Situation Model Updating in Young and Older Adults: Global versus Incremental Mechanisms

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Abstract

Readers construct mental models of situations described by text. Activity in narrative text is dynamic, so readers must frequently update their situation models when dimensions of the situation change. Updating can be incremental, such that a change leads to updating just the dimension that changed, or global, such that the entire model is updated. Here, we asked whether older and young adults make differential use of incremental and global updating. Participants read narratives containing changes in characters and spatial location and responded to recognition probes throughout the texts. Responses were slower when probes followed a change, suggesting that situation models were updated at changes. When either dimension changed, responses to probes for both dimensions were slowed; this provides evidence for global updating. Moreover, older adults showed stronger evidence of global updating than did young adults. One possibility is that older adults perform more global updating to offset reduced ability to manipulate information in working memory.

During narrative comprehension, readers construct *situation models*, which are working memory representations of the situation described in the text. Situation models are thought to represent information along various dimensions such as the characters, their goals, space, and time (Zwaan & Radvansky, 1998). Information relevant to these dimensions often changes throughout the s>> BDCE Newaracters and rnfornge3ctet informatio(4.72665 l44ls 20king)< ers, their,

spatial location but information relevant to other dimensions is not updated. Presumably,

kitchen for a glass of milk. Theories that incorporate global updating mechanisms would predict that the change in spatial locations should render information from the previous location as well as attributes of the character less accurate and slower to a recognition probe. Specifically, global updating should cause information about the TV's location as well as information about Elvira to be cleared from the situation model.

Evidence for global updating includes a study conducted by Speer and Zacks (2005)

Method

participants demonstrated the same reading time patterns: Both groups slowed down while reading character shift sentences but not while reading spatial shift sentences.

conducted a follow-up mixed modeling analysis only on the character probes for the young adults. However, the fixed effect of Updating was not significant, $F < 1.0$, $p = .549$.

Accuracy—Figure 6 presents mean accuracy for character and spatial probes following no

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dimension) approached differing significantly from the condition in which no updating was hypothesized (probes on no change trials).

Young and older adults showed no updating effects in accuracy (see Figure 6). That is, readers' accuracy did not differ significantly across the three updating conditions. The lack of an updating effect in the accuracy data was unexpected; however, even if information has been updated (i.e., cleared from working memory), it presumably can be retrieved from long-term memory – perhaps even activated long-term memory (Cowan, 2001). Thus, even though information is no longer active in working memory, readers may be able to retrieve the information from long-term memory and accurately respond to the recognition probes. However, responses would take longer if retrieval requires a cue-driven search through long-term memory as opposed to output from working memory.

The lack of strong evidence for updating effects in young adults' response times and

only, $F_{(1,72)} = 4.69$, $p = .034$, $\eta^2 = .05$, which indicates that older adults were less accurate whenthte

Radvansky and Copeland (2010) discuss, situation model updating can occur even in the absence of increased sentence reading times. Thus, it seems unlikely that the young adults in the current experiment did not perceive the shift sentences as important changes.

The memory probe results provide evidence that older adults updated their situation models in a global fashion. This provides support for comprehension theories such as Event Segmentation Theory and the Structure Building framework. Other work has provided evidence of incremental updating (e.g., Kurby & Zacks, 2012) and the current results do not rule out the occurrence of this updating mechanism, but they do entail that theories that only specify an incremental updating mechanism (for example, the Event Indexing Model) need to be modified to include a global updating mechanism.

Curiel JM, Radvansky GA. Spatial and character situation model updating. Journal of Cognitive Psychology. 2014; 26:205–212.

Stine-Morrow EAL, Gagne DD, Morrow DG, DeWall BH. Age differences in rereading. Memory & Cognition. 2004; 32:696–710. [PubMed: 15552347]

Stine-Morrow EAL, Morrow DG, Leno R III. Aging and the representation of spatial situations in narrative understanding. Journal of Gerontology: Psychological Sciences. 2002; 57B:P291–P297.

Therriault DJ, Rinck M, Zwaan RA. Assessing the influence of dimensional focus during situation model construction. Memory & Cognition. 2006; 34:78–89. [PubMed: 16686108]

Thomas RC, Hasher L. Reflections of distraction in memory: Transfer of previous distraction improves recall in younger and older adults. Journal of Experimental Psychology: Learning, Memory, and Cognition. 2012; 38:30–39.

Trueswell JC, Tanenhaus MK, Garnsey SM. Semantic influences on parsing: Use of thematic role information in syntactic ambiguity resolution. Journal of Memory and Language. 1994; 33:285–318.

