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Word-Finding Difficulties: Exploring Tip-of-the-Tongue States in Young and Old Adults

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A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Health and Rehabilitation Sciences

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WORD-FINDING DIFFICULTIES: EXPLORING TIP-OF-THE-TONGUE STATES IN
YOUNG AND OLD ADULTS

(Thesis format: Monograph)

by

Allison J. Partridge

Graduate Program in Health and Rehabilitation Sciences

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science (Health and Aging)

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Abstract

A Tip-of-the-Tongue (TOT) occurs when you are trying to think of a specific word but lack the ability to bring it to mind. The present study examined implicit learning processes operating under errorful (20-second delay) or errorless (0-second delay) learning conditions in TOT states. Participants included 15 young (20-30 years) and 15 old (65-88 years) adults who were tested twice a week for four weeks on a definition-word pair task. For young participants, results indicated that a TOT was more likely and older participants were more likely to indicate they did not know the word on a consecutive session after a 0-second delay. Over multiple sessions, older participants were more likely to resolve after persisting in a TOT state for 20-seconds. Results are inconsistent with the view that the longer people spend practicing an incorrect pathway, the more likely they are to experience a TOT on the next session. Rather, the findings suggest that remaining in a TOT state and purposefully searching for the word may facilitate word finding, at least in the short term.

Keywords: Tip-of-the-tongue, TOT, Word-finding difficulties, Word retrieval, Aging, Implicit learning, Errorful learning, Errorless learning

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Word-Finding Difficulties: Exploring Tip-of-the-Tongue States in Young and Old Adults

Introduction

It is a commonly held belief that older individuals have more trouble finding words. Indeed, this view is supported by empirical evidence demonstrating that older adults use longer pauses in sentences (Cooper, 1990), use more word reformulations (Schmitter-Edgecombe, Vesneski, & Jones, 2000), and have greater difficulty finding words in a discourse task (Heller & Dobbs, 1993). Considerable effort has been aimed at trying to understand this age-related decline in word retrieval skills. However studies that utilize picture-naming tasks, the most commonly used measure of word-finding difficulties, have found contrasting results. Goulet and Ska (1994) reviewed 25 picture-naming studies and found that the naming accuracy of older adults varied across studies. From their comprehensive review, they concluded, “an age-related decline in picture naming is an inconsistent finding” (p. 629). They attributed this finding to the variability in research methods used as well as participant characteristics. The use of alternative measures other than picture-naming tasks has the potential to improve our understanding of word-finding difficulties as people age.

One alternative approach to examining the processes involved in word retrieval is to explore the phenomenon known as “tip-of-the-tongue” states. When experiencing a tip-of-the-tongue (TOT), an individual knows what he or she wants to say but cannot come up with the phonological form of the word. TOT states are common. They happen across languages (Schwartz, 1999), and in both older (Brown & Nix, 1996; Schwartz & Frazier, 2005) and younger adults (Schwartz, 2006; Warriner & Humphreys, 2008). A TOT is more likely to occur on uncommon words (Burke, MacKay, Worthley, & Wade, 1991) and to recur on words for which a TOT has previously occurred (Warriner & Humphreys, 2008). Recently,

rapid resolution of a TOT state has been found to result in improved recall of the same words 48 hours later in young adults (Warriner & Humphreys, 2008). This finding is interesting because it could have implications for the treatment of word retrieval difficulties. What is needed, however, is the replication and extension of these findings across time (i.e., more than one day) and across age groups. The purpose of the present study was to address this knowledge gap by examining the impact of persistent and resolved TOT states on word retrieval in healthy young and older adults.

When individuals experience the feeling that a word is on the “tip-of-the-tongue,” they are encountering a word retrieval failure. Although TOT states are both common and normal for healthy individuals, they are often accompanied by feelings of extreme frustration. This frustration is caused by the fact that individuals feel that they indeed know the word they are trying to say, however for some reason they cannot bring it to mind. Competing hypotheses of TOT states suggest either insufficient activation to enable retrieval of the phonological label (Burke et al., 1991) or over activation of phonologically related targets leading to interference (Jones, 1989). Based on evidence that TOT states tend to recur on the same word, Warriner and Humphreys (2008) suggested that a TOT strengthens incorrect associations in the process of word retrieval through implicit learning. Nevertheless, the extent to which such implicit learning processes may hold across a range of ages and over longer periods of time remains unknown.

