Interference by process, not content, determines semantic auditory distraction

John E. Marsh *, Robert W. Hughes, Dylan M. Jones

School of Psychology, Cardiff University, Cardiff, Wales CF10 3AT, UK

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Distraction by irrelevant background sound of visually-based cognitive tasks illustrates the vulnerability of attentional selectivity across modalities. Four experiments centred on auditory distraction during tests of memory for visually-presented semantic information. Meaningful irrelevant speech disrupted the free recall of semantic category-exemplars more than meaningless irrelevant sound (Experiment 1). This effect was exacerbated when the irrelevant speech was semantically related to the to-be-remembered material (Experiment 2). Importantly, however, these effects of meaningfulness and semantic relatedness were shown to arise only when instructions emphasized recall by category rather than by serial order (Experiments 3 and 4). The results favor a process-oriented, rather than a structural, approach to the breakdown of attentional selectivity and forgetting: performance is impaired by the similarity of process brought to bear on the relevant and irrelevant material, not the similarity in item content.

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1. Introduction

One of the most influential constructs in memory research is interference: the ease with which items are retrieved from memory is dictated, at least in part, by other stimuli or events that are similar in some way to the target (see, e.g., Anderson, 2003; Baddeley, 1986; McGeoch, 1942; Nairne, 1990; Nairne, 2002; Neath, 2000). The classical, structuralist, view has been that such interference-by-similarity-of-content directly causes forgetting, that is, forgetting is a passive side-effect of structural changes that result from the storing of new, similar, events in memory (Anderson, 1983; Cowan, 1999; McGeoch, 1942; Mensink & Raaijmakers, 1988; Oberauer & Lange, 2008; Oberauer, Lange, & Engle, 2004; Salamé & Baddeley, 1982). However, an alternative, more functional, view is that ‘forgetting’ (or the impairment of retrieval) reflects the legacy of dynamic and adaptive selective attention processes (such as inhibition; e.g., Houghton & Tipper, 1994) that are designed to resolve conflict during the selection of candidates at retrieval (e.g., Anderson, 2003). Set within this quintessentially attentional approach to forgetting, the present article explores the nature of phenomena relating to impaired retrieval from memory due to distraction from irrelevant auditory events using the structuralist, interference-by-similarity-of-content, approach as a theoretical counterpoint.

One line of research in which a dynamic selective attention framework has been used to reconstrue putatively mnemonic phenomena is that concerned with the disruptive effects of to-be-ignored sound on visual-verbal serial recall whereby a list of around 6–8 verbal items (e.g., letters or digits) is to be recalled in strict serial order (the irrelevant sound effect—hereafter ISE—e.g., Colle & Welsh, 1976; Jones, Madden, & Miles, 1992; Jones & Tremblay, 2000; Salamé & Baddeley, 1982). The mere presence of background sound depresses serial recall appreciably, the weight of evidence favoring the view that the effect results from interference-by-process, and is not a passive side-effect of having similar items to remember and to ignore.

* Corresponding author. Tel.: +44 29 20 876788; fax: +44 029 20 874858.
E-mail address: marshje@cardiff.ac.uk (J.E. Marsh).

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(Hughes & Jones, 2005; Jones & Tremblay, 2000). Specifically, this 'classical' ISE is thought to result from the obligatory, preattentive, serialization (or ordering) of sound sequences producing competition for the deliberate process of serializing the to-be-remembered items. Here we examine whether the principle of interference-by-process can be extended to a setting in which the focal memory task involves not serial processing but semantic retrieval strategies: Does the concurrence of similar semantic processing (rather than serial processing) applied to relevant and irrelevant material now dictate the form and degree of distraction? What little evidence there is seems to suggest that the structural accounts seem perfectly adequate and irrelevant material now dictate the form and degree to which it is distinct from that found in serial recall, and to examine thereafter how such distinct phenomena might be reconciled with a dynamic process-oriented approach to interference.

