In “Maintenance of semantic information in capacity-limited item short-term memory” by Haarmann and Usher (2001), a computational model was used alongside behavioural data to support the idea of a short-term memory (STM) system with a limited capacity and lexical semantical representations. The model accurately predicted results from two experimental tasks. In the first task, the estimated STM component for recall of adjacent word associates was greater than those which were separated by five other non-semantically related words. This suggests adjacent word items have excitatory links which allow them to remain coactive in the STM item store. In the second task, increasing memory load had a more negative effect on the retention of word items presented earlier, rather than later, in the order of presentation in a cued-recall task.

These findings are significant because previous models by other investigators have employed STM traces that were exclusively phonological. Should STM traces actually involve semantic representations as suggested by the results of Haarmann and Usher (2001), the way in which phonological-only models code information would be inaccurate. Similarly, if the human brain employs displacement, as opposed to decay, as a mechanism for forgetting, the current findings provide a framework for developing a more coherent picture for such a mechanism.

While this study provides valuable insights into how verbal STM may be encoded, it does have some inherent weaknesses. Firstly, while evidence presented supports one theory, it does not employ a methodology which compares various theories. The only model tested involved a semantic coding and displacement from a limited store mechanism. It did not test models with alternative hypotheses to see if such models may also simulate human behavioural data for the given tasks. It is possible that there exists a model, yet to be explored, which incorporates a very different mechanism and simulates behavioural data even more precisely than the model used in the present study. It is also possible that Haarman and Usher’s (2001) model does not accurately
simulate behavioural data for other tasks involving verbal STM encoding, and a model with a different mechanism may be more accurate at predicting behavioural results for these other tasks.

Moreover, while the model in question does simulate behavioural data, it does not conclusively demonstrate that the human brain uses a mechanism like that employed in the model. The actual mechanism by which the brain could carry out coding for verbal STM could deviate from the model in a much more complex way. The authors themselves point out that their model does not take into account interactions between semantic and phonological representations in memory. Had the model taken these interactions into account, it may not have given the same results as the behavioural data. Similarly, the model does not take into account how episodic memory learning could affect semantic STM retention. It is possible that the framework within the brain which processes episodic STM memory is related in some aspects to the way in which semantic STM is processed, but the mechanism the model uses may only simulate semantic processing and not the related episodic processing in STM.

If other means of investigation, including neurophysiological and neuroimaging methods, could test various theories of verbal STM coding and provide converging evidence for an STM component with a limited capacity and semantical representations, the conclusions made in this paper be much better grounded. One final limitation of this modeling study is the scope of information it provides in big picture of how memory works. Although it is speculated that the memory processes explored may occur in the frontal cortex, the location(s) of the neural correlates or neural circuitry involved the coding of verbal STM are not examined. Functional imaging and electrophysiological evidence may not only provide further support the conclusions offered in the present study, but could also give a clearer picture as to how verbal STM mechanisms play out in the human brain.