Tip-of-the-Tongue States

A person experiences a TOT when he/she is unable to think of a word but feel certain that he/she knows it, and that it is on the verge of coming back to him/her (Brown & McNeill, 1966). A TOT state can be distinguished from forgetting or not knowing a word based on a feeling of “knowing.” This feeling of knowing is explained by Schwartz and Metcalfe (2011)

as being part of the metacognitive or “higher” level in their two-level model. The first level, referred to as the cognitive or “basic” level, consists of the process of trying to retrieve the missing word from memory. Conversely, the metacognitive or “higher” level involves the conscious feeling associated with being in a TOT state. At this level we overtly recognize that we are experiencing a TOT and are then able to distinguish being in a TOT state from simply forgetting the word altogether.

In addition to this metacognitive component, metalinguistic considerations address the level of failure within a word-retrieval system. More specifically, in a TOT state, individuals know the meaning of the word they are looking for but are unable to retrieve the phonological label. One of the earliest studies that explored access to relevant phonological information in TOT states was performed by Brown and MacNeill (1966). In their pioneering study, they asked participants to read definitions of rare words and then respond in one of three ways: to write down the target word if they knew it, to leave the page blank if they did not know it, or to indicate if they were experiencing a TOT state by writing down any information they knew about the word. Results showed that when participants indicated that they were experiencing a TOT state, they were able to record some of the letters in the target word as well as information about the number of syllables and where the primary stress occurred. This suggests that participants who were experiencing a TOT had some access to phonological information, but not enough to activate the word fully.

Two competing hypotheses have been advanced to account for TOT states. According to the Transmission Deficit hypothesis (also known as Incomplete Activation) developed by Burke et al. (1991), “when a TOT occurs, a lexical node in the semantic system becomes activated, giving access to semantic information about the target word, but at least some phonological information remains inaccessible because insufficient priming is transmitted to

enable activation of connected phonological nodes” (p. 545). This account explains why participants in the previous study were able to provide some information about letters and syllable location (Brown & MacNeill, 1996). This hypothesis is consistent with theoretical models of spoken word production. Successful word retrieval begins with the selection of a lemma, which is a lexical representation of the meaning of the word (Abrams, 2008). At this stage, the grammatical properties of the lemma are formed and the sounds that make up the word are assembled (Levelt, Roelofs, & Meyer, 1999). According to the Transmission Deficit of TOT, it is during this phonological stage that problems are encountered. Insufficient priming prevents complete phonological information from being readily available to the speaker. This in turn causes an individual to be unable to form the word, and therefore experience a TOT state.

An alternative to the Transmission Deficit hypothesis is the Inhibition hypothesis. The proponents of this hypothesis suggest that rather than attributing TOT experiences to insufficient activation, TOTs are caused when there is too much activation, in this case, of other nontarget words (Jones, 1989; Jones & Langford, 1987; Roediger, 1974). These nontarget words act as “blockers” or “interlopers” which prevent the target word from being selected (Jones, 1989). The reason these nontarget words become activated is because they are either semantically or phonologically related to the target word. Because of their activation, the search for the target word is clouded by these nontarget words, thereby leading one to experience a TOT on a particular word. To test this hypothesis, Jones and Langford (1987) conducted a laboratory study in which participants were presented with definitions and asked to come up with the target word. However, primes that were either phonologically or semantically related to the target word were presented to participants immediately after the definition. In addition, a third condition in which the prime was unrelated to the target word

was also included. Results showed that participants were more likely to experience a TOT when the prime was phonologically related to the target word, as compared to when it was semantically related or unrelated to the target word. These results suggest that the interference caused by the non-target words appear to be most disruptive at the phonological level of activation.

A similar result was found in a study by Reason and Lucas (1984) in which participants used diaries to record details about TOT experiences in their everyday life. Participants were encouraged to write down “blockers” that prevented them from accessing the desired word when they were experiencing a TOT. Analyses of these “blockers” revealed that they consistently shared common phonological properties (syllable and structural) as well as semantic properties with the target word.

