

## **Introduction**

The psycholinguistic literature is in general agreement that lexical access for speech production involves retrieval of three different types of information namely, conceptual-semantic, syntactic, and phonological information, in at least two distinct processing stages (Dell and O'Seaghdha, 1992; Levelt, 2001). The function of the first stage is to select an abstract representation of the target lexical item containing only semantic and syntactic information, and the function of the second stage is to phonologically encode the chosen lexical item in preparation for articulation.

Research on language production in older adults with unimpaired cognitive abilities suggests that naming problems associated with advanced age generally arise in, or just before, the second stage of phonological processing (see Burke et al., 1991, Transmission Deficit Hypothesis (TDH)). However, as this processing stage involves various substages, e.g. segment retrieval, syllable encoding, etc. (Levelt, 2001), which occur at very fast rates, the specific nature of the problem has not yet been identified.

The dynamic real-time measure of event related potentials (ERPs), permits investigating distinct processing stages in speech production (van Turennout et al., 1997; Schmitt et al., 2001). However, substages of phonological retrieval in older adults have not yet been examined. Thus, it is unknown whether older, as compared to younger, adults would have greater difficulty in accessing segmental or syllabic information. The results of this study would provide this information.

The motivation for this study arose from research investigating tip-of-the-tongue (TOT) states in the non-clinical population (Burke et al., 1991) and from the aphasia literature exploring lexical access problems in the clinical post-stroke population (Dell, Schwartz and Martin, 1997; Wambaugh, Linebaugh, and Doyle, 2001). Findings from this study provide direction to the psychological/cognitive research aimed at improving quality of life with age. Data obtained provides evidence for particular substages of difficulty to be targeted in working towards enhancement of word retrieval in healthy aging. Additionally, findings serve as a compass for future investigations of word retrieval problems in clinical populations. The implications therefore indirectly relates here to aphasia research of assessment and rehabilitation for word-finding difficulties.

## **Research Design**

Participants implicitly named pictures and made a phonological decision about its name that required either a push of a button (GO trials) or withhold a response (NOGO trials). Both reaction time (RT) and ERP data were collected. The ERP components of interest were: 1) the N200 (the NOGO minus GO difference wave), occurring at around 200 ms post-stimulus onset indicating withholding a motor response (e.g. push-button), thus reflecting the upper approximation of encoding the particular information for the decision, 2) the P300, occurring at around 300 ms post-stimulus onset reflecting the relative effort to perform a task, and 3) the visual evoked potentials (VEPs), which are a sequence of very early peaks (50-150 ms post-stimulus onset) in response to visual stimuli.

## **Hypotheses**

It was expected that: 1) The older, as compared to younger, adults would demonstrate an N200 effect with a later latency on both phonological tasks, as per the TDH. This delay would not be due to earlier sensory deficits as the VEPs would not be delayed in the older participants. 2) The older, as compared to younger, adults would demonstrate greater P300 amplitudes overall on both tasks due to greater cognitive effort needed to perform the tasks. This hypothesis is consistent with cognitive aging theories of cognitive slowing with age thus making the task more difficult for them. 3) For the typical aging process, the segment task would be more affected than the syllable task, given the fact that during word-finding breakdowns syllable information is often most likely spontaneously available (Brown and McNeill, 1966). 4) Overall RTs were expected to be later for the older, as compared to the younger, adults.

## **Procedures**

Each participant performed two phonological tasks. In task #1, participants were instructed to make a segment decision (final /n/ vs. /r/) about the picture name. Two instruction sets were created and participants were randomly assigned to receive either one of these instructions. Namely, half of the participants were asked to “Go” (i.e. press the button) if the name ended with a /n/ sound and “Nogo” (i.e. don’t press the button) if the name ended with a /r/ sound, while the other half of the participants were asked to “Go” if the name ended with a /r/ sound and “Nogo” if it ended with a /n/ sound.

In task #2, participants were instructed to make a syllable judgment. Again two instruction sets were created and participants within each age group were randomly assigned to receive either one of these instructions. Half of the participants were asked to “Go” if the name had one-syllable and “Nogo” if the name had two-syllables, while the other half of the participants were asked to “Go” if the name had two-syllables and “Nogo” if it had one-syllable.

## **Stimulus Materials**

Stimuli consisted of 28 digitized colored Snodgrass and Vanderwart (1980) pictures which were repeated ten times per task. Picture names were of moderate frequency with an average word frequency of 37 per million (range: 6-148 per million) (Francis and Kucera, 1982) and average number of phonemes 3.6 (range: 1-6 phonemes).

## **Participants**

Two groups of 16 younger (23-40 years) and 16 older (68-80 years) adults were tested. Participants were pre-familiarized with the pictures prior to testing. As well, a questionnaire was given to collect background information, and a five-minute Mini-Mental State Exam was administered in order to rule out dementia.

## **Results**

1) Between group comparisons revealed that N200 onsets and peak latencies were later in the older, as compared to the younger, adults. However, both groups showed comparable VEP peak latencies, which lend support to the theory of specific task-related, rather than generalized sensory delays with aging. Within group comparisons revealed that the onset of processing for the syllable task began earlier than the segment task only in the young group. The older group, however, had the same onset time for both tasks.

2-3) Additionally, older adults showed greater P300 amplitudes, as compared to younger adults, reflecting greater effort and difficulty overall on the phonological tasks.

4) RTs were later for the older, as compared to the younger, adults.

## **Conclusions**

These data reveal that older, as compared to younger, adults are slower and recruit more cognitive effort to retrieve phonological information in an implicit naming task. Moreover, even when older adults correctly name pictures, the processes that permit them to do so are delayed at very early phonological stages.

Implications of the study are that healthy older adults might benefit from particular practice with phonological tasks, mainly of syllabic information, to improve retrieval. Future studies should investigate the effects of phonological practice in improving word retrieval in aging. Additionally, age affects on other substages of phonological processing, e.g. metrics, syllabification (as per Levelt, 2001) should be conducted.

Moreover, ERP investigations of naming problems should extend to the brain-damaged population, as well, e.g. anomia, apraxia. Results of this study can serve as an age-matched control for investigation of phonological retrieval deficits in the brain-damaged population. Studies focused on therapeutic remediation at the appropriate level of difficulty and investigation of effects of post-treatment changes in brain processing of the brain-damaged population should follow.

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