



When distraction benefits memory through semantic similarity[☆]



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ABSTRACT

The processing of the relation between targets and distracters which underpins the impairment in memory for visually presented words when accompanied by semantically related auditory distracters—the between-sequence semantic similarity effect—might also disambiguate category membership of to-be-remembered words, bringing about improved memory for these words at recall. In this series of experiments the usual impairment of the between-sequence semantic similarity effect is reversed: we show that related distracters can improve memory performance when multiple-category lists are studied and a category-cued recall test is used at retrieval. The results indicate not only that irrelevant speech distracters are routinely processed for meaning, but also that semantic information gleaned from this stream is retained until recall of the memoranda is cued. The data are consistent with a revised interaction-by-process framework.

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Introduction

Performing difficult or challenging cognitive tasks requires focused attention, for which it is necessary to partition task-relevant information from the external environment and the distractions it presents. Complete disengagement, however, is less than desirable if a flexible system of attention is to be realized: the cognitive system should be equipped with means of monitoring most of the ensemble of environmental events so as to alert the individual to events particularly germane to the individual's overall goals. The logical consequence of such a system is distractibility. It means that even when a person is highly

absorbed in performing a cognitive task, changes in environment are likely to affect cognitive performance.

One particularly interesting instance is the case of auditory distraction in a memory task (see reviews by Beaman, 2005; Hughes & Jones, 2003; Jones, Hughes, & Macken, 2010). A long tradition of research has examined how performance in tasks such as serial or free recall is impeded by the presence of auditory distraction in the form of either speech (e.g., Jones, Madden, & Miles, 1992; Salamé & Baddeley, 1982) or non-speech sounds (e.g., Hughes, Vachon, & Jones, 2007; Jones & Macken, 1993). An overall framework for understanding auditory distraction effects is one of interference-by-process (Jones & Tremblay, 2000), according to which the similarity between the processes engaged in performing the primary memory task and those used to register the environment determine the degree of interference observed in memory performance. Thus, if a memory task is one of visual serial recall which requires primarily the processing of order of the memoranda, an automatic process of seriation of a

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sequence of auditory distracters impairs memory performance (Beaman & Jones, 1997, 1998). However, if a task is one of free recall which requires primarily the processing of the meaning of the memoranda, semantic processing of auditory distracters determines memory impairment (Marsh, Hughes, & Jones, 2008). Results such as these have been used to inform hypotheses about the structure and organization of memory (e.g., Jones, Beaman, & Macken, 1996; Jones, Hughes, & Macken, 2006; Neath, 2000; Page & Norris, 2003; Salamé & Baddeley, 1982) and the extent to which supposedly unattended information is processed (e.g., Jones, 1999; Macken, Tremblay, Houghton, Nicholls, & Jones, 2003).

In the present study our interest lies in auditory distraction processes observed in memory tasks that require memorizing and recalling semantically-rich materials in the form of words. These processes have most commonly been examined with a free recall task (e.g., Neely & LeCompte, 1999). The hallmark of interference-by-process in free recall is a finding of a *between-sequence semantic similarity effect* (also referred to as a *semantic auditory distraction effect*). When the task is to remember a list of words derived either from a single category (e.g., Beaman, Hanczakowski, Hodgetts, Marsh, & Jones, 2013; Marsh, Sörqvist, Hodgetts, Beaman, & Jones, 2015; Marsh et al., 2008), or up to four different semantic categories (Marsh, Hughes, & Jones, 2009; Marsh, Perham, Sörqvist, & Jones, 2014), ability to correctly recall suffers more in the presence of auditory distracters that are related to to-be-remembered (TBR) items. Thus memory based on semantic processing of TBR words is impeded by processing of semantic aspects of auditory distraction, a finding consistent with the interference-by-process framework. Where TBR words come from a single category, related to-be-ignored (TBI) auditory distracters – words from the same semantic category – produce an exaggerated memory impairment. Where TBR words are drawn from multiple categories, related TBI distracters are words from one of these categories and the exaggerated memory impairment relative to semantically unrelated distraction is found for TBR items that match the category of TBI items and also other items presented in the same TBR list (Marsh et al., 2009).

A number of possible specific mechanisms could potentially account for the between-sequence semantic similarity effect in free recall. These mechanisms are not mutually exclusive. According to the attentional shift hypothesis, presenting semantically related auditory distracters induces an attentional shift away from the focal memory tasks and towards processing of the distracters (Bell, Buchner, & Mund, 2008; Cowan, 1995; Parmentier, 2008). If fewer attentional resources are devoted to processing TBR items, subsequent memory performance is likely to suffer. The idea here is thus that participants' ability to ignore distracters is not perfect. As mentioned earlier, the attentional system needs not only to support performance in the focal task but it also needs to monitor the environment for germane events and auditory distracters that are related semantically to processed TBR items can be seen as such germane events that need to be attended to. Indeed, studies on distraction that manipulated the

significance of auditory distracters, either by using distracters rich in emotional content (Buchner, Rothermund, Wentura, & Mehl, 2004) or by using participants' own names as auditory distracters (Röer, Bell, & Buchner, 2013), have found that presumably more significant distracters caused a greater memory impairment for TBR items, consistent with the attentional hypothesis.

The attentional shift hypothesis can be seen as an extension of theoretical frameworks that postulate that a finite level of resource or activation is shared between all current stimuli (Neath, 2000; Oberauer & Lange, 2008). This form of resource-sharing also gives rise to ideas of inhibition as a means of top-down control to avoid runaway or inappropriate activation levels. By an inhibitory mechanism, the between-sequence semantic similarity effect might then reflect an overhead cost incurred when recruiting inhibitory processes to resist related distracters in order to facilitate encoding of TBR words (Marsh, Sörqvist, Beaman, & Jones, 2013; Marsh et al., 2008). In this account also, the impairment to memory of TBR items arises when resources are devoted to processing of distraction instead of TBR items. However, whereas the attentional shift hypothesis postulates that resources are purposefully devoted to processing distraction when there is a chance it is germane to the main memory task (i.e. it is semantically related to TBR items), the inhibitory hypothesis postulates that resources are allocated to avoid further processing of distraction by means of inhibition. The main line of support for the inhibitory hypothesis comes from examining the after-effects of related auditory distraction in the form of negative priming in free recall: impaired memory performance when related TBI items become TBR items in the next memory list (Marsh, Beaman, Hughes, & Jones, 2012; Marsh, Hughes, Sörqvist, Beaman, & Jones, 2015). However, the contribution of inhibition to negative priming in free recall has recently been questioned by Hanczakowski, Beaman, and Jones (2016), who argued for a simpler proactive interference account of this effect, leaving the status of the inhibitory hypothesis unclear.

Another means by which related distraction can cause forgetting is via overwriting at, or immediately subsequent to, encoding (Nairne, 1990; Neath, 2000). Here it is argued that specific features of related distracters overwrite memory trace of a TBR item, displacing some or all of its individual or characteristic features. With missing features, the TBR item is later more difficult to reconstruct and thus memory performance suffers.

The attentional shift, inhibitory and overwriting hypotheses rely upon a hypothetical operation at encoding disturbing later recall but the primary locus of the between-sequence semantic similarity effect may lie not at encoding but rather at retrieval of TBR items more directly. Via a process of blocking, related TBI items encoded in memory might interfere with retrieval of TBR words by increasing the size of the sampling set and thus reducing the chances that each one of the TBR words is sampled (cf. Marsh et al., 2008). The blocking hypothesis links the semantic auditory distraction paradigm with numerous other memory paradigms, such as the part-set cuing paradigm (Rundus, 1973) or the retrieval practice

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