with limitations

10.1. Bare minimum days

10.1.1. 52C Have "lazy days" where you slob about in the house in tracky bottoms and sweater

10.1.2. 108C If possible, do things *slowly*.

10.1.3. 1558C Think today shall be another day where we don't really do anything.

10.1.4. 2199C My strategy for the day is to make life as easy as possible.

10.1.5. 2203-4C no food battles today. Toddler is getting the fail safes, toast and marmite, juice, sausage roll for lunch, yogurt, fish fingers and peas for tea.

10.1.6. 2207C today is not a bath day (toddler not a fan)

10.1.7. 2212-4C "bare minimum" days. I "grant" myself them every now and again. No housework, everything goes in the dishwasher, no bath for DD [daughter].

10.1.8. 2225-6C, 2231-3C Bare minimum day here too. DS already in front of Thomas the tank engine (and likely to stay there for most of the day). Yes to no food battles and minimal cooking. Cheese on toast here! Yes to no bath and yes to absolutely no washing up or housework till the evening. And yes to lying on floor and letting them drive cars and jump all over me while I quietly groan all day.

10.2. Fill time

10.2.1. 35-44C...i wrote down a plan for the day and ticked them off as i went along. Even just small things like 8am wash up. 8.30 hoover living room, 9am coffee...2 t spoons in cup!! 10am washer on, 10.10 ds sleep in cot, 11am ds up, in pram, out for a walk...make ds [son] walk to tire out for tonight etc etc

10.2.2. 47-8C Also every day, without fail, wind or shine, i would get ds out for a walk, even just around the block, he was able to run off some energy, and it killed up to an hour

10.2.3. 50C We went to the library, to visit friends, to soft play anything to get out for a few hours.

10.2.4. 52-4C i used to put water in the bath and a load of toys and chuck ds in to play for an hour...he loved it and it killed an hour!

10.2.5. 597-9C Decided that my only tips so far are too keep as busy as possible after a bad night to try to block out the tiredness.

10.3. Use ‘modern living’ to help

10.3.1. 159-60B You feel tired to walk half a mile to the clinic and take the car instead.

10.3.2. 327-9A Oh my goodness, yes, shopping when sleep-deprived. I do the bulk of mine online now, so that I can return to the list over a few days and wrestle it into something sensible.

10.3.3. 499B now only do home shopping

10.3.4. 208-11C Another thing which keeps me going in the night is my iPhone...I know I am very lucky and it was an extravagance but really felt I needed something to help make things less grim when I felt like the only person awake in the world.

10.3.5. 218C Screen time is bad for sleep but too tempting isn't it?

10.3.6. 570, 2-3C My (shameful) top tip if you have older children has to be C beebies!... we are now watching postman pat with coffee (me) milk (toddler) and a plate of toast. Suddenly it's all a bit more bearable!

10.3.7. 2201C ditto cbeebies

10.3.8. 2236-7C Just bought mini pizzas and am considering using leftover paper plates to eat them so no washing up! Too sluttish?!

10.3.9. 1504-6C Another tip to deal with sleep deprivation: Get a slow cooker. Shove stuff in there in the morning (or at some point in the middle of the night), start it mid-morning, and you will have a good dinner ready without having to really think much.

10.4. Keep organised

10.4.1. 80C Like idea of making a list too

10.4.2. 95-101C Mornings are best for my DD [daughter], she'll happily play in the playpen unsupervised so I get the most done between 7 and 8am. I make packed lunch for DH [husband] and do an extra one for me, so I don't have to find time at lunchtime. I make two cups of tea or coffee at a time and keep one hot with a saucer on top or zap it in the microwave later. I give DD her bath in the morning and get in with her, saves me having to rush about showering during her nap and frees that time up for other things.

10.4.3. 179C Making a to-do list.

10.4.4. 226C making lists.

10.5. Make allowances for cognitive failures

10.5.1. 513-14B Talking out loud to myself in the supermarket as it's the only way to remember what I went in for.

10.5.2. 340-2A After searching through handbag and changing bag [for car keys], I always find them on the driver's seat, where I have tossed them because I knew I would forget.

10.5.3. 553-7B I also have a list of preposterously mundane tasks on the white board that I'd forget to perform if they weren't written down (things like 'hang out washing') because I can't keep track of whether it's Sunday or Wednesday.I've had to buy a mini white board to go on my fridge. On it I write the day and date (changing it every night during the midnight feed)

10.5.4. 32-4 A Just thought of another one - hunting out and using the free bath thermometer from the Bounty pack because you can't rely on your own hand to tell you the temperature of the water any more!

10.5.5. 345-6A On the subject of driving, we are all taking great care not to drive if we've reached the winking bathmats level, aren't we? Tiredness on the road is not at all funny.

10.5.6. 1201-3C I’m still able to magically get the alcohol from the bottle, into a glass and then into my mouth without spilling a drop

10.5.7. 1232C Managed to co-ordinate glass to mouth when one [Baileys] was poured though!

10.6. Acknowledge inability to cope

10.6.1. 70C I just can't seem to get it together.

10.6.2. 82C feel overwhelmed

10.6.3. 170C I'm having a not-functioning day.

10.6.4. 230-1C...she is 13mths and I have no idea how to make this stop

10.6.5. 1108-9C I just feel like I can't go on like this.

10.6.6. 1226C I was so unable to cope

10.6.7. 1312C I'm at my wits end

10.6.8. 1405-6C I'm too sleep fuddled to think clearly, but something's gotta give. Can't go on like this.

10.6.9. 1548-9C this is not sustainable. I don't know what I'm supposed to do.

10.6.10. 1678C I just don't know what to do anymore.

10.6.11. 1705-7C just broke down completely after a few minutes of wailing. Too tired to cope with all this

10.6.12. 1715-7C I did try the no cry sleep solution with DS [son] and it didn't work for me cos it requires quite a lot of thinking planning and doing and I was way beyond being able to cope with that by that point.

10.6.13. 1820C The feeling of not coping is too great

10.6.14. 1824-5C Seriously want to enjoy my baby I go back to work in Feb and want to have happy times but I just can't cope.

10.6.15. 1897-8C When I'm sleep deprived all routine goes out the window and I seem to get nothing done.

11. Hallucinations and visual disturbances

11.1. Visual hallucinations

11.1.1. My sure sign of severe sleep deprivation is when I'm convinced that the picture of a fish on DS's changing mat is winking at me

11.1.2. 105-7A I am so relieved that you mentioned winking bathmats. For me, I know I need to have some sort of rest when I start asking DH [husband] if he has noticed the fruit flies in here...

11.1.3. 10-11B You stir in the night and mistake DH [husband] / the teddy / the pillow for your baby. Sometimes you 'see' baby's face superimposed on them.

11.1.4. 96-7B OP, so glad you mentioned the baby's face superimposed on your DH's [husband’s]. Thought I was totally nuts for doing that.

11.1.5. 147B Glad I'm not the only one having borderline hallucinations!

11.1.6. 159-60B You see chimpanzees driving cars and you mainline tea and cake.

11.1.7. 227-8B Dreaming awake: strange images and ideas would drift through my mind. No control over them.

