Word Comprehension in Younger and Older Adults: When is a Difference a Deficit?

Dr Meredith Shafto *is engaged on a long-term project to understand the cognitive changes that happen as we age. In the article below, she describes her current work on language comprehension.*

As the world's population continues to age, there is an increasing interest in the cognitive changes that occur with normal ageing. Because language is a critical everyday skill, and language deficits are closely associated to general cognitive deficits, a number of researchers focus on how language abilities may be affected by normal ageing. It is clear from this research that although some aspects of language decline, others do not, and it is not trivial to identify the factors that underpin spared and impaired language function. Even at the level of understanding a single word, there are a number of difficulties. One issue that is not always adequately addressed is how to separate deficits due to *cognitive ageing* from changes that reflect what we might term *language expertise*. On one hand, older adults do suffer declines in some cognitive abilities which may be necessary for good language performance. On the other hand, older adults have decades' more experience with language than young people, and even understanding a single word can be strongly influenced by this experience.

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I have conducted a series of experiments focusing on word comprehension in old age, which were completed in Oxford and Cambridge as part of two British Academy funded projects. These experiments are part of a growing literature which seeks to identify the conditions under which fundamental language comprehension processes may differ between younger and older adults. The results highlight the difficulty of both identifying reliable age differences and interpreting them.

Language and ageing: Why does it matter?

Common beliefs about older adults' language abilities are not often complimentary. Popular images are often of older speakers distracted by fond memories, wandering off the topic, and forgetting the names of key figures in the story. Equally negative stereotypes exist about older adults' ability to understand what is said to them, with an enduring image of older listeners who have missed the point of the conversation because they cannot follow it quickly enough, they are out of touch with modern terminology and topics, or perhaps they are simply deaf, distracted, or demented.

The persistence of negative beliefs about older adults' language skills can have a real impact on how they are treated. For example, younger adults sometimes adopt a style of speech when addressing older adults termed *elderspeak*, which involves simpler sentences, slower speech, and exaggerated intonation. This style comes from the speaker's belief that older adults require more communicative support than average, and it shares a lot in common with how people speak to babies and pets. Sadly, in response to being spoken to in this manner, older adults can come to believe that they have more communication problems,[1] leading to a vicious circle of declining confidence and social withdrawal.

Research on language and ageing does not support a universal decline in language comprehension in old age, but when differences between age groups are found, it is often assumed that any deviation from the younger pattern reflects impairment. However, it is possible that some age-related *differences* may not be age-related *deficits*. For example, although older adults may wander off topic, this may be due to their desire to be interesting rather than efficient story-tellers; indeed, older adults' stories are rated more favourably than younger adults' stories by both young and older adults.[2] This reinterpretation creates two very different explanations of age-related differences in language comprehension: first that older adults suffer declines in some aspect of the fundamental content, structure, or function of their language systems; or second, that older adults' behaviour reflects their greater experience processing language.

Representing a word

In order to examine word comprehension in old age, we must begin with a model of how words and ideas are represented in the mind. There are a number of such models, but many share core characteristics, and Figure 1a shows a schematic of how word knowledge may be represented. Note that words are associated with features (e.g., *dog-pet*), and that words and features are interconnected. Thus, unlike a mental 'dictionary' with separated entries, most researchers agree that word knowledge exists in a mental *network*. This network is flexible and Figure 1b represents what types of changes happen with experience: new words are added (e.g., *ostrich*), new information is learned about existing words (e.g., *bear – found in the arctic*), new connections are formed between ideas (e.g., *dog – can be dangerous*), and existing connections are strengthened through repeated use (e.g., *bear – animal*). Modifications to this network occur not only in childhood when language is first acquired, but throughout the lifetime; for example, vocabulary knowledge continues to increase in adulthood up to very old age.[3]

Effects of experience on word comprehension

There are a number of effects of experience that do not require a lifetime of language use, but are highly reliable in young adults and capture fundamental aspects of the structure and function of a network of word knowledge.

Word frequency. Perhaps not surprisingly, words that are more frequent in the language (like *dog* and *chicken*) are comprehended more quickly than less frequent words (like *ostrich*). A word's frequency is usually calculated from public sources like newspapers and radio shows, but ultimately it depends on each individual's experience of the language: *ostrich* is a low frequency word in English generally, but not for an ostrich farmer.