A challenge to the inhibition hypothesis was raised by Harley and Bown (1998) who argued, “phonological neighbours contribute to, rather than hinder phonological retrieval in speech production” (p. 162). Using a definition-target word design, Harley and Bown observed that self-reported TOT experiences were less likely for words that have many phonological neighbours. These results were interpreted to suggest that the presence of more phonological neighbours facilitated lexical recall. Based on their findings, Harley and Bown suggested that the transmission deficit hypothesis should be favoured over the blocking or inhibition hypothesis.

Another strength of the transmission deficit hypothesis is its ability to explain why certain words may be more likely to cause TOT states. For example, less common or low frequency words are more likely to induce TOT states than high frequency words (Burke et al., 1991). Because these words are not frequently used in our day-to-day language, the connections from the lemma to most or all of the phonological nodes become weak. This

leads to insufficient priming, which in turn leads to problems when it comes time to enable activation. This can be equated to the old adage “if you don’t use it, you lose it.” Although the word is not gone from our lexicon forever, it can sometimes feel like the word is “lost” when one is experiencing a TOT on a particular word.

Recurring TOT States and Learning

Another interesting observation about TOT states is that they can recur on the same word (Warriner & Humphreys, 2008). One proposed explanation to account for this phenomenon is that simply experiencing a TOT once on a given word makes one more likely to experience a TOT again on that same word through implicit learning. Implicit learning refers to learning that takes place without conscious awareness of what had been learned (Seger, 1994). According to this account, unsuccessful searching for the phonological label would lead to the strengthening of associations between the known semantic information and an incorrect phonological label or no label (Warriner & Humphreys, 2008). It would follow from this reasoning that more time spent in an unresolved TOT state would lead to greater reinforcement of incorrect search pathways (Warriner & Humphreys, 2008). Warriner and Humphreys set out to test this idea by eliciting TOT states in undergraduate participants using low frequency definition-word pairs. Participants were presented with low-frequency definition-word pairs one at a time on a computer screen. The participants were required to read each definition and respond in one of three ways: KNOW, DON’T KNOW, or TOT. If participants felt they knew the word but could not bring it to mind to say it, they were instructed to press TOT on a keypad. In doing so, participants were randomly assigned either a 10- or 30-second delay before the target word was displayed. During this time the definition remained on the screen and participants were encouraged to continue to try and come up with the word. Forty-eight hours later, the participants were tested on the same

definition-word pairs. Results showed that participants were more likely to experience a TOT on a given word on Day 2 if they had been stuck in a TOT state for 30 seconds compared to 10 seconds on Day 1 (Warriner & Humphreys, 2008). The investigators suggested that the longer participants spend in the delay, the more time they spend in incorrect practice, which in turn makes them more likely to experience a TOT on Day 2. Warriner and Humphreys suggest, “these results are evidence that the unresolved state associated with a TOT has been implicitly learned and that, when attempting to produce a word that evoked a TOT on a previous occasion, the strengthened incorrect links to phonology increased the likelihood that one will end up in the same unresolved state as before” (p. 540).

Errorless and Errorful Learning

One potential way to manipulate implicit learning of an erroneous state is to apply errorless learning practices. Errorless learning is “a technique wherein individuals are prevented from making errors when initially learning information” (Anderson & Craik, 2006, p. 2806). Rather than allowing participants the opportunity to search for a response in their long-term memory, participants are immediately provided with the target response so as to avoid incorrect practice. In doing so, the goal is to strengthen the association between the target stimulus and the response (Middleton & Schwartz, 2012). In other words, the pathways in the brain between the target stimulus and the correct response are strengthened so that in the future, when confronted with the same question, one is more likely to select the correct answer given this reinforced pathway.

A review of errorless learning by Middleton and Schwartz (2012) described how the approach originated in amnesia research. They explain, “the basic notion was that responses experienced during training become primed in memory by means of implicit learning mechanisms that continue to operate in amnesia. Such learning pertains to errors and correct

responses alike. In neurologically intact individuals, conscious or explicit memory of having made an error minimizes the impact of error learning” (pg. 139). However, those with amnesia are unable to experience this conscious recognition of making an error because of the inherent deficit in explicit memory. Therefore, errors are unconsciously “learned” through implicit learning. From this, errorless learning approaches in rehabilitation were designed so that errors were avoided and thus not learned and reinforced through implicit learning mechanisms.