11.1.8. 338 -41B you fall asleep sat upright feeding your ds and dream you're holding a cat but when you look down it is covered in beetles so you throw it off your lap and wake startled to a screaming newborn that you've just thrown (luckily just onto the bed)

11.1.9. 566B You see brown bears & heads on your bedroom dressing table at 4am

11.1.10. 223-4C i was a zombie..ev hallucinated was that tired [saw dwarfs waving and running round tesco and fush swimming up thev curtains].

11.1.11. 714C Am starting to hallucinate.

11.1.12. 720-2C I know exactly what you mean about sleep deprivation making you hallucinate. I can see wispy shadows at the corners of my vision which I am fairly sure aren't really there.

11.2. Auditory hallucinations

11.2.1. 58-60B i swear in the first few weeks on ds's (son’s] life i had sound hallucinations. Does this make sense? basically I heard a loud scream when i was drifting off to sleep once and my dh [husband] didn't. It was freaky.

11.2.2. 109-12B Yes, I've done the hallucinating thing as well. In dd1's [daughter 1’s] first weeks I could *swear* I could hear a baby crying, and kept making dh[husband] go and check, even though the monitor was right next to me and working fine.

11.2.3. 324B I Love this. And have done most of them. Especially the phantom crying...

11.3. Visual disturbances

11.3.1. 26-7B You stare and stare at the clock but your eyes are so bleary all you can make out is 8888.

11.3.2. 92-4B everyone on tv starts to look strange, like pixies. Mindy you, when I was at my most sleep deprived 'Lark Rise to Candleford' was on and they all did look like pixies.

11.3.3. 470B Eyes burning do much you can't open them fully

11.3.4. 506-7B The one that really chimes is not being able to read the time on the clock. Horrifying.

11.3.5. 741-3C I remember being on the postnatal ward and talking to a midwife who only had one eye. It was only the next day I realised she had both eyes, mine were just not functioning at the time and I couldn't see. Scary!

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12. Action slips

12.1. Failures of intended action

12.1.1. 110A I keep pouring milk in my juice glass or juice in my bowl

12.1.2. 117-20A Went for coffee with my SIL [sister-in-law] on Friday (yesterday?!) and fed DS [son] some sweet potato. Stirred my cappucino for ages with a yellow plastic spoon loaded with mash and posset. I just said "Oh" weakly in its general direction and she merely nodded and raised her eyebrows as though that said it all (she has 1yr and 3yr old).

12.1.3. 203A...putting my purse in the fridge, and a pint of milk on the side.

12.1.4. 253A I put conditioner on my face today thanks to too many early starts! Oops!

12.1.5. 276A I also managed to mix up the hand cream and lipbalm <bleugh>

12.1.6. 304-5A I unpacked the shopping and couldnt find the baby wipes and then found them in the fridge a while later...nice and chilled

12.1.7. 311-2A Ended up at home...with some fruit tea and a joint of beef. We don't drink fruit tea. I had actually gone [to the supermarket] to get soup and some nappies.

12.1.8. 271-4A I **keep** squirting the conditioner onto my hand first, then, realising my mistake, trying to shampoo my hair with one hand. I could wash the conditioner off my hand and start again I suppose but I'm too much of a cheapskate

12.1.9. 41B You put the coffee jar in the fridge and still haven't found the milk.

12.1.10. 52B Also - going to put a dirty nappy in the fridge.

12.1.11. 101-2B You look down and you've put cat food in the bowl you were intending for cereal. Then you sort it all out and go to put the cereal in the fridge.

12.1.12. 174-5B Going to use your clubcard in a self service machine, shouting at it when it doesn't scan, then realising you're actually in morrisons, not tesco...

12.1.13. 179B you put cat crunchies in the washing powder drawer....

12.1.14. 113-4B trying to use my work pass instead of my oystercard on the underground

12.1.15. 190-2B and my poor Mum after my sister was born, making nourishing bone broth, then sieving out the nutritious broth down the sink and being left with a sieveful of manky lamb bones

12.1.16. 217B You try several times to change the tv channel with your mobile.

12.1.17. 237-9B You find the cheese in the cutlery drawer, the coffee in the fridge, the remote control in your handbag (at work) and a car in your shoe. And that's just Wednesday.

12.1.18. 259-60B I poured orange juice on DD1 [daughter 1] cereal. She noticed not me. Thankfully DD2 [daughter 2] is still on the boob or she may have got a Tropicana surprise.

12.1.19. 284-5B So many of these sound familiar. I found the salt in the microwave the other day.

12.1.20. 294B I started to dollop mayonnaise on my muesli instead of yoghurt. I stood there staring at the spoon with the feeling that something was wrong, but just couldn't place what.

12.1.21. 300-2B you are spooning mayo over a salad when DH [husband] comes over to peck you on the cheek, instead of offering your cheek and licking the spoon you muddle the 2 and lick DH's nose

12.1.22. 306-9B Getting into the wrong car (it was actually a similar-looking green focus) on the petrol forecourt...and only realising I was sitting in someone else's driver's seat when I smelt tobacco (I don't smoke)...jumped out before being seen...I think????!!!

12.1.23. 363-5B I have been thinking my hair was really dry recently, this morning I noticed that I have been conditioning it with shampoo!

12.1.24. 383-5B You open a cupboard and have no idea what you are looking for or why the kitchen towel is not there until you veeerrry slowly realise that you have opened the cutlery drawer.

12.1.25. 417-8B throwing the baby's socks in the bin instead of the washing machine.

12.1.26. 441-3B You put your mobile phone in the fridge and the cheese in your handbag. You find yourself trying to peel potatoes with a tin opener (not sure whether this one's down to sleep deprivation or pregnancy brain!).

12.1.27. 480-1B A couple of days ago I put a jar of pepper in the fridge and then a used chopping board back in the cupboard after making dinner.

12.1.28. 486B I took my wii remote to work with me instead of my mobile...

12.1.29. 492-4B Get home to find i'd put my keys in his nursery bag and his dummy in the pocket of my bag instead!

12.1.30. 547-9B I have also sat down in the passenger seat of the car and wondered why I wasn't going anywhere.

12.1.31. 566B You make coffee using bisto instead of nescafe

12.2. Failure by omissions in action sequence

12.2.1. 29-30B You wonder why the last load of washing isn't very clean, then realise you forgot to put any soap in (DH [husband] actually did this not me!)

12.2.2. 264-5B You are so tired you put moisturiser on your face...without taking your glasses off first...& yes I have done it!

12.2.3. 326-7B Add to that nearly blinding myself by trying to remove my corneas thinking they were my contact lenses

12.2.4. 356-9B You complain that the 'crappy cheap teabags' that DH has bought are far too weak and demand he come and look at the pathetic cup of tea you have made, only for him to point out that if you boil the water in the kettle it tends to make a stronger brew

12.2.5. 366B I have made many cold water cups of tea too.

12.2.6. 440B You forget to use oven gloves when taking trays out of the oven.

12.2.7. 39-40C reading... I seem to read the same pages every night and have been on the same book for about six weeks...

12.2.8. 1230-1C I was sent to Asda for Baileys and nearly came home without it - that's how far gone I am.

12.3. Failures in self-care

12.3.1. 71-6B Only realised about the slippers because the snow was making my feet wet

12.3.2. 71-2B You push the pram all the way to the post office, then realise you are still wearing your slippers and your top is on inside out.

12.3.3. 133B You realise you haven't washed your hair for a week.

