Investigating the relationship between two approaches to verbal information processing in working memory :

AN EXAMINATION OF THE CONSTRUCT OF WORKING MEMORY COUPLED WITH AN INVESTIGATION OF META-WORKING MEMORY

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ABSTRACT

Working memory is a process whereby persons can preserve information for a short time while concurrently engaging in other cognitive operations. The literature describes two approaches to working memory. The first approach (Baddeley, 1986) can be described as a complete model of working memory. However the second approach is not as clearly a distinct model, although its history, literature, application, simulation and operational definitions can arguably allow one to describe it as a separate model or strand of working memory for the present purposes. Rather, what will be termed the "quantitative/process model" deals only with verbal information and is far less complete than Baddeley's model in other domains. A central issue is thus how these two models relate with respect to how they handle verbal information. Baddeley (1986) delineated working memory as a set of interconnected components consisting of a Central Executive, a Phonological Loop, and a Visuo-Spatial Sketch-Pad. In this dissertation, this is termed the qualitative/structural model of working memory. Daneman and Carpenter (1980, 1983) delineated working memory as a process involving both a traditional span component and a concurrent operation. This approach, which will be referred to as the quantitative/process model of working memory, has been presumed to involve the Central Executive of the qualitative/structural model of working memory. This presumed relationship is scrutinised in the present dissertation in the context of an alternate hypothesis that the quantitative/process model involves more of the phonological loop than has been presumed. Thus, the first issue this dissertation addressed was how these two models or approaches to working memory account for verbal information. The second facet of the present investigation was to examine whether persons were able to report on their meta-memory for working memory.

Seven linked experiments are reported in the present dissertation. Participants for all seven experiments were predominantly students at local tertiary institutions and ranged in age from 16 to 48 years. The experimental conditions were presented as a two-factor within-subjects design in Experiments 1 to 6. The first general factor was word-type varying either across word-length (Experiments 2, 4, and 6) or across phonological similarity (Experiments 1, 3, and 5). The second factor was whether articulatory suppression was used or not (Experiments 1 to 6). In Experiments 1 and 2, stimuli were presented as a complex-span task (sentence plus word), where in Experiments 3 to 6, stimuli were presented as a simple-span task (word only). Experiment 5 also had a between-subjects factor determined by whether words were sampled from a 10 item pool or from a pool without replacement. Experiment 6 had a between-subjects factor determined by the presentation pace of the stimuli (at 1 per second or self-paced). Finally, Experiment 7 directly compared complex-span and simple-span presentations against a second factor of word-type varying across both phonological similarity and word-length (control, phonologically similar, 3-syllable).

In all seven experiments, participants were measured on dependent variables of recall in the correct serial position and recall in any serial position of the words that were presented. From the difference between these two measures of content, an estimate of the loss of order information (order errors) was calculated. A measure of the time each participant spent viewing (for simple-span tasks) or verifying (for complex-span tasks) the stimuli was made to assess processing time. Finally, before each trial, participants made an estimate of how many items they expected to recall in any order (a measure of their online meta-memory). In Experiments 5 to 7, a measure of the time each participant took to articulate the pool of words they had

been asked to recall was taken to provide an estimate of their articulation rate.

The main research questions for this set of studies were as follows: (1) that the quantitative/process model of working memory also uses the Phonological Loop, not just the Central Executive, and hence both models of working memory use the same process to preserve visually presented verbal information; (2) that measurement of dimensions of order and processing time, in addition to the dimension of content or capacity, will contribute independent information to the description of working memory function; and (3) that persons are able to monitor and report on their working memory. Data from the present set of studies provide support for these three hypotheses[1]. The present investigation showed that a concurrent operation does not preclude phonological similarity and word-length effects used to define the components of the qualitative/structural model of working memory. Concurrently, dimensions of content and order, but not processing time, were shown to be important in describing working memory. The conclusion from these results is that both models of working memory refer to the same construct and that preservation of verbal information can be better accounted for by a single process. Finally, in all instances persons were accurate in predicting their general working memory performance. The data also show that persons may be able to predict the effect of some parameter changes on their performance.

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[1]The raw data upon which this dissertation was based can be obtained in the first instance from the author at the following address: Llewelyn A. Richards-Ward

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The results of the present research suggest that verbal information is handled similarly in both models or approaches and tends to falsify that verbal information is retained primarily in the Central Executive in one model and the Phonological Loop in the other. Second the results suggest that persons do have a degree of meta-working memory. These results are discussed in terms of their implications for how working memory and meta-working memory can be described. Finally, some future directions for research are outlined.

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