In contrast, proponents of errorful learning argue that ‘learning from your mistakes’ may not be a bad thing. During errorful learning, participants are encouraged to make errors. More so, participants are urged to make guesses and not be afraid to come up with the wrong answer (Metzler-Baddeley & Snowden, 2005). Fillingham, Sage, and Ralph (2006) employed a hierarchical procedure to test their errorful learning therapy in participants with aphasia. Participants were shown a series of pictures and were asked to name them. If their response was incorrect, they were given the first phoneme and letter followed by the first two phonemes and letters if they were still unable to name the object. After this, the target word was given and the participant was asked to repeat the word. McKissock and Ward (2007), on the other hand, used a confrontation naming procedure to test errorful learning. In their design, participants with aphasia were strongly encouraged to guess and to provide a name for each picture shown to them. However, instead of providing them with gradual phonemic and syllabic cues, participants were provided with accuracy feedback and the correct name after each response. Participants were also required to repeat the target word out loud if they answered incorrectly.

In addition to the errorful learning condition, both of the Fillingham et al. (2006) and McKissock and Ward (2007) studies also included an errorless condition, in which errors

were prevented by immediately providing the name in tandem with the presentation of the picture. Results indicated that both errorless and errorful learning procedures were comparable as a form of therapy for participants with aphasia. However, this finding only held true when taking into account performance within days of therapy (Middleton & Schwartz, 2012). Over longer intervals, the errorful methods led to better performance than the errorless methods. It is also worthwhile to note, “participants who did better at errorful treatment were those with the best working and recall memory, and attention” (Fillingham et al., 2006, p. 129).

Pyc and Rawson’s (2009) retrieval effort hypothesis may offer some support for the superiority of errorful learning. It proposes that “not all successful retrievals are created equal: given that retrieval is successful, more difficult retrievals are better for memory than less difficult retrievals” (p. 438). This idea, that successful but difficult processing will be better recalled than successful but easier processing, is the basis of the desirable difficulty framework (Bjork, 1994, 1999, as cited in Pyc & Rawson, 2009). Pyc and Rawson varied the conditions in which retrieval was practiced by manipulating the interstimulus interval (ISI; the number of items between a practice trial and a given item) and the criterion level (the number of times items required to be correctly retrieved). Results on final test performance indicated that the more difficult the retrieval practice was, the higher the final test performance. Therefore, as difficulty increased (due to ISI and criterion level) on the retrieval practice, so did final test performance, which provides support for the desirable difficulty framework. Pyc and Rawson concluded “conditions under which retrieval is successful but more difficult produce greater benefits to memory than conditions under which retrieval is successful but easier” (p. 440).

Although not designed to study errorless/errorful learning specifically, Warriner and Humphreys' (2008) findings related to implicit learning are relevant. In their study, Warriner and Humphreys found that shorter TOT states on Day 1 led to better recall of those words on Day 2, which can be considered to be more consistent with an errorless rather than errorful account. The short (10-second) delay in the TOT state would result in quick resolution of the error whereas the long (30-second) delay would correspond to being in a persistent error state. The higher retrieval rates on Day 2 after the short delay suggest that quick resolution of the error facilitated recall. It must be acknowledged, however, that the short delay condition in this study did not provide immediate resolution of the error state—participants continued in the TOT state for 10 seconds. In order to test directly whether immediate resolution of the TOT state facilitates later recall, a zero-delay condition must be included as was the case in the present study.

Word Retrieval and Aging

As mentioned previously, a common complaint of older adults is that they find it more difficult to find words. Cooper (1990) compared the performance of both young and old adults (ages 20 to 78) on a picture description task and found that advanced age accounted for 7 to 8% of the variance in the following measures: increased prepositional phrases, indefinite wording, and pause duration.