12.3.4. 138-9B You wear creased, un ironed clothes inside out and don't care that people notice.

12.3.5. 459-61B I went for my 6 week check up. After cooing over dd [daughter] the receptionist asked if I was bf. Went into waiting room and found breast pad poking right out the top of my shirt!

13. Nocturnal disorientation/reality check

13.1. Losing and forgetting the baby

13.1.1. 13-14B Still asleep yourself, You wake DH [husband] in the night yelling 'where's the baby?' DH [husband] points out he's in the moses basket where he always was

13.1.2. 16-18B You have kafka-esque dreams including one about talking to a random man, then suddenly becoming aware you have been unwittingly breast-feeding him for the past half an hour.

13.1.3. 50-1B Yes - I've done the 'where's the baby?!' thing (she was sleeping in my arms) and a few others.

13.1.4. 86-8B I woke in a panic and asked dh who the baby in the cot was. It was dd [daughter], but I was convinced she was asleep on me - could really feel her. Not surprising as that's where she spent much of her first weeks!

13.1.5. 116-9B You sit there rocking gently when you're not actually holding the baby. You wake up convinced he is in the bed and you fell asleep feeding him, then panic when you can't find him. (he was in his basket as usual).

13.1.6. 144-6B I have exactly the same experience as you thinking I've fallen asleep feeding him and he's under the covers...so bizarre! Happens nearly every night.

13.1.7. 151-5B Yup it's weird isn't it! I've even stopped dressing him in his white sleepsuits when we have our white bedding on, as I used to think he was in there somewhere and I just couldn't see him....lifting up pillows and panicking and so on. Sounds really bizarre when I type it out now but seems perfectly logical at 3am!!

13.1.8. 325B frantic searching for baby in bed.

13.1.9. 331-4B Thanks for the laugh guys. I too have done the frantic searching of the bed for the baby only to find him back in his crib...where I put him...then again I also found him in my arms on my lap when I fell asleep sitting up in bed while breastfeeding. Now that was scary!

13.1.10. 349-52B That happened all the time in my house. Sometimes, DS [son] would cry, I'd stumble over to the cot and panic that he wasn't in there only to realise the crying was coming from the bed and at some point I'd lifted him in without waking!

13.1.11. 370-75B You're sitting on the sofa in dim light talking to your DH [husband] in his PJ's sat on the opposite sofa. Drowsily breastfeeding DD [daughter] and talking about how tiring it is getting up in the night. Then you realise that DH [husband] is actually asleep in bed the lucky bastard and you've been talking to the sofa.

13.1.12. 398-400B You are staying with friends and you think "I hope they stop that baby crying or it will wake my DS [son]" (who it has taken me three hours to get to sleep!!) before realising that it's your DS [son] that is crying!!

13.1.13. 404-9B I've also done the "OMG where's the baby?" shout when I've woken up in the night. For some reason I think DH [husband] has DD [daughter] over his side of the bed & might have squashed her. Many a time after being shaken awake he's blearily pointed at the Moses basket to a peacefully sleeping baby. I thought it was just me going mad, glad to hear lots of others have done the same

13.1.14. 532-5B I reached a whole new level with the "I've lost the baby in the bed" syndrome last night. I was convinced that the DUVET was my baby and was worried that it was so lightweight and immaterial...I woke up to find myself rifling through it undoing the buttons thinking they were the poppers to his

13.1.15. 559-60B I often wake up hearing crying and think, 'Blimey - there's a baby in the house!' before remembering it's my baby and I'd better see to it, sharpish.

14. Unreliable memory

14.1. Memory loss

14.1.1. 97-8A I say "Right then. Right then" a lot, to make it sound like I am getting on with things efficiently, when in truth I have completely forgotten what I was doing.

14.1.2. 191-2A when you get to Morrisons and...you cant remember how you got there [and] you still have your big pink fluffy slippers on

14.1.3. 80-1B Your sister phones for a chat and refers to a recent conversation you have no recollection of at all.

14.1.4. 219-23B The poor cow I saw in the supermarket queue ahead of me one day rhythmically pushing a trolley back and forth, back and forth. I pointed out that she didn't have a baby with her. Her knackered response was; "Oh fuck I forgot. I left him at his Grandma's"

14.1.5. 277-8B You can't remember how many times or when you got up in the night anymore.

14.1.6. 287-90B And just the other week DD2 [daughter 2] (3 months) was asleep in her cot, me asleep in my bed, and I woke up with her in bed with me. It must have been me, except I've not a shred of memory of it. Unless she is really quite stellar at rolling when I'm not looking!

14.1.7. 517B Having absolutely no idea what day of the week it is.

14.1.8. 554-5B I can't keep track of whether it's Sunday or Wednesday.

14.1.9. 778C constantly forgetting things.

14.2. Memory lapses

14.2.1. 7-8A You stare at a counter top with a teapot and kettle on it for up to a minute, trying to remember what these things do and in what order you are supposed to use them.

14.2.2. 10-14A You walk through the house picking up things that need your attention, then find yourself in the kitchen holding a sock, a free newspaper, a hair bobble, a phone charger and a jar of Sudocrem, then sit at the kitchen table for a bit because you can't work out why you are holding them and what they might do when you put them all together.

14.2.3. 245-6A I rather suspect I went in [the kitchen] to make a much needed coffee. I am still coffee-less, but I know *exactly* what will happen if I go back in the kitchen...

14.2.4. 224-39A On Friday I went to our local shopping centre & parked in the multi-storey. Paid for the parking ticket at the machine thingy on foot and then inserted the ticket at the barrier as I was driving out. So far so good. I drove to the bottom of the ramp where there is a set of traffic lights. My brain broke at that point and I had a complete panic (looking around frantically, checking pockets, bag, "shit, shit, where the f*ck is it?!") that I couldn't find my parking ticket (to insert, apparently, at the imaginary barrier THAT WASN'T THERE!) It honestly took about 2 minutes for my eyes & brain to link back up (i.e. traffic lights = drive through when green, no need for ticket which had already been swallowed by the actual, real barrier). Oh dear.

14.2.5. 262-4A When you are in the shower and you simply can not remember whether you have just used the shampoo or conditioner. You then do not have any idea of what you should do next to rectify the situation!

14.2.6. 262-8A Also, when you are trying to make something for dinner, get halfway through and realise that you do not have a vital ingredient. (E.g. canned tomatoes for Spaghetti Bolognese.)

14.2.7. 87-92A Guess what we had for dinner tonight? A lovely chicken casserole, made to a new recipe from a book, which bubbled away for 6 hours in the slow cooker. When I dished it up at six o'clock, it was a beef casserole.

14.2.8. 297-301A i spend all my time trying to find entertainment for my ds [son] (7months) so i can get on with things but by the time hes happy playing with a toy ive forgotten what i was going to do get distracted by a lone baby wipe on the floor wonder into another room come back out wondering why i went in there and he is fed up with his entertainment and complaining. and we do it again.....

14.2.9. 308-9A I walked around the supermarket 3 times...because I didn't know why I was there or what I needed to buy...

14.2.10. 314-6A Driving into work to show off DS for the 1st time, I went round the same roundabout twice, then took the wrong exit. Normally a 30 minute journey, it took me closer to 50 minutes what with wrong turns and general confuddlement!

14.2.11. 331-3A Let me loose in an actual SHOP and the pressure is all too much for me. The chances of emerging with things that can be combined into an identifiable meal are very, very low.