Semantic priming. In Figures 1a and 1b, words are connected to each other via the features that they share (e.g., *animal*) which means that when *bear* is activated, some activity is passed to *dog*. The *semantic priming effect* refers to the finding that this shared activity can speed up the comprehension of the related word (*dog*) compared to an unrelated word. For example, after reading *bear*, you will read *dog* faster than you will read *pencil*. Just like the frequency of the word, measurements of the similarity of two words are made for English generally, but the effect ultimately depends on what connections an

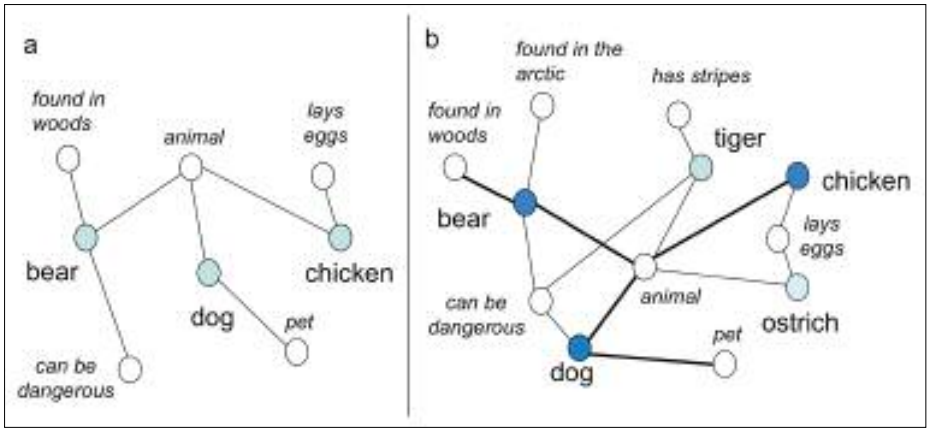

Figure 1. *(a) A schematic representation of word knowledge. Note that words have associated features (dog-pet) and that words are connected via shared features (dog and bear are both animals). (b) A schematic representing the effect of experience on the network in Figure 1a. New words are added to the network (ostrich, tiger), new connections to features have been formed (dog-can be dangerous), some words are higher frequency than others (represented with darker shades of blue) and some connections are stronger than others (represented with thicker lines)*

individual forms and strengthens between two words.

Top-down effects. Roughly speaking, the influence of 'top-down' processing during language comprehension reflects the use of prior knowledge to influence understanding. For example, when you first arrive at work you might be quicker to comprehend 'Good morning' than 'Good evening' because you expect 'morning' to follow 'good' at the beginning of the day. Although that is a simple example, top-down processing is important for many levels of language comprehension, from helping people understand speech in a noisy room, to lending a sense of overarching structure to a story.

The three effects outlined above are important for evaluating language in old age, because each effect reflects a basic aspect of word comprehension which may be affected by age, but each effect is also highly influenced by linguistic experience. Thus, these effects provide particularly good candidates for highlighting the difficulty of interpreting age-related differences in comprehension tasks.

Comprehending words in old age: impairment or expertise?

Word Frequency. Older adults do not always show the same effect of word frequency as younger adults; for example, in some studies older adults show only a small or negligible difference between the time to read a low frequency and high frequency word. Age-related decline in an effect which is normally robust questions the integrity of a basic aspect of comprehension in old age. However, this age difference can also be explained by age-related increases in word knowledge. In short, compared to younger adults, older adults have more practice with uncommon words, narrowing the gap between low and high frequency words. Put another way, younger adults may not yet be familiar with low frequency words, especially if they are very unusual. This suggestion is supported by the finding that younger adults' spelling accuracy is more affected by the word's frequency than older adults'.[4] In a related experiment I conducted in Oxford, older and younger adults showed very similar effects of frequency when detecting spelling errors, with spelling errors more difficult to detect in low frequency (e.g., *damsel*) compared to high frequency (e.g., *medical*) words. The lack of an age difference in my study may be because error detection is easier than the spelling task used previously, or because the low frequency words I used were still common enough to be familiar to younger adults – in any case, there is little support for the notion that older adults suffer a deficit the way they process word frequency.

Semantic priming. Understanding the effect of age or experience on semantic priming is complicated by mixed results in the literature. Some researchers report a larger priming effect in old age: to use our earlier example, after reading *bear*, young people are faster to read *dog* compared to *pencil*, and this difference is larger for older adults. However, other researchers report no effect of age on the size of the priming effect. Recent research I carried out with colleagues in Cambridge has begun to elucidate some of the factors underlying these mixed results. We found that when the related words share features (e.g., *brush-broom*), there is no age difference in the size of the semantic priming effect. However, when the related words are often associated with each other but don't share meaning (e.g., *elbow-grease*), there was a larger priming effect for older adults compared to younger adults. Previous experiments have tended to use a mixture of the two types of relatedness, and this may have led to unreliable age differences. However, if older adults do have larger priming effects under some conditions, the question still remains as to why. Some researchers suggest this reflects cognitive decline, as enlarged priming effects are also found in patients with Alzheimer's Disease. An alternative is that increased priming reflects older adults' more numerous and stronger connections between words (as seen by comparing Figures 1a and 1b); it is the strength and number of these connections that determines the effect of priming.[5]