Another way to study word-finding difficulties is to use a discourse task. Schmitter-Edgecombe et al. (2000) presented young and old participants with images that depicted a scene and asked them to describe what they saw. Results indicated that the older participants (ages 58 to 93) had a greater proportion of word-finding errors than the young participants (18 to 22) including more substitution errors as well as word reformulations.

In another discourse task that involved viewing a short cartoon video, young and old participants (ages 28-76) were told to describe the video in terms such that an individual who had not previously viewed it would understand. Results showed that the older adults had more difficulty finding words to describe the cartoon characters. In addition, the older adults made more errors with respect to object labels compared to the younger adults (Heller & Dobbs, 1993). Therefore, in addition to subjectively reporting trouble with word-finding, older adults also show these difficulties on both picture-naming and discourse based tasks.

TOT and Aging

There also is evidence that as individuals age, they are more likely to experience TOT states. Heine, Ober, and Shenaut (1999) employed a definition-target word task with three age groups: *young* (consisting of ages 18-24), *young-old* (consisting of ages 60-74), and *old-old* (consisting of ages 80-92). Results showed that the number of TOT experiences increased with age. More specifically, there were significant differences in the proportion of TOT experiences for the young versus the old-old group, as well as the young-old and old-old group. They also found evidence for “an age-related increase in the time needed to retrieve targets once participants were in a TOT state for that target” (p. 453).

To further explore their results, Heine et al. (1999) asked the same participants to record naturally occurring TOT experiences in structured diaries over a 4-week duration. Results from the diaries mimicked the findings from their laboratory task. Interestingly, although the oldest group experienced more TOT states and also required more time to resolve these states, given enough time, “the success rate for all age groups was above 90% with the older groups actually outperforming the younger groups by resolving more of their recorded TOTs” (p. 455).

In addition to age-related changes in word retrieval, word-finding difficulties are associated with neurological traumas such as stroke and head injury. An improved understanding of the processes that underlie word-finding may lead to the development of more effective word-finding therapies for affected individuals. One way to study word-finding is to explore the process in healthy individuals. While frank word-finding difficulties may be rare in healthy individuals, TOT states are relatively common and also represent failure in the word retrieval process. Thus by studying TOT states, we may develop a better understanding of mechanisms and strategies with therapeutic potential.

The Present Study

The purpose of the present study was to examine implicit learning processes in healthy young and old adults operating under errorful or errorless induced conditions in TOT states. The experimental design was based on that of Warriner and Humphreys' (2008) TOT study, with an aim to both replicate and to extend their findings of lower TOT recurrences in young adults the day after experiencing shorter versus longer TOT states. One goal of the present study was to compare performance between healthy young and old adult groups. Based on previous research, it was expected that the older participants would display more TOT states than the younger participants due to the word retrieval difficulties that are common with aging (Cooper, 1990; Heller & Dobbs, 1993; Heine, Ober, & Shenaut, 1999; Schmitter-Edgecombe et al., 2000).

A second goal of the present study was to investigate implicit learning under errorful or errorless conditions. In order to match closely the concepts of errorful versus errorless learning, the time spent in a TOT state was either a 20-second delay or a 0-second delay, respectively. Warriner and Humphreys employed 30-second versus 10-second delay conditions, which meant that neither condition was truly errorless as even the short delay

condition allowed individuals to remain in an error state for 10 seconds. Findings of a lower recurrence of TOT states after a 0-delay would be consistent with Warriner and Humphreys' results and indicate an advantage for errorless learning. Findings of a lower recurrence of TOT states after a 20-second delay, however, would indicate an advantage for errorful learning.

A final goal of the study was to examine the stability of the learning effects beyond the 'next day' findings reported by Warriner and Humphreys (2008). In the present study, participants completed the word-finding task twice a week for four weeks, for a total of eight sessions over a month-long period. Findings of improved recall in cases of no delay would reflect the role of positive reinforcement of correct pathways through implicit learning under errorless conditions. Similarly, persistent errors in the delay condition would be indicative of the detrimental effects of unresolved retrieval errors. Conversely, improved recall in the delay condition or lower recall in the no delay condition may reflect the stability of learning under errorful conditions in which a person is urged to make guesses and not be afraid to come up with the wrong answer. The findings were intended to have important implications for treatment methods for individuals with word-finding difficulties, such as those with aphasia due to acquired neurogenic disorders.