14.2.12. 339-40A every time I go anywhere in the car, I do the "pat the pockets and panic" dance after strapping the kids in, because I can't find my keys.

14.2.13. 169-70B Looking at the full bath and wondering if you've just got out of it, or if you're just about to get in it ...

14.2.14. 196-8B You get to the checkout at the supermarket and look around and realise you've forgotten your baby. Cue sprint through shop and finding buggy - and a small excited crowd - in the meat aisle.

14.2.15. 269-70B You take off with someone else's trolley in the supermarket, and its an aisle and a half before you realise that those groceries are not yours.

14.2.16. 274-276B You wonder why there are already contact lenses in the case when you've got them in your eyes... Oh no you don't... You took them out two minutes ago...

14.2.17. 317B Leaving the car unlocked almost every day.

14.2.18. 380-1B You are at breakfast with a spoon in your hand and you can't figure out whose mouth it needs to go in.

14.2.19. 423-5B One night, while breastfeeding an excema-ridden baby for the umpteenth time and trying to remember which breast she fed from last, I actually couldn't work out my left from my right.

14.2.20. 488-9B spent an hour and half (and totally trashed my flat) looking for my glasses..which were on my head..

14.2.21. 496-9B Left my wallet at the tesco checkout.
Left shopping at the self-serve tesco check out (was concentrating on not leaving the wallet!

14.2.22. 524-5B Forgetting what country you're in and attempting to conduct conversations in the wrong language.

14.2.23. 543-4B I ordered a meat pizza and it came and I wondered who had put meat on my pizza as I've been veggie for 10+ years.

14.2.24. 544-7B Then sent DH [husband] to change DD's [daughter's] poopy nappy but hadn't brought any nappies. Young nervous waiter came along saying my husband needed me in the washroom - so I had to stand over a wriggling naked baby in a public loo while he went out to buy nappies.

14.2.25. 259-60C I'm always forgetting things (have left the keys in the car ignition overnight on more than one occasion).

14.2.26. 785-8C Does anyone find they keep forgetting to eat? I struggle so much making and feeding the kids that by the time I realise they've finished and I'm left with slobbered over scraps, I'm too knackered to make anything else.

14.2.27. 803-4C Turned up to an appointment today two days early, which is not like me.

15. Language production problems

15.1. Cannot find the words

15.1.1. 4-5A You are struggling to make small talk with someone and suddenly blurt out "You'll have to forgive me, my words have stopped working."

15.1.2. 61A My sentences start well but after bit drop off

15.1.3. 143-4A Oh...I can never finish a conversation. Even the slightest distraction and I completely forget what I'm on about, who I'm talking too.

15.1.4. 161-2A Hilarious when with other sleep deprived people who do the same! You keep going 'what were we talking about?' and 'you know that thing we started talking about earlier?'

15.1.5. 167-9A ...we sit there having the most hilerious conversations that just don't go anywhere because we can't remember what we were talking about

15.1.6. 282-3A It's going to be great fun when I am back at work confusing people with my ending free sentences

15.1.7. 20-1B You trail off in conversation, unable to finish a sentence, because you can't remember the necessary word.

15.1.8. 121-4B You lose all word-finding capabilities and then shout at your DH [husband] because he doesn't understand what you mean when you ask him to put the thingy over there on top of the wotsit and pass the other thingy here. No, not that one - that thing over there. THERE!!! (points furiously across the room).

15.1.9. 313B An old lady asks your toddler's name and you can't remember.

15.1.10. 519-22B Talking to DD [daughter] (everyone tells me it's good for her) but not making much sense - e.g. as I'm dressing her, trying to say "... and we put your arm in your sleeve" but being able to muster only "... and we put, er, this thing in, ummm, this thing", because I've forgotten the words "arm" and "sleeve".

15.2. Find the wrong words

15.2.1. 230-3B Trying to have an intelligent conversation six weeks after birth, nodding sagely while my friend explained how ships got into bottles, and then asking him (so proud I could actually engage with a grown up): "Is that how they get geese into bottles as well?" (It seemed to make sense at the time).

15.2.2. 318-9A I frequently lose my english, and even though it's my 1st and native language, I have found myself using french or czech instead. Neither of which I actually speak.

15.2.3. 35B You confuse your friend's name with her daughter's.

15.2.4. 439B You say goodbye to your DH (who works nights) and tell him to sleep well.

15.2.5. 411-2B Also I've referred to 10 wk old DD [daughter] as a "he" so many times I've lost count. Hope I stop soon or the poor soul will get a complex!

15.2.6. 434-5B Great thread. Here's another one: during the day you find yourself saying 'good night' to people instead of 'goodbye'... I have had some strange looks.

15.2.7. 439B You say goodbye to your DH [husband] (who works nights) and tell him to sleep well.

15.3. Disfluency

15.3.1. 77A I know what you mean about the slow motion talking...

15.3.2. 56-7A I find myself going into slow motion, including talking very slowly cos I forget what I'm saying half way through...

15.3.3. 259A I say "right then" a lot as well... LOL.

16. Clumsiness

16.1. Poor co-ordination

16.1.1. 53-4B And completely missing handles/kettle switch/things you're trying to pick up.

16.1.2. 62-3B I would also walk into loads of furniture and totally forget and then the next day say to my mum 'where did i get that bruise from?'

16.1.3. 67B It takes you five goes to do up the poppers on the babygro

16.1.4. 164-5B You don't realise you've picked up the iron the wrong way until you flinch and drop it and find most of the skin of your thumb went with it.

16.1.5. 470-1B literally not being able to walk straight (veering off to the side).

16.1.6. 475B also tripped over the pram wheel

16.2. Potential risk to others

16.2.1. 674-5, 677-9C I realised that she wanted to be on her tummy...I agonised over whether I was being selfish and it was unsafe for her, but I decided a sleep deprived mummy is also unsafe during the daytime so I went for it.

16.2.2. 1034-5C I feel like I am a danger to myself and the children because I am so clumsy with tiredness

16.2.3. 1249-53C My ex DP [partner] crashed the car with us in it at 4pm in the afternoon on a clear road we were not hurt he had just momentarily nodded off without realising it. The problem about getting help is the more tired you are the less scope you have to make good decisions, your brain becomes fogged- its not good for or your family. Sleep is an absolute necessity to function

Appendix H. *Mumsnet* and Netmums – permission to launch online survey

Mumsnet

On 9 November 2011 23:06, *Mumsnet* Towers <contactus@mumsnet.com> wrote:

Thanks for contacting us about this. We're sure there are Mumsnetters out there who would consider being case studies for you. You are very welcome to start a thread asking for volunteers. Please put your request in the Media Requests section here: http://www.mumsnet.com/Talk/media_nonmember_requests. There is a £30 charge for this, as a contribution to our running costs. (Just click on the link and follow the instructions and you'll automatically be taken to the payment page.) Good luck with finding the people you need!

Best,

Catherine
MNHQ

Netmums

On 10 November 2011 09:51, *Netmums* Customer Services help@netmums.com wrote:

Hello Alison

Thanks for getting in touch.

We do have a surveys request forum which would be the ideal place for you to post your request for information. You do need to register in order to post and then you'll find the forum here: http://www.netmums.com/coffeehouse/netmums-mums-panel-251/survey-requests-735/

If you need any help do get back in touch.