1.1. Irrelevant sound effect in serial recall

The debate between the structuralist and process-based standpoints can be observed in microcosm in a body of research showing that the presence of irrelevant, to-be-ignored, sound markedly increases forgetting in a (usually visually-presented) serial recall task (e.g., Colle & Welsh, 1976; Jones et al., 1992; Salamé & Baddeley, 1982). The conventional viewpoint, that forgetting can occur as a direct and passive consequence of the structural similarity between to-be-remembered and irrelevant episodes or stimuli (e.g., McGeoch, 1942), is evident in several theoretical accounts of the ISE that view it as a mere consequence of preattentive perception, as cues to the order of those elements as a by-product of priming, or as perceiving the order cue (e.g., Neath & Surprenant, 2001). Although these accounts differ in their detail of how interference arises, the important point for present purposes is that they are all examples of an interference-by-content approach: recall is impaired as a result of the similarity in identity (i.e., content) between to-be-remembered and to-be-ignored items.

Several strands of evidence converge to weaken the interference-by-content approach. First, non-speech sounds such as tones—which bear little or no resemblance to the to-be-remembered items—produce disruption similar in degree and kind to that from irrelevant speech (e.g., Jones & Macken, 1993; Neath & Surprenant, 2001). Second, the magnitude of disruption is unrelated to the degree of phonological similarity between to-be-remembered and to-be-ignored items (Jones & Macken, 1995; LeCompte & Shaibe, 1997; but see Hughes & Jones, 2005) thereby disconfirming the predictions of an early account based on the concept of a phonological store (Gathercole & Baddeley, 1993; Salamé & Baddeley, 1982). As a result of these findings, the phonological store account of the ISE has been modified and expressed computationally such that irrelevant speech disrupts a representation of order within the passive store rather than interfering with item representations (Norris, Baddeley, & Page, 2004; Page & Norris, 2003). However, problematic for any account that views irrelevant speech as disrupting the phonological store is recent evidence showing that rehearsal is a precondition for its expression (Jones, Macken, & Nicholls, 2004).

Third, the interference-by-content approach fails to acknowledge adequately the critical importance of the nature of focal task processing, the impairment of recall being chiefly determined by the co-existence of similar to-be-remembered and to-be-ignored items within a store. That is, they cannot account for why the ISE is only found if the focal task necessitates or tends to encourage a serialization process (e.g., serial rehearsal) and why the mere presence of similar content between the memory material and the sound is not sufficient (or necessary) for the effect (Beaman & Jones, 1997; Farley, Neath, Allbrtiton, & Surprenant, 2007; Henson, Hartley, Burgess, Hitch, & Flude, 2003; Hughes, Vachon, & Jones, 2007; Perham, Banbury, & Jones, 2007).

Whilst the preoccupation of the interference-by-content approach is with item identity, on the interference-by-process account, the key determinant of the disruption in serial recall is the extent to which both the irrelevant sound and the focal memory task share similar serialization (or ordering) processes (Jones, 1993; Jones & Tremblay, 2000). A key observation underpinning this account is that from irrelevant sound during serial recall is the extent to which both the irrelevant sound and the focal memory task are serially similar and that these processes (cf. Bregman, 1990). These irrelevant order cues compete for—and hence impair—the deliberate serialization process (serial rehearsal) supporting ordered recall of the to-be-remembered items (Hughes & Jones, 2005; Jones, 1993). In support of this view, the ability to encode the order of stimuli in an attended changing-state auditory sequence predicts the degree to which that sequence is disruptive when presented as irrelevant sound during serial recall (Macken, Phelps, & Jones, in press).

In sum, results based on research using the serial recall paradigm favor a dynamic process-based approach (Jones & Tremblay, 2000). However, the phenomenon of interference-by-process seems highly specific to a particular process (serialization) and little evidence is available with respect to whether such conflict occurs between other types of processes. In the present study, therefore, we addressed whether the phenomenon extends to auditory distraction in the context of a focal task that is likely to be
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