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The Role of Environmental Context in Dementia

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Outline

- The BIC Model (Diana et al., 2007) and its implications
- The role of Environmental Context (EC)
- EC and Alzheimer’s Disease

- Just a suggestion I would like to put out there.
The BIC Model

On the basis of associative memory, source memory, and remember/know studies.

(Diana et al., 2007)
Environmental Context

- “A conceptual garbage can” (Smith et al., 1978)

- Environmental Context (EC): Information in the physical environment, where a stimulus is presented, that is incidental to the manner in which the stimulus is encoded.
  - That is, as opposed to influential context, which influences the interpretation of the stimulus:
    E.g.  
    Strawberry - Jam  
    Traffic - Jam

- The typical Global EC experiment presents subjects with material in one EC and then tests their memory for this material in the same or in a different EC.
  - As opposed to Local EC

(see also Bjork and Richardson-Klavehn, 1989)
The Reinstatement Paradigm

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<tr>
<th>Encoding</th>
<th>Retrieval</th>
<th>Performance</th>
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<tr>
<td>Context A</td>
<td>Context A</td>
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Tested recognition memory employing a *Local EC* manipulation.

Employed the IRK (Independence Remember Know) procedure (Yonelinas & Jacoby, 1995) assuming that recognition comprises recollection and familiarity (see Yonelinas, 2002).

EC effects for recollection but not for familiarity.

Pattern of results replicated by Markopoulos et al. (2010)
Unpublished experiment

Method:

– Sixty-four participants
– **Encoding**: 80 nouns in EC A or EC B (memorization or natural/man-made task)
– **Questionnaire & Partial Test**: 20 Targets and 20 Distractors
– **Filler task**: 15 min drawing task (waiting area)
– **Recognition**: 32 participants returned to encoding EC and 32 were led to the new EC.
– **Item types**: 60 P items, 20 T items, 20 D items
EC main effect: $F(1,60) = 130.436, \ MSE = 0.011, p < .001$

Type x EC interaction: $F(2,120) = 27.278, \ MSE = 0.003, \ \text{Huynh-Feldt} \ p < .001$
EC main effect: $F(1,60) = 152.259$, $MSE = 0.906$, $p < .001$

Type x EC interaction: $F(2,120) = 14.863$, $MSE = 0.374$, Huynh-Feldt $p < .001$
Unitization hypothesis

• One possible exception to the assumed context-independence of familiarity is the ‘unitization’ of associative information (e.g. context) and item information (Yonelinas, 2002).

• Wais, Mickes & Wixted (2008): Source memory information accompanying know responses Caldwell & Masson (2001): Familiarity-based recognition of object-location associations. The locations were realistic environments (rooms of a house) with which the participants actively interacted.
Unitization hypothesis

• In contrast to previous findings, **Perirhinal Cortex** has been found to be involved in certain types of associative memory.

• Haskins et al. (2008) observed **Perirhinal Cortex** involvement in memory for novel compound words as opposed to words in sentences (see also Ford et al., 2010; Staresina & Davachi, 2008).
  
  • **In sentence**: The ___ for the bath cost one ___ **STEAM TOKEN**
  • **Novel compound**: A pastry eaten by mountain climbers **SLOPE BREAD**
What’s the point?

- All the research discussed so far in terms of neuroimaging is based on memory for context (e.g. Diana et al. 2007), not the influence of context on item memory.

- **BUT**: Hayes et al. (2007)
- PhC at encoding associated with retrieval success at scene-object and scene-scene conditions.
- PhC at recognition associated with retrieval success at scene-object condition (Hit vs Miss) – Mental Reinstatement?
- PhC at recognition differentiated between Hits at scene-object and Hits at object-object conditions.
EC and Alzheimer’s Disease

- AD is progressive with arguably distinct stages (see Braak & Braak, 1991).
- The Entorhinal Cortex is affected early on, signalling the first memory problems.
- As the anterior regions of MTL are affected first (ErC and PrC), while the posterior regions (PhC) are intact, *item memory should be affected, but context-processing should be ok* (see Didic et al., 2001).
EC and Alzheimer’s Disease

- **However**: Evidence that memory for context is impaired early on in AD, while item-based memory is intact
  - E.g. Dalla Barba (1997):
    - AD patients produced fewer *Remember* responses than controls, but did not differ in *Know* responses.
- So, it is assumed that AD patients cannot benefit from context-reinstatement.
  - But this conclusion is based on studies of memory FOR context!
EC and Alzheimer’s Disease

**SO:** The big question is “Can AD patients benefit from EC reinstatement despite their poor memory for context?”

**ANSWER:** I have no idea!
EC and Alzheimer’s Disease

- **However**: There are ‘Hints’
- Barak et al. (2013):
  - Tested Traumatic Brain Injury patients
  - TBI patients have episodic memory impairment similar to early AD
  - Manipulated Global EC (rooms) in the reinstatement paradigm.
  - TBI patients showed EC effects (mostly for free recall, less for cued recall, and not for recognition).
  - TBI patients benefitted more from EC reinstatement than healthy controls.
Putting it all together...

- Different areas of the MTL seem to be dedicated to the processing of items and of context.
- Even if memory for context is impaired, perhaps EC reinstatement can be of benefit.
- Figuring out what the exact mechanisms are for EC reinstatement is crucial.
- Different types of EC might produce different outcomes.