Downstream Effects of Prediction on Word Recognition — The Influence of Working Memory Load and Capacity

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Listeners use prior sentence contexts to predict upcoming words which can facilitate processing of these words.[1/2] Prediction not only has immediate effects on word processing, but also downstream effects on memory encoding of words. We aimed to replicate that prediction can initiate the formation of memory representations.[3/4/5] We also sought to examine how working memory load modulates prediction-driven forming of memory representations. Specifically, we tested two views against each other: Forming memory representations could benefit from short linguistic contexts where less information has to be kept in working memory during prediction, creating smaller working memory load.[6] Otherwise, longer sentence contexts may allow predictions to linger in working memory for a longer time, causing stronger representations.[7/8]

In three self-paced reading studies German adults read predictable sentences ending with plausible target words of *low* predictability (e.g., *To open the door Jens looks for the handle*). We manipulated working memory load: Study 1 presented short and long sentences. The distance (i.e., the number of words) between the predictive context and the target word consisted of four additional words in the long sentences. In study 2, the distance manipulation consisted of up to nine additional words in the long vs. the short sentences. Here, we also showed long sentences with an additional semantic cue prior to the target word (e.g., *below the doormat*) that should support lingering of predictions in working memory. In study 3, the target word was shown either in the mid or end of a sentence to control whether words in the end position, i.e. words that do not need to be kept in working memory across the whole sentence, allow stronger representations.

In all studies, we tested readers' (n = 80) memory for presented target words (e.g., *handle*), predicted but not presented lure words (e.g., *key*), and unrelated new words (e.g., *message*). In study 1, memory was also tested for unpredictable but semantically related context lures (e.g., *entry*). Table 1 shows an example item. All studies included two working memory span tasks.

GLMMs on the proportion of "old" ratings for the recognition words with the factors word type and sentence type revealed for each study that readers successfully discriminated old target words from new words while showing more false alarms to predicted lure vs. new words. Thus, predictable words lingered in memory even when predictions were disconfirmed, meaning that prediction has long-term effects on cognition. In study 1, memory did not differ for new words vs. context lures, showing that the effect did not derive from semantic association but from prediction. Study 2 found no evidence that additional cues supporting lingering of predictions in working memory affect recognition. In sum, we found no effect of the working memory manipulation (short vs. long distance; mid vs. end position). However, individual differences in working memory skill affected false memory. In study 1, higher working memory skill was related to fewer false alarms for lure words, showing that working memory plays a role for the prediction-driven forming of memory representations. In sum, we show that prediction affects memory, but future studies may test working memory manipulations with more complex linguistic structures to ascertain the impact of working memory load on memory representations.

Table 1

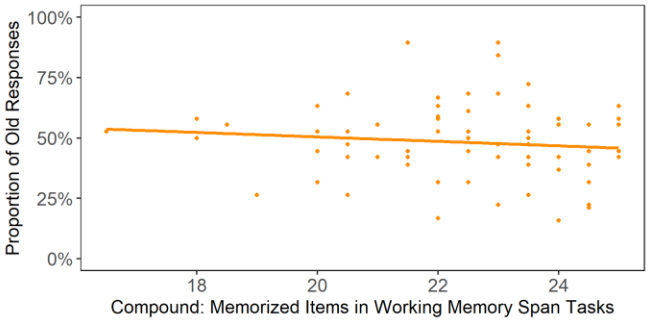
Example Item

Study	Condition	Sentence	Dist.
1	Short	**Weil Jens die Haustür öffnen möchte**, sucht er den eisernen **Griff** unter dem Stein.	4
1	Long	**Weil Jens die Haustür öffnen möchte**, sucht er den von einem Handwerker gefertigten eisernen **Griff** unter dem Stein.	8
2	Short	**Weil Jens die Haustür öffnen möchte**, sucht er den eisernen **Griff**.	4
2	Long	**Weil Jens die Haustür öffnen möchte**, sucht er unter dem Stein den von einem Handwerker gefertigten, eisernen **Griff**.	11
2	Long, additional cue	**Weil Jens die Haustür öffnen möchte**, sucht er unter der Fußmatte den von einem Handwerker gefertigten, eisernen **Griff**.	11
3	End position	**Weil Jens die Haustür öffnen möchte**, sucht er den von einem Handwerker gefertigten, eisernen **Griff** unter dem Stein.	8
3	Mid position, short	Jens sucht, **weil er die Haustür öffnen möchte**, den eisernen **Griff** unter dem Stein, den ein Handwerker gefertigt hatte.	2
3	Mid position, long	**Weil Jens die Haustür öffnen möchte**, sucht er den eisernen **Griff** unter dem Stein, den ein Handwerker gefertigt hatte.	4

Note. An item in its conditions across the studies with the predictive context and target word in bold. For study 2, the additional semantic cue is underlined. In all studies, memory was tested for the target word Griff, the lure word Schlüssel, and the new word Nachricht. In study 1, it was also tested for the context lure Eingang. Dist. (distance) is the number of words between the context and target word.

Figure 1

Recognition of Lure Words Depending on Working Memory Capacity (Study 1)



Note. Increases in working memory skill (indicated by the compound score of the number of memorized items in two working memory span tasks) was associated with fewer old ratings for lure words.

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