The influence of a secondary task on the understanding of continuous discourse by younger and older adults.

Dana R. Murphy, Meredyth Daneman, and Bruce A. Schneider
Department of Psychology
University of Toronto at Mississauga
Mississauga, ON L5L 1C6

Schneider, Daneman, Murphy, and Kwong See (1998) showed that when sound levels were adjusted to compensate for individual differences in hearing, the ability of both younger and older adults to answer questions based on connected discourse was nearly equivalent at all levels of noise. In the absence of such adjustments, older adults answered fewer questions correctly than younger adults. These two results suggest that poorer hearing, rather than a decline in cognitive processing, is the reason why older adults are less able to recall information from connected discourse. However, in the previous study, the participants were able to focus their attention on the connected discourse. In everyday listening situations, we often have to divide our attention between two different tasks. Thus, it is possible that age-related difference in performance would emerge in a divided attention situation even after stimulus levels had been adjusted for individual differences in hearing. In two experiments we tested younger and older adults' ability to extract and remember information from connected discourse in the presence of a distracting secondary task.

Experiment 1

Method

Participants

Twelve younger adults (mean age of 21.5) and twelve older adults (mean age of 71.5) participated in this study. All participants had normal hearing (thresholds at or below 25 dB HL up to 2000 Hz). Thresholds for low-predictability, sentence final words in the modified SPIN test were also determined for each participant.

Materials

Passages. Digital recordings were made of a male actor reading six passages. In the noise condition these digitized passages were added to a background consisting of a 12-speaker babble and presented to the listener over the right earphone.

Secondary Task. Throughout the experiment, a circle appeared on the computer monitor sitting in front of the participant inside the sound booth. At random points around its perimeter a small square would occasionally appear. Participants were required to use the ball on top of a stationary mouse to move the curser from the center of the circle to the square target on its perimeter as quickly as possible.

Procedure

Passages were presented either in quiet (Q) or in a moderate level of noise (N) under one of three distraction conditions. In the no distraction (ND) condition, participants only had to listen to the passage. In the low distraction (LD) condition, the circle appeared every 6 seconds and participants were required to move the cursor to the circle while listening to the passage; in the high distraction (HD) condition the circle appeared every 3 seconds. In all cases, participants were instructed to make listening to the story their primary responsibility. Immediately after each passage, the participants answered a series of multiple choice questions regarding the material they had just heard. One half of these questions concerned specific details mentions in the story (detail questions), while the other half of the questions required participants to synthesize material (integrative questions).

In all conditions, the story was presented monaurally to the right ear 50 dB above the level of each participant's right-ear babble threshold. In the noise condition, the level of noise was adjusted relative to each individual's low-context SPIN threshold. Those with a higher tolerance for noise (i.e. a low SPIN threshold) received a higher level of noise, while those with a low tolerance for noise received less noise. The ratio of discourse to babble for a person whose SPIN threshold was 0 dB was -12 dB. The SN ratio for other participants was obtained by adding -12 to each individual's low-context SPIN threshold.

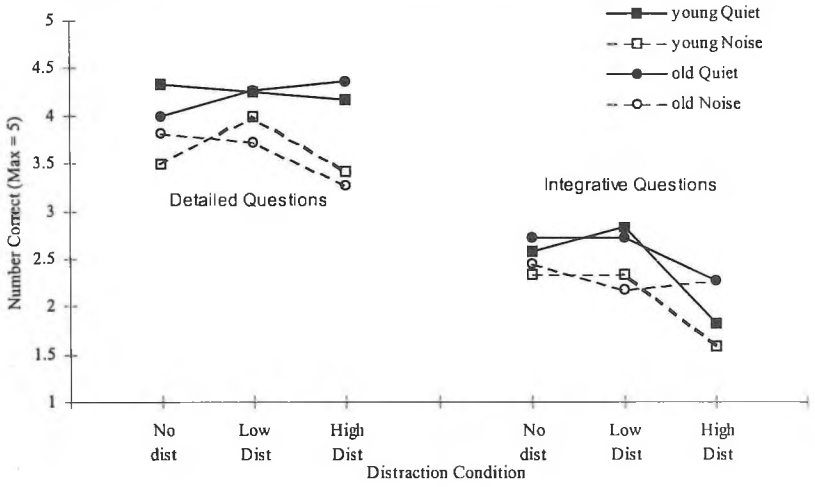
All tests were administered in a double-walled sound attenuating chamber.

Results

Figure 1 presents the number of questions answered correctly as a function of age, question type, noise, and distraction. A 2 Age (younger vs. Older) x 2 Question Type (Detail vs. Integrative) x 2 Noise Condition (Quiet vs. Noise) x 3 Distraction (No Distraction vs. Low Distraction vs. High Distraction) MANOVA was conducted on the number of questions answered correctly. This analysis revealed a significant main effect for question type, $F(1,21)=184.61$, $p<.0001$. Therefore, the data in Figure 1 are split according to this main effect, with the lines on the left hand side of the figure representing performance on detail questions and the lines on the right hand side of Figure 1 representing the performance on integrative questions. Interestingly, the younger and older adults performed similarly across the two types of questions (i.e. there was no age x question type interaction).