Top-down effects. Although experience can affect comprehension of a word in isolation or in relation to one other word, *top-down processing* can have an even greater effect when the word appears in a sentence or a story. An overall representation of an ongoing story is called a *situation model*, and while it contains information about the relationship between elements of a story in time and place (e.g., which character has the knife and where she is in the house), it does not necessarily include much specific linguistic information (e.g., the exact wording of the first sentence). Past research has demonstrated that older adults not only form situation models as readily as younger adults, but they may use this level of information *more* than younger adults[6]. This age difference may indicate an age-related impairment whereby older adults are forced to rely on their expectations and the gist of the story, because they are no longer able to remember detail accurately. An alternative explanation is that the situation model is the level at which people, young and old, strive to understand a story; by prioritising this level of processing instead of trying to memorise a story verbatim, older adults are demonstrating their expertise in language processing.[6]

What follows from this possibility is an unexpected prediction: if experience leads to more top-down processing, experts on a subject may actually be *worse* in some circumstances at detecting changes in specific details. Indeed, when asked to memorise a list of words about investment banking, people with banking expertise suffer more memory errors than novices,[7] an unexpected finding that can be understood in terms of top-down processing: whereas novices must rely on verbatim memory, experts use their experience to decide what words they *expect* on the list, and this can easily lead them to 'remember' words that were not on the list.

An experiment I conducted in Oxford tested the notion that if older adults use top-down processing more, under specific circumstances this could impair their ability to process the meaning of words. Older and younger adults proofread passages for either spelling errors (e.g., *overhead* for *overhaed*) or errors in meaning (e.g., *sun* for *moon*). Older adults were just as good at detecting the spelling errors, and thus were not generally impaired at attending to specific details. However, older adults were worse at noticing the errors in meaning, which is in keeping with the notion that they are more influenced by top-down factors – that is, when it came to the meaning of the passage,

Subject	*Older adults worse than younger adults*	*Older adults as good as or better than younger adults*
Vocabulary	What is the word for formally renouncing the throne? _____	What is the word for formally renouncing the throne? a) Inherit b) Coronation c) Abdicate
Spelling	Spell this word to dictation: *"blatancy"*	Is this word misspelled? *blatency*
Proofreading stories	Circle the error in meaning: *In the Himalayas, owing to a far greater range between day and night temperatures, and the fact that the moon is almost directly overhead at noon…*	Circle the error in spelling : *In the Himalayas, owing to a far greater range between day and night temperatures, and the fact that the sun is almost directly overhaed at noon…*

Figure 2. *Some examples of how the successful use of older adults' knowledge depends on the task and the manner of accessing the information. Older adults are worse at producing words to definitions, spelling to dictation, or proofreading for meaning errors. However, they have higher vocabulary scores when assessed in multiple choice tasks, and can detect spelling errors in isolation or in a story context*

they understood what they expected to be there. A single study is not conclusive, however, and additional experiments conducted in Cambridge are aimed at further testing the conditions under which older adults process the meaning of a passage differently from younger adults. Preliminary results suggest it may not be as simple as older adults being more affected by the strength of the story's context. For example, recent results indicate that older adults' proofreading ability does not decline with a stronger or more predictive context.

Assessing word knowledge in old age: It matters what test you use

If older adults know so much about language, what drives negative stereotypes and why do older adults complain about forgetting words they used to know? It turns out that in order to find out what older adults really know, you have to be careful about *how* you assess their knowledge. Figure 2 highlights some of these issues in the context of vocabulary, spelling, and story proofreading abilities. Older adults have difficulty when information must be produced, as when spelling a word to dictation, but can demonstrate their knowledge in other ways. An experiment I conducted in Oxford demonstrated that older adults were worse at producing a correction to a spelling error, but confirmed previous research[8] that older adults are just as good as younger adults at detecting the spelling errors – indicating knowledge of the correct spelling.

Conclusions

There is a growing interest in language in old age, which reflects the importance of language efficacy for everyday life, and the link between declining language abilities and general cognitive decline. It is clear from research to date that patronising speech styles such as elderspeak are not necessary for older adults to comprehend language, and do not reflect older adults' real linguistic ability. More research on comprehension in old age is necessary to examine fundamental issues about the representation and use of word knowledge as we age. The role of experience must be taken into account, and researchers in this and other areas of ageing research should be careful not to assume every difference between age groups is a deficit for older adults.

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Notes

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