Kind Regards,

Donna,
The *Netmums* Helpdesk team

Appendix I. Invitations, consent, questionnaire and debrief forms for online survey and face to face testing (additional information in italics) of mothers of children aged under five years
Names of published scales used with permissions are indicated in bold.

BATH SPA UNIVERSITY

School of Society Enterprise and Environment

Sleep patterns and everyday functioning in parents of babies and young children

We would like to invite you to take part in a study which is being carried out as part of a PhD project by Mrs Alison Wadeley under the supervision of Dr Alison Lee, both at Bath Spa University.

When people become parents their sleep patterns often change significantly but the possible impact of this on such things as attention, memory, mood and everyday functioning is not well understood. The aim of this study is to explore whether these things are associated.

We are looking for parents who:
- are aged 18 years or over.
- are mentally and physically in good health.
- are not taking medication which affects sleep or mood.
- have no sleep disorders such as insomnia, sleep apnoea, restless legs syndrome, night terrors or sleep walking.
- have parental responsibility for and live with at least one child aged under 5 years
- have child(ren) who are in good health
- have spent nights during the week prior to completing this questionnaire with their child(ren) in their usual home (i.e. not on holiday, staying with friends or relatives, on night-shifts or in any other atypical situation).

If this describes you we would like to ask you to complete an online questionnaire. All procedures have been approved by Bath Spa University, School of Society, Enterprise and Environment Ethics Committee.

This questionnaire is divided into sections. To answer the questions all you need to do is make a choice or enter some brief information. It should be completed by yourself without discussion with anyone else. Any questions you prefer not to answer can be left blank. Most people find that the questionnaire takes about 20 minutes to complete. The questions ask about:
- general information such as your age and ages of others in your family
- your sleep patterns
- your everyday attention, memory, co-ordination and mood
- your handedness

The final part of the questionnaire has a short scale about your everyday functioning. We would like you to fill this in for yourself. The questions then appear again, but this time we would like you to ask another adult who currently knows you well (such as a husband/partner, good friend or adult family member) to complete them. If you are happy for them to answer these, please ask them to complete the questions without discussing them with you. Their participation is voluntary and protected by the same ethical standards as detailed here. If there is no such person or you would rather they did not answer these questions, please leave them blank.

In addition you will be asked to complete five short tests of attention, reasoning, memory and word-generation, three of which are computerised and self-administered. The tests are routinely used in research with healthy, non-clinical populations of adults and are not diagnostic. The questionnaire and all of the tests can be completed in under an hour.

You do not have to take part in this study if you do not want to. If you do decide to take part you may withdraw at any time without having to give a reason. At all stages, procedures are in place to ensure your anonymity.

If you have any questions, or would like to find out our results, please contact us. The final publication of the results is expected by June 2014.

Thank you for considering taking part in this study.

Contact details:

Dr Alison Lee and Ms Alison Wadeley are in the School of Society, Enterprise and Environment and can be contacted at Bath Spa University, Newton Park, Newton St Loe, Bath, BA2 9BN or by telephone during the working day: (Dr Lee: 01225 875 726; Mrs Wadeley: 01225 875 793) or by e-mail at any time: a.c.lee@bathspa.ac.uk or a.wadeley@bathspa.ac.uk

Participant consent

1. I have read the accompanying information relating to the study 'Sleep patterns and everyday functioning in parents of babies and young children'.
2. I understand the purposes of the study and what will be required of me. I agree to the arrangements described in the information sheet, in so far as they relate to my participation.
3. I understand that I have the right to withdraw at any time.
4. Partner's consent (as 1 above)
5. Partner's consent (as 2 and 3 above)

Sleep survey questions

6. Which country are you currently living in?
7. Please give your age to the nearest year
8. Please state your gender

9. What is your highest educational qualification? (Please choose one.)
   - University Higher Degree (e.g. MSc, PhD)
   - First degree level qualification including foundation degrees, graduate
   - membership of a professional Institute, PGCE
   - Diploma in higher education
   - Teaching qualification (excluding PGCE)
   - Nursing or other medical qualification not yet mentioned
   - A Level
   - Welsh Baccalaureate
   - International Baccalaureate
   - AS Level
   - Higher Grade/Advanced Higher (Scotland)
   - Certificate of sixth year studies
   - GCSE/O Level
   - CSE
   - Standard/Ordinary (O) Grade / Lower (Scotland)
   - Other school (inc. school leaving exam certificate or matriculation)
   - None of the above

10. What is your highest vocational qualification? (Please choose one.)
    - Youth training certificate
    - Key Skills
    - Basic skills
    - Entry level qualifications (Wales)
    - Modern apprenticeship/trade apprenticeship
    - RSA/OCR/Clerical and commercial qualifications (e.g. typing/shorthand/book-keeping/commerce)
    - City and Guilds Certificate
    - GNVQ/GSVQ
    - NVQ/SVQ - Level 1 - 2
    - NVQ/SVQ - Level 3 - 5
    - HNC/HND
    - ONC/OND
    - BTEC/BEC/TEC/EdExcel/LQL
    - SCOTVEC, SCOTEC or SCOTBEC
    - Other vocational, technical or professional qualification
    - None of the above

11. How many hours per week do you currently work?

12. Who else lives with you in your family home?

Adult	Age to nearest year	Relationship to you

13. Child age (year, months, weeks)

14. Some people regard themselves as 'larks' (prefer to get up and go to bed early and feel more alert in the morning) and some see themselves as 'owls' (prefer to get up and go to bed later and feel more alert in the afternoon/evening). How you would describe yourself?

    Very much a 'lark' 1 2 3 4 5 6 7 8 9 10 Very much an 'owl'

As adults most of us know what kind of individual sleep pattern suits us best IF YOU COULD SLEEP UNDISTURBED BY OTHERS IN THE WAY THAT IS RIGHT FOR YOU:

15. What time would you go to bed intending to sleep?

16. How easy would it be for you to fall asleep?
    Extremely difficult 1 2 3 4 5 6 7 8 9 10 Very easy

17. What time would you wake feeling rested and ready to start your day?

18. How many times during the night would you get out of bed?

19. What would be your longest continuous period of night-time sleep?
    Enter hours and minutes

20. How long would you nap for during the day?
    Enter hours and minutes

21. What would the quality of your night-time sleep be like?
    Awful 1 2 3 4 5 6 7 8 9 10 Excellent

22. If you were not particularly tired in the day but had the chance to nap, how easily could you fall asleep?
    With great difficulty 1 2 3 4 5 6 7 8 9 10 Very easily

23. If you felt sleepy in the day, how easily could you resist falling asleep?
    With great difficulty 1 2 3 4 5 6 7 8 9 10 Very easily

ESS

24. Still thinking about your personal sleep patterns, IF YOU COULD SLEEP IN A WAY WHICH IS RIGHT FOR YOU how likely would you be to doze off or fall asleep in the following situations, in contrast to just feeling tired? Please use the following scale to circle the most appropriate number for each situation:

0 = would *never* doze or sleep.
1 = *slight* chance of dozing or sleeping
2 = *moderate* chance of dozing or sleeping
3 = *high* chance of dozing or sleeping
na = does not apply to you

Situation	*Chance of Dozing or Sleeping*				
Sitting and reading	0	1	2	3	na
Watching TV	0	1	2	3	na
Sitting inactive in a public place	0	1	2	3	na
Being a passenger in a motor vehicle for an hour or more	0	1	2	3	na
Lying down in the afternoon	0	1	2	3	na
Sitting and talking to someone	0	1	2	3	na
Sitting quietly after lunch (no alcohol)	0	1	2	3	na
Stopped for a few minutes in traffic while driving	0	1	2	3	na

25. Is your sleep currently disturbed by your child(ren) aged under 5? Yes/no
    If yes, how long has this disturbance been going on?

