The constant cost of short-term memory loss

When we try to make sense of what someone says to us we maintain a record of this information in memory. Many psychologists think that humans evolved a 'verbal short-term memory' system for this purpose, and we can measure the capacity of an individual's verbal short-term memory by asking them to immediately repeat back a list of words in the order in which they were presented. The typical adult capacity for short words is about 7 items, so read this list out to a friend and see if they can remember it correctly: "bee, tent, shoe, cup, gate, tree, lamp".

However, some individuals suffer from severely reduced short-term memory capacities, as a result of head injuries that affect the areas of the brain that support this system. It has been assumed that this loss of verbal short-term memory capacity arises for one of two reasons. The first is a failure to store any information in verbal short-term memory. Potential evidence for this view comes from a phenomenon called the 'phonological similarity effect'. This is the established finding that people find it easier to remember words that sound different to each other (such as the list above) compared to lists of similar sounding words (e.g., "cat, van, rat, map, man, tap, hat"). This pattern shows that people are maintaining these words in memory in terms of their spoken sounds, but this effect is often not seen in individuals with impaired verbal short-term memory capacity. The second suggestion follows from a different phenomenon, called the 'word length effect'. This is the standard finding that we remember more short words than long words (e.g., "helicopter, policeman, telephone, banana, newspaper, grandmother, jellyfish"). One possible explanation for this is that long words take longer to rehearse (say to ourselves) in our heads. The absence of this effect in individuals with loss of verbal short-term memory capacity has therefore been taken to indicate a failure to rehearse.

In this work we re-analyzed data on these two effects in an existing database of adult participants with a range of verbal short-term memory abilities. We found that some individuals did fail to show these two signature effects when these effects were measured in the standard way, that is, in terms of the difference in number of words remembered correctly in each condition. However, we also scored the two effects in percentage terms, by seeing what percentage drop in performance was caused by having to remember similar sounding or long words. This new analysis produced evidence that these effects lead to costs of a constant percentage in all individuals. This, in turn, can explain why individuals with impaired verbal short-term memory appear not to show these effects at all. To give an example, in a country where everyone pays 25% tax, an individual who earns $100,000 will pay $25,000 in tax; a person earning $100 dollars will pay $25 tax. The latter amount is much smaller in real terms, but represents the same percentage. In a psychological study where our measurement is never perfect, a very small real cost of similarity or word length seen in an individual who does not remember much in the first place may be very hard to detect.

This means that we cannot assume that people with impaired verbal short-term memory capacity do not use this system at all, or do not rehearse. This still leaves open the question of how best to understand these problems, but it suggests that training people to rehearse and to maintain

information in a verbal form may have more potential for therapeutic interventions than was previously assumed.

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Publication

Interpreting potential markers of storage and rehearsal: Implications for studies of verbal short-term memory and neuropsychological cases.
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