THE COMPLEX INTERACTION OF LANGUAGE COMPREHENSION IN WORKING MEMORY

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Working memory has been found to be more complex than earlier research had supposed. The earliest view was one of simple capacity and any observed effects were interpreted as reaching the limits of that capacity. Baddeley (1990) presents a more dynamic model. The model that Baddeley has evolved is working memory consisting of three components: phonological loop, spatial-visual sketchpad, and central executive. The issue of interest is the phonological coding of visual language material and the interference that certain acoustic stimuli exert on that coding. Certainly, this model is not the only one, but by looking at some of the interesting effects observed in divergent research, it continues to be one that at the very least has heuristic value.

Salamé and Baddeley (1982) investigated the interference effects of acoustic similarity. These effects were on the recall of visually presented digit sequences suggesting an encoding process that makes them acoustic in nature. A masking process of this acoustic version of the visual information is suggested. Though white noise did have a significant masking effect, unattended speech, i.e., speech in a language not familiar to the participants, had a more significant effect. Varying the intensity of noise was not nearly as disruptive as the pattern of the noise, most particularly unattended speech. This result is contrary to simple masking explanations.

Salamé and Baddeley (1987) investigated patterned interference with the phonological store and found broadband noise failed to have a significant effect. However, the unattended speech sounds did have a significant deleterious effect. Experiment 3 added the feature of covert and overt rehearsal, while overt rehearsal had a significant effect, the noise level did not. A filtering mechanism that allows speech sounds into the phonological store while excluding non-speech-like noise is suggested (Salamé & Baddeley, 1987, p. 1192).

To investigate the filter concept more fully, Salamé and Baddeley (1989) experimented with various types of music, both instrumental and vocal. In digit symbol recall tasks, vocal music produced the most recall errors followed by instrumental music which was significant as compared to the quiet condition. In experiment 3, unattended Arabic speech was added and also pink noise that had its amplitude modulated by the Arabic prose. The unattended speech had the most significant effect on errors, whereas the modulated pink noise did not have a significant effect. Variance in amplitude did not distract attention, indicating acoustic similarity as the factor at work with the unattended speech.

The phonological loop is seen as two structures, the phonological store and the rehearsal loop (Baddeley, 1990). Articulation was considered earlier as the mechanism of the rehearsal loop, but it has now been rejected. Baddeley and Wilson (1985), in testing persons with dysarthria, found that acoustic confusion of phonemically similar material occurred when read, just as it does with persons once they have learned to read silently. This confusion indicates that the code conversion process occurs at a higher level than the articulation mechanism. Campbell and Dodd (1982, 1980) also concluded that articulation cannot account for cross-modality effects. Normal hearing participants produced modified recency and suffix effects when a speaker was seen, but not heard. Normal hearing participants use lip-reading to a certain degree. The recency and suffix effects are associated with acoustically presented lists, rather than visually presented lists.

Gathercole (1986) used a distracter task to determine if the modality effects are the result of articulation or not. The result was a significant recency effect for read aloud lists, regardless of the suppression task. Mouthed suppression only had a non-significantly disrupt recall of both silently read and read aloud list. The act of articulation is not the disruptive factor. Experiment two of Gathercole (1986) replaced the mouthed suppression task with a spoken suppression task. The spoken suppression task significantly reduced the recency effect of the read aloud lists. Total recall accuracy was also significantly reduced for both the silently read and read aloud lists in the spoken suppression condition. The acoustic nature of the suppression task, rather than its involvement with articulation, appears to explain the result the best.

Morris and Jones's (1990) exposed participants to sounds prior to performing digit recall tasks. When conditioned with unattended speech and recall tested under these conditions, the recall errors were reduced. Pink noise produced no such reduction. Speech similarity seems to be the requirement to condition a person against speech interference in recall tasks, rather than exposure to comparable noise levels. Morris and Jones (1990) suggested a combination of both the filter rejection and speech detection paradigm to be at work; Salamé and Baddeley (1989) suggested it might be either or. Clearly there is still much evolution occurring regarding the functioning of the phonological loop and the central executive deemed to control this interference.

Short-term memory is more dynamic than once thought. Acoustic coding of visual language material occurs to some degree. The code is speech related. The conditions of interference are complex, indicating some level of processing. Attention could play a role, but the mechanism of interference seems to be related to acoustic similarity with speech, rather than variations in intensity causing distraction. Articulation is not the answer in producing the code conversion of visual into acoustic. Further investigation into this acoustic coding and the mechanisms of interference is on going.

References

Baddeley, A. (1990). *Human memory* New Jersey: Lawrence Erlbaum Associates, Publishers.
Baddeley, A. & Wilson, B. (1988). *Journal of Memory and Language, 27,* 479-498.
Baddeley, A. & Wilson, B. (1985). *Journal of Memory and Language, 24,* 490-502.
Campbell, R., & Dodd, B. (1982). *Canadian Journal of Psychology. 36* (3), 508-514.
Campbell, R., & Dodd, B. (1980). *Quarterly Journal of Experimental Psychology.* 32, 85-99.
Gathercole, S. E. (1986). *Quarterly Journal of Experimental Psychology.* 38A, 461-474.
Morris, N. & Jones, D. M. (1990). *Perception & Psychophysics, 47*(3). 291-297.
Salamé, P. & Baddeley, A. (1982). *Journal of Verbal Learning and Verbal Behavior. 21,* 150-164.
Salamé, P. & Baddeley, A. (1987). *Ergonomics. 30*(8), 1185-1194.
Salamé, P. & Baddeley, A. (1989). *The Quarterly Journal of Experimental Psychology. 41A*(1), 107-122.