Noise had a significant influence on the ability to remember details from the discourse. This noise effect was similar for the two age groups. However, there was no effect of level of distraction, and no interactions of degree of distraction with any of the other variables including age. Thus, at least when the secondary task was visual, younger and older adults were equally good at completing the two tasks simultaneously. These

Figure 1
Mean number correct as a function of Question Type, Age, noise, and Distraction



results differ from what might be expected given the literature on the cognitive abilities of older adults. In particular, younger and older adults are often found to have more difficulty completing a secondary task at the same time that they complete a primary task (McDowd & Craik, 1988). However, in most research of this nature, the primary and secondary tasks tend to be very similar and tap the same cognitive resources. In Experiment 1, the primary task was a verbal task (listening to discourse), while the secondary task was non-verbal. Perhaps differences could be found between the age groups if a verbal distracting task were used. Thus, in Experiment 2, we had younger and older adults monitor the computer screen and answer true/false questions that appeared at regular intervals throughout the experiment. These questions were in the form of single sentences. Individuals were instructed to answer the questions as quickly and as accurately as possible while at the same time maintaining the task of listening to the story as their primary responsibility. Given that the participants were now required to focus on verbal information in both the primary and secondary task, we expected them to be more influenced by the introduction of the distracting secondary task. In addition, given the greater difficulty that older adults are know to have in selective and divided attention tasks, we expected the secondary distraction task to influence the performance of the older adults more than that of the younger adults.

Experiment 2

Method

Participants

A second group of 12 younger (mean age = 20.08) and 12 older adults (mean age = 73) who met the same screening criteria as in Experiment 1, served as participants for this experiment.

Materials

The discourse passages were the same as in Experiment 1. The distraction task consisted of the presentation of a sentence to which the participant was to respond "True" or "False".

Procedure

The identical two noise conditions were crossed with three levels of distraction: no distraction (ND); low distraction (LD, sentences presented every 20 seconds); and high distraction (HD, sentences presented every 10 seconds). All other testing procedures were the same as in Experiment 1.

Results and Discussion

Figure 2 presents the mean number of questions answered correctly as a function of question type, distraction condition, age group, and noise condition. The data were subjected to a 2 age (younger vs. older) x 2 question type (detail vs. integrative) x 2 noise (quiet vs. noise) x 3 distraction (no distraction vs. l ow distraction vs. high distraction) MANOVA. As can be seen in Figure 2, there was a significant Question Type effect with participants being most accurate with detail questions. Thus, the data in Figure 2 were split according to question type, with the lines on the left side of the figure representing the performance on detail questions and the lines on the right side representing the integrative questions.

Noise again reduced the accuracy with which questions were answered by the same amount for both younger and older adults. Interestingly, this influence of noise was only noticeable in the detail questions.

Unlike the visual secondary task used in Experiment 1, the T/F sentence secondary task used in this experiment proved to make answering questions more difficult. Again, the influence of distraction was similar between younger and older adults as the age x distraction interaction was not significant.

There was also a significant question type x noise interaction as well as a question type by distraction interaction. However, separate ANOVAs completed on the two different types of questions revealed that these interactions were driven by the fact that very little was happening for Integrative questions. That is, while there was a significant noise and distraction main effect among the detail question data, there was no effects for these two variables among the Integrative Question data.

General Discussion

Younger and older adults with relatively good hearing were tested for their ability to hear and remember continuous discourse in background noise while simultaneously engaged in a second, lower-priority task. All participants were tested at signal and noise levels which compensated for differences in hearing (babble) threshold and differences in their ability to recognize individual words in noise. In two experiments, noise had identical effects on the ability of younger and older adults to remember continuous discourse. In Experiment 1, neither the younger nor the older adults were influenced by the requirement to perform a secondary visual task. However, in Experiment 2, the participants' ability to answer detail questions about the discourse dropped significantly when they were required to simultaneously answer a number of T/F questions. This indicates that in order for the secondary task to interfere with listening to the passage, it may have to engage some of the same processes that are being utilized to process the passage. Interestingly, the younger and older adults were equally affected by this secondary task. Thus, it appears that older adults without significant hearing loss can understand continuous discourse as well as younger adults if their individual thresholds for speech in noise are taken into consideration and that these older adults may also be able to deal with distracting and secondary events as efficiently as younger adults.

References

McDowd, J. M. & Craik, F. I. M. (1988). Effects of aging and task difficulty on divided attention performance. Journal of Experimental Psychology: Human Perception and Performance, 14, 267-280.

Schneider, B. A., Daneman, M., Murphy, D. R., & Kwong See, S. T. (1998). Discourse comprehension in noise: The effects of aging. Manuscript submitted for publication.

Figure 2
Mean Number Correct as a Function of Question type, Distraction Condition, Age, and Noise condition