26. Is your sleep currently disturbed by your child(ren) aged 5 to 17 years that you currently live with? Yes/no. If yes, how long has this disturbance been going on?

27. Is your sleep currently disturbed by any adults that you currently live with? Yes/no If yes, how long has this disturbance been going on?

NOW, THINKING ABOUT THE PAST WEEK (7 days), in general:

28. What time did you go to bed intending to sleep?

STILL THINKING ABOUT THE PAST WEEK (7 days), in general:

29. How easy was it for you to fall asleep?
Extremely difficult 1 2 3 4 5 6 7 8 9 10 Very easy

30. What time did you wake and start your day?

31. What was the quality of your night-time sleep like?
Awful 1 2 3 4 5 6 7 8 9 10 Excellent

32. On how many nights in the past week (7 nights) did your child/ren aged under 5 wake you at least once from your sleep?

33. For the whole of the past week (7 nights): How many times in total were you woken from your night-time sleep by your child/ren aged under 5 years?

34. For the whole of the past week (7 nights): How much night-time sleep in total did you lose due to your child/ren aged under 5 years? Please state hours and minutes.

35. For the whole of the past week (7 nights): How disruptive to your night-time sleep do you think the sleep pattern of your child/ren under 5 has been?
Not at all 1 2 3 4 5 6 7 8 9 10 Severely disruptive

36. On how many nights in the past week (7 nights) did your child/ren aged 5 -17 years wake you at least once from your sleep?

37. For the whole of the past week (7 nights): How many times in total were you woken from your night-time sleep by your child/ren aged 5-17 years?

38. For the whole of the past week (7 nights): How much night-time sleep in total did you lose due to your child/ren aged 5-17 years? Please state hours and minutes:

39. For the whole of the past week (7 nights): How disruptive to your night-time sleep do you think the sleep pattern of your child/ren aged 5 -17 years has been?
Not at all 1 2 3 4 5 6 7 8 9 10 Severely disruptive

40. On how many nights in the past week (7 nights) did other adults that you live with wake you at least once from your sleep?

41. For the whole of the past week (7 nights): How many times in total were you woken from your night-time sleep by other adults that you live with?

42. For the whole of the past week (7 nights): How much night-time sleep in total did you lose due to other adults that you live with? Please state hours and minutes

43. For the whole of the past week (7 nights): How disruptive to your night-time sleep do you think the sleep pattern of other adults that you live with has been?
Not at all 1 2 3 4 5 6 7 8 9 10 Severely disruptive

44. Over the whole of the past week, how long was your longest, single, continuous period of night-time sleep? Enter hours and minutes

45. For the whole of the past week (7 days): How much time did you nap for in total?
Enter hours and minutes

46. During the past week, if you felt sleepy in the day, how easily were you able to resist falling asleep?
With great difficulty 1 2 3 4 5 6 7 8 9 10 Very easily

ESS

47. DURING THE PAST WEEK, how likely would you have been to doze off or fall asleep in the following situations, in contrast to just feeling tired? Please use the following scale to circle the most appropriate number for each situation:
0 = would *never* doze or sleep.
1 = *slight* chance of dozing or sleeping
2 = *moderate* chance of dozing or sleeping
3 = *high* chance of dozing or sleeping
na = does not apply to you

Situation	*Chance of Dozing or Sleeping*				
Sitting and reading	0	1	2	3	na
Watching TV	0	1	2	3	na
Sitting inactive in a public place	0	1	2	3	na
Being a passenger in a motor vehicle for an hour or more	0	1	2	3	na
Lying down in the afternoon	0	1	2	3	na
Sitting and talking to someone	0	1	2	3	na
Sitting quietly after lunch (no alcohol)	0	1	2	3	na
Stopped for a few minutes in traffic while driving	0	1	2	3	na

48. Over the past week, what has been your most usual night-time sleeping place?
- In a room on my own
- In the same bed as my partner
- In the same room as my partner but in a different bed
- In the same bed as one or more of my children
- In the same bed as my partner and one or more of my children
- In the same room as my partner and one or more of my children but in different beds
- Cannot/prefer not to say

FAS

49. These questions are about how fatigued you currently feel as opposed to sleepy. Please place a number from 1 to 5 next to each statement:

1Never 2 Sometimes 3 Regularly 4 Often 5 Always

- I am bothered by fatigue
- I get tired very quickly
- I don't do much during the day
- I don't have enough energy for everyday life
- Physically, I feel exhausted
- I have problems starting things
- I have problems thinking clearly
- I feel no desire to do anything
- Mentally, I feel exhausted
- When I am doing something, I can concentrate quite well

REVISED EHI

50. Please choose which option best describes which hand you use for the activity in question

Activity	Always left	Usually left	No preference	Usually right	Always right
Writing					
Throwing					
Scissors					
Toothbrush (when not advised to swap hands by dentist)					
Knife (without fork)					
Spoon					
Match (when striking)					
Computer mouse or touchscreen					

ARCES

51. The following statements are about minor mistakes and absent-mindedness everyone notices from time to time. How frequently these sorts of things have happened to you IN THE PAST WEEK. Please place a number by each statement using the following key:

1 Never 2 Very rarely 3 Occasionally 4 Quite often 5 Very often

- I have absent-mindedly placed things in unintended locations (e.g., putting milk in a cupboard or sugar in the fridge
- When reading I find that I have read several paragraphs without being able to recall what I read
- I have misplaced frequently used objects, such as keys, pens, glasses / spectacles, etc.
- I have found myself making clothing mistakes e.g. wearing mismatched socks, buttons wrongly fastened, item of clothing inside out
- I have gone into a room to get something, got distracted, and left without what I went there for
- I fail to see what I am looking for even though I am looking right at it
- I begin one task and get distracted into doing something else
- I have absent-mindedly mixed up targets of my action (e.g., pouring or putting something into the wrong container)
- I make mistakes because I am doing one thing and thinking about another
- I have gone to the fridge to get one thing (e.g. milk) and taken something else (e.g. juice)
- I have to go back to check whether I have done something or not (e.g. turning out lights, locking doors)
- I go intend to do one thing (e.g. brush my teeth) and end up doing something else (e.g. brush my hair)

MFS

52. The following statements are about minor memory lapses everyone experiences from time to time, but we have very little information about just how common they are. The great majority of time these little foibles are harmless, though they do have serious safety implications in industry and everyday life. We want to know how frequently these sorts of things have happened to you IN THE PAST WEEK.