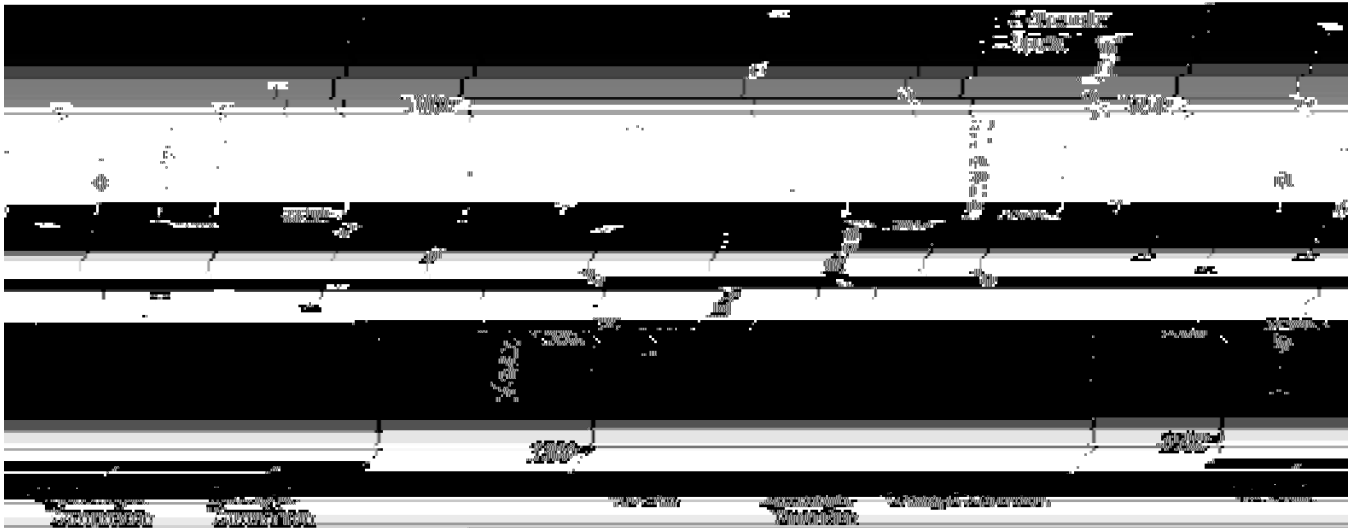Wilson M. MRC Psycholinguistic Database: Machineusable dictionary, version 2.00. Behavior

Figure 4.
Mean raw response time to the probe phrases presented after no shift, probe phrases related to unchanged information, and probe phrases related to the changed information for young and older adults. Note that young and older adults mean response times are on different scales. Error bars are s5.m / nh4r ofd to lts . 4.
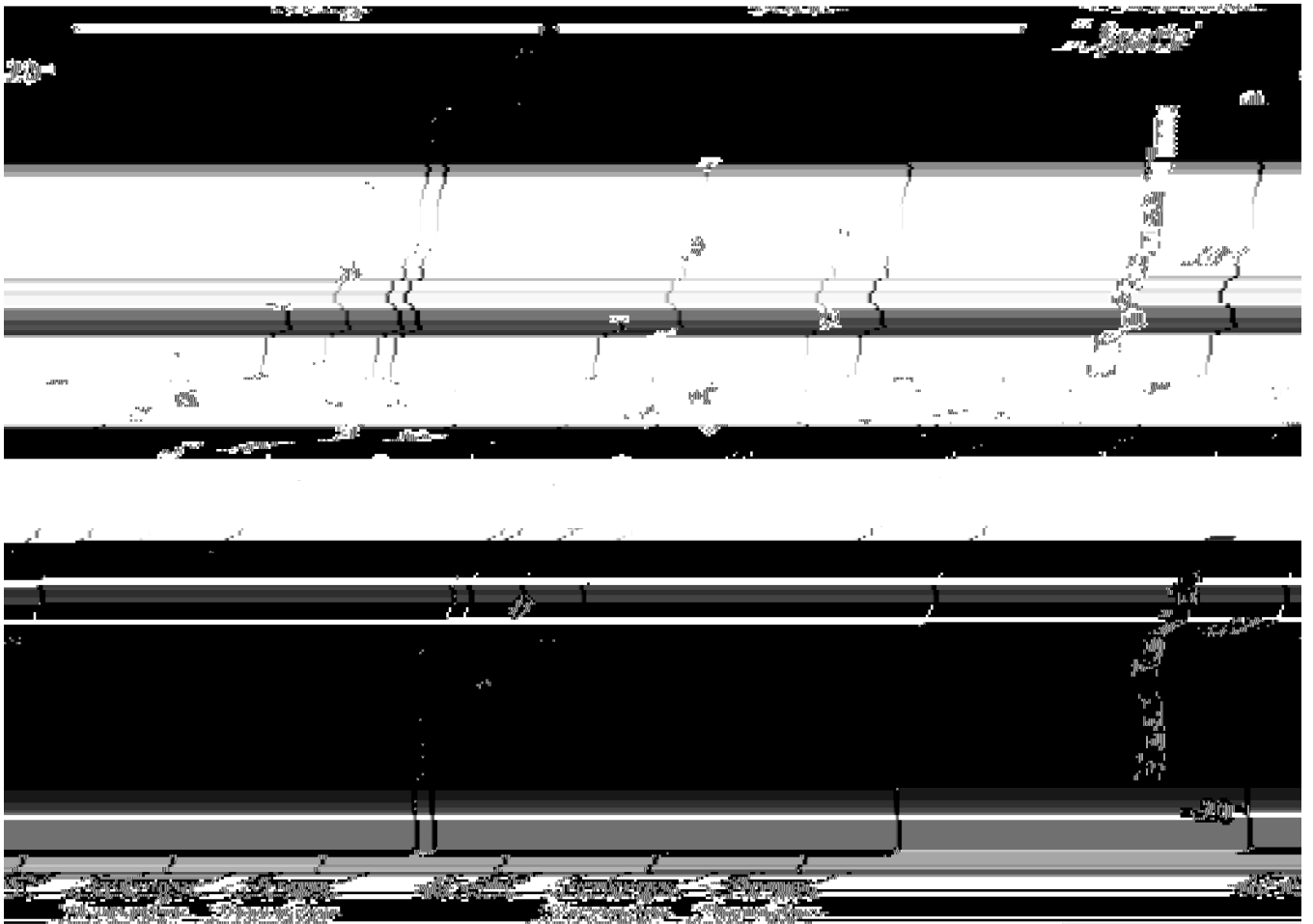
Figure 5.