Please place a number by each statement using the following key:

1 Never 2 Very rarely 3 Occasionally 4 Quite often 5 Very often

- I leave important letters/emails unanswered for days
- I forget appointments
- I forget people's names immediately after they have introduced themselves
- I forget people's names, even though I rehearsed them
- I find I cannot quite remember something though it is on the tip of my tongue
- I forget what I went to the supermarket to buy
- I forget important dates like birthdays and anniversaries
- I double-book myself when scheduling appointments
- I forget passwords
- I remember facts but not where I learned them
- Even though I put things in a special place I still forget where they are
- When I go to introduce my friends I forget their names

53. Bumping into things

During the last week, while moving forward on your own in good visibility, have you bumped into things? Yes/no

If yes, which side of your body did you bump?
Number of times: right left

54. During the last week, while pushing something in front of you in good visibility, such as a buggy, shopping trolley, lawnmower, have you bumped into things with it? Yes/no

(If yes) Which side did you bump?
Number of times: right left

55. Do you drive the family car? Yes/no/no car
(If yes) Is the car left or right hand drive? Left, right

56. (If yes) On which side of the car is the steering wheel? Left, right

- (If you drive) Have you bumped into anything in the last week while driving forward in good visibility? Yes/no
  (If yes) Which part of the car did you bump? Front right, centre front, front left, right side, left side, rear right, rear centre, rear left.

- Have you had a near miss in the last week while driving forward in good visibility? Yes/no
  (If yes) On which part of the car was the near miss? Front right, centre front, front left, right side, left side, rear right, rear left, rear centre

- Have you bumped into anything in the last week while reversing in good visibility?
  Yes/no
  (If yes) Which part of the car did you bump? Front right, centre front, front left, right side, left side, rear right, rear left, rear centre

- Have you had a near miss in the last week while reversing in good visibility? Yes/no
  (If yes) On which part of the car was the near miss? Front right, centre front, front left, right side, left side, rear right, rear left, rear centre

ADDI

57. Below is a list of feelings, sensations, problems, and experiences that people sometimes have. How much you have felt or experienced things this way during the past week, including today? Please enter a number next to each item using the following scale:

1 Not at all 2 A little bit 3 Moderately 4 Quite a bit 5 Extremely

1. Felt sad
2. Felt discouraged
3. Felt worthless
4. Felt really happy
5. Felt nervous
6. Felt hopeless
7. Blamed myself for a lot of things
8. Felt numbness or tingling in my body
9. Felt like I had accomplished a lot
10. Felt like I had a lot of interesting things to do
11. Felt like I had a lot to look forward to
12. Felt like a failure
13. Was proud of myself
14. Felt dizzy or lightheaded
15. Was short of breath
16. Hands were shaky
17. Felt really ''up'' lively
18. Had a very dry mouth
19. Felt confident about myself
20. Muscles twitched or trembled
21. Felt like I had a lot of energy
22. Was disappointed in myself
23. Heart was racing or pounding
24. Was trembling or shaking
25. Worried a lot about things
26. Felt really good about myself
27. Had trouble swallowing

DEX

58. These questions are about some of the difficulties people sometimes experience. We would like you to read the following statements and rate them on the five-point scale given below according to your own experience.

0 Never 1 Occasionally 2 Sometimes 3 Fairly often 4 Very often3

- I have problems understanding what other people mean unless they keep things simple and straightforward
- I act without thinking, doing the first thing that comes to mind
- I sometimes talks about events or details that never actually happened, but I believe did happen.
- I have difficulty thinking ahead or planning for the future
- I sometimes get over-excited about things and can be a bit 'over-the-top' at these times

- I get events mixed up with each other and gets confused about the correct order of events
- I have difficulty realizing the extent of my problems and am unrealistic about the future
- I am lethargic or unenthusiastic about things
- I do or says embarrassing things when in the company of others
- I really want to do something one minute, but couldn't care less about it the next
- I have difficulty showing emotion
- I lose my temper at the slightest thing
- I am unconcerned about how I should behave in certain situations
- I find it hard to stop repeating saying or doing things once I've started
- I tends to be very restless and 'can't sit still' for any length of time
- I find it difficult to stop doing something even if I know I shouldn't
- I will say one thing, but do something different
- I find it difficult to keep my mind on something and am easily distracted
- I have trouble making decisions or deciding what I want to do
- I am unaware of or unconcerned about how others feel about my behaviour

DEX-R (if other person is present)

The final part of the questionnaire has some questions for someone who currently knows you well (such as a husband/partner, good friend or adult family member) to complete about your everyday functioning. If you are happy for such a person to do this, please ask them to complete the questions without discussing them with you. Their participation is voluntary and protected by the same ethical standards as yourself. If there is no such person or you would rather they did not answer these questions, please leave them blank

These questions are about some of the difficulties people sometimes experience. We would like you to read the following statements and rate the person who has completed this rest of this survey on a five-point scale according to your experience of that person.

0 Never 1 Occasionally 2 Sometimes 3 Fairly often 4 Very often

1. Has problems understanding what other people mean unless they keep things simple and straightforward.
2. Acts without thinking, doing the first thing that comes to mind.
3. Sometimes talks about events or details that never actually happened, but s/he believes did happen.
4. Has difficulty thinking ahead or planning for the future.
5. Sometimes gets over-excited about things and can be a bit 'over-the-top' at these times.
6. Gets events mixed up with each other and gets confused about the correct order of events.
7. Has difficulty realizing the extent of his/her problems and is unrealistic about the future.
8. Seems lethargic or unenthusiastic about things.
9. Does or says embarrassing things when in the company of others.
10. Really wants to do something one minute, but couldn't care less about it the next.
11. Has difficulty showing emotion.
12. Loses his/her temper at the slightest thing.
13. Seems unconcerned about how s/he should behave in certain situations.
14. Finds it hard to stop repeating saying or doing things once started.
15. Tends to be very restless and 'can't sit still' for any length of time.
16. Finds it difficult to stop doing something even if s/he knows s/he shouldn't.
17. Will say one thing, but do something different.
18. Finds it difficult to keep his/her mind on something and is easily distracted.
19. Has trouble making decisions or deciding what s/he wants to do.
20. Is unaware of or unconcerned about how others feel about his/her behaviour.

School of Society Enterprise and Environment

Debrief

Thank you for completing our questionnaire

Sleep patterns in babies and young children often present parents with significant challenges and yet most of the research in this area focuses on infants and how best to establish good sleep habits. The impact of sleep changes on the parents themselves is often only implied or alluded to in very general terms. This research aims to clarify some of the ways in which parents' sleep preferences and current patterns may be related to specific aspects of everyday attention, memory, language, co-ordination and mood. This area is currently under-researched and your responses will be used to help understand more fully what the likely impact of different levels of sleep disruption might be. Your contribution to this study is therefore very valuable and very much appreciated.

Please be assured that the results will not allow us to make clinical diagnoses or offer remedies for infants' sleep problems as they are entirely exploratory at this stage and are based on scales and tests suitable for normal populations of people.

If you would like to read more, here is an experimental study, which tested sleepy parents, and a non-experimental study which investigated coping with fatigue in the first few weeks after birth:

Plessow, F., Kiesel, A., Petzold, A. and Kirschbaum, C. (2011) Chronic sleep curtailment impairs the flexible implementation of task goals in new parents. *Journal of Sleep Research,* 20 (2), pp. 279-287.

Runquist, J. (2007) Persevering through postpartum fatigue. *Journal of Obstetric, Gynecologic and Neonatal Nursing*, 36 (1), pp. 28-37.

All data collected in this study will be analysed in an aggregated form – your responses will not be singled out; only averaged results will be reported in any future publications. You will remain anonymous.

Thank you again for participating in this study. Results are expected to be available in June 2014. If you would like further information the researchers, Dr Alison Lee and Mrs Alison Wadeley, are in the School of Society, Enterprise and Environment and can be contacted at Bath Spa University, Newton Park, Newton St Loe, Bath, BA2 9BN or by e-mail at any time: a.c.lee@bathspa.ac.uk or a.wadeley@bathspa.ac.uk

Appendix J. Summary of chapter 3 findings for *Parkinson's UK*

BATH SPA UNIVERSITY School of Society Enterprise and Environment

This study was carried out as part of a PhD project by Mrs Alison Wadeley under the supervision of Dr Alison Lee, both in the School of Society, Enterprise and Environment at Bath Spa University, Newton Park, Newton St Loe, Bath, BA2 9BN. Contacts:
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COGNITIVE CORRELATES OF SLEEPINESS IN PARTNERS OF PEOPLE WITH PARKINSON'S DISEASE

It is well-known that Parkinson's disease (PD) can affect sleep but little is known about what this is like for both the person with PD and their partner. The aim of this study was to see whether the presence of PD was associated with sleep patterns, everyday functioning and mood in couples in which one person had Parkinson's disease. Permission was sought from *Parkinson's UK* to approach regional *Parkinson's UK* groups in the autumn of 2006. Ethical approval was granted by the *NHS: Bath Research Ethics Committee* and the study was supported by Bath Spa University.

During regular *Parkinson's UK* meetings, couples were invited to take part in a questionnaire study. Two questionnaires were designed, one for the person with PD and one for their partner. Questions were asked about many aspects of preferred and actual sleep patterns, mood and everyday slips of memory and attention. There was also a simple pencil and paper test of visual attention which is known to be sensitive to functioning in the left and right hemispheres of the brain. All the measures used were non-clinical, meaning that they asked about sleep, mood and everyday slips that are considered to be within a normal range.

Sixty-one couples completed questionnaires. All participants thought that their sleep was not quite as good as it could be, but the presence of PD, which in the majority of cases was mild, was not associated with partners' sleepiness. In partners, self-reported sleepiness was associated with everyday slips of memory and attention and with anxious mood. In people with PD these everyday slips were associated with lower mood, but not sleepiness. All of these effects fell into what is considered to be a normal range.

In most people, there is a very slight, natural tendency to attend to the left side of the near visual world than to the right. As the brain starts to feel sleepy, this leftward preference becomes more exaggerated. This change occurred in sleepy partners and sleepy people with predominantly left-side PD symptoms but not in sleepy people with predominantly right-side PD symptoms. We do not know precisely why this is, but it would appear that partners and people with left PD show similar effects of a sleepy brain, while people with right PD seemed to be protected from this.

There was little, if any, evidence to link any of these findings with sleep disruption due to partners' PD or to suggest that they were due to anything other than normal sleepiness. The findings strongly suggest that the sleep of study participants was generally not much affected by the presence of PD and was no more disturbed than might be expected in couples in general.

Appendix K. Summary of chapter 4 and 5 findings for *Mumsnet, Netmums* and mothers of children aged under 5 years

BATH SPA UNIVERSITY School of Society Enterprise and Environment

These studies were carried out as part of a PhD project by Mrs Alison Wadeley under the supervision of Dr Alison Lee, both in the School of Society, Enterprise and Environment at Bath Spa University, Newton Park, Newton St Loe, Bath, BA2 9BN. Contacts:
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Ethical approval was granted by Bath Spa University School of Society Enterprise and Environment's Research Ethics committee and by *Mumsnet* and *Netmums*

Sleep patterns in babies and young children often present parents with significant challenges and yet most of the research in this area focuses on infants and how best to establish good sleep habits. The impact of sleep changes on the parents themselves is often only implied or alluded to in very general terms. This research aimed to clarify some of the ways in which parents' sleep experiences, preferences and current patterns are affected by their children and how this might be related to specific aspects of everyday attention, memory, language production, co-ordination and mood.

Study 1. Perceived effects of sleep disruption due to children, in an online community of mothers

In this study, the content of a selection of *Mumsnet Talk* online discussion strings about the perceived effects of 'sleep deprivation' due to parenting babies and young children was analysed. The main question was: How do mothers, whose sleep is disrupted by their children, think this affects their own everyday functioning? The main purpose of this study was to identify these effects so that some of them could be more precisely measured in a follow-up Study 2.

Key findings: Significant sleep disruption due to children was a feature of parenthood for the 122 discussion participants. Mothers believed that this disruption led to different degrees of negative effects on specific aspects of physical, emotional, and daily functioning. Ten different discussion themes were identified, including such things as '*changing relationships with others*' and '*accepting and living with limitations*'. A further six themes were found in which mothers described how they thought that their thinking processes were adversely affected (for example '*unreliable memory*' and '*language production problems*'). Sleep disruption, therefore, appeared to have many consequences and presented challenges that needed to be actively coped with day-to-day. Mothers reported employing a number of strategies to help them manage this situation, which they saw as being of uncertain duration.

Study 2. Cognitive correlates of sleepiness and fatigue in sleep-disrupted mothers of children aged under five years

Study 2 aimed to find out whether the physical, emotional, thinking, speech and co-ordination effects identified by *Mumsnet Talk* participants in Study 1 differed according to the level of sleep disruption, sleepiness and fatigue they said they had experienced in the previous week. It took the form of an online survey of 126 *Mumsnet* and *Netmums* participants with at least one child under 5 years of age. Survey questions were chosen specifically to reflect some of the sleep-related effects thought to be important by participants in Study 1. They also included a number of well-respected scales measuring sleepiness, fatigue, mood, daily attention, memory, co-ordination and general functioning. Where possible, mothers' partners also completed a short questionnaire about mothers' general daily functioning. All of these scales measure functioning in a range which is considered normal for healthy adults.

A further 37 mothers completed the online survey, and were also visited by the researcher in order to complete a selection of thinking tests which had been selected according to Study 1 findings. The tests measured simple short-term memory and problem solving and more demanding word fluency and concentration.

Key findings: Under 5s disrupted their mothers' sleep, to a greater or lesser extent, in 80% of cases. Greater self-assessed sleepiness and fatigue were associated with greater sleep disruption. Greater fatigue and sleepiness were, together, associated with more self-assessed daily attention and memory lapses, and with a higher frequency of self-reported clumsiness and minor accidents. Self-assessed fatigue and mood were, together, associated with self-reported, general, everyday functioning (for example, '*easily distracted'*, '*problems making decisions'*).

In the tests, greater self-reported fatigue was associated with slightly poorer simple problem solving and word fluency. Greater sleepiness was associated with slightly impaired concentration in the most demanding test. Simple short-term memory was unaffected. Partners' assessment of mothers' general everyday functioning was a good predictor of how well mothers did on the more demanding concentration test, but did not predict performance on any of the other tests.

With the exception of simple short-term memory, effects of sleep disruption, sleepiness and fatigue, identified by *Mumsnet Talk* participants, were evident in both self-reported and directly tested aspects of daily functioning. Some of the adverse effects of sleep disruption that mothers experience were therefore, measurable, but the effects were small and within the normal range. For the most part, these effects were undetectable by others who knew the mothers well.