Method

Participants

Participants included 15 young adults (ages: $M = 24.33$ $SD = 3.48$; Range: 20 to 30 years; 7 men, 8 women) and 15 older adults (ages: $M = 71.73$; $SD = 6.04$; Range: 65 to 88 years; 5 men, 10 women). Two additional participants, one in each age group, began the study. However, they had to discontinue due to the time commitment. They were not included in the analyses because of their incomplete data set.

The young adult participants were recruited through word of mouth as well as posters on the Western University campus. The older adult participants were recruited through advertisements placed in a local community newspaper as well as a posting at the Canadian Centre for Activity and Aging in London, Ontario. The postings requested healthy participants who were interested in participating in a research study investigating word recall. Interested participants contacted the researchers to find out more information about taking part in the study. Participants were reimbursed 25 dollars at their final session as compensation for their participation. The study was approved by the Health Sciences Research Ethics Board of The University of Western Ontario (REB 16879E; see Appendix E).

Health and demographic information were collected at session one to screen for appropriateness for the current study. Participants were required to be proficient in English as well as have no health issues that would interfere with their performance on this study (e.g., no uncorrected vision problems or neurological issues). Highest level of education obtained was similar across groups (younger adults: 4 participants had graduate, 8 had undergraduate, and 3 had secondary; older adults: 6 participants had graduate, 4 had undergraduate, 4 had college, and 1 had secondary).

Materials

The stimuli for the TOT task in the current study were generated using WebCelex. WebCelex is an online lexical database that categorizes words based on their frequency of occurrence in oral and written sources (Baayen, Piepenbrock, & Gulikers, 1995).

Words that had a frequency of zero were selected from the database because our aim was to evoke TOT states in our participants. More so, I chose words that participants would have some familiarity with, but were not so common that they would easily come to mind.

From this database, 125 words were chosen and then piloted for suitability. Words that were judged to be too familiar or unfamiliar were excluded. However, four of these omitted words were used as practice items at the start of each session. Similar to Warriner and Humphreys (2008), ten “false” definitions were included in each session to ensure that participants were responding accurately. Each session had ten unique false definitions, which brought our stimulus list to a total of 100 definition-word pairs per session. Therefore, the stimulus list was the same 90 words for all eight sessions, plus ten “false” prompts that differed for each session. Definitions were presented to participants in randomized order on each session. A list of the words and definitions is provided in Appendix A.

Procedure

All testing took place at the H.A. Leeper Speech and Hearing Clinic at Western University. Participants completed two research sessions a week for up to four weeks, for a total of up to eight sessions. The TOT task was completed at each session and lasted anywhere from 10 to 45 minutes. A neuropsychological test battery was completed on the first and final session for each participant. Sessions were discontinued if participants reached 100% accuracy on the TOT task over two subsequent sessions before the eighth session. Seven of the younger and two of the older participants met this accuracy criterion prior to the eighth session (younger: 2 participants completed at each of sessions 4, 5, and 6, and 1 at session 7; older: 2 participants completed at session 7). It is important to note that there was at least one day between each session, so that participants were not tested on consecutive days. The delay parallels the protocol of Warriner and Humphreys (2008) who tested participants on Day 1 and then 48 hours later on Day 2.

TOT task. At the start of each session, detailed instructions were read to the participant. All participants reported normal hearing and normal or corrected-to-normal

vision. Each session began with four practice trials before the actual experiment began. The stimuli were presented using E-Prime 2.08 (Schneider, Eschman, & Zuccolotto, 2002), and all data were recorded and stored in a data file by the E-Prime program. Participants sat next to the experimenter in front of a widescreen 15-inch laptop monitor. Participants were not required to make any key presses at any point during the experiment, so they sat at a comfortable distance that still allowed them to read the print on the screen.

In each trial, a definition was presented in the middle of the computer screen and participants were instructed to read each definition aloud and then state their answer. Participants were encouraged to answer as quickly as possible after reading the definition to avoid participants spending a prolonged period of time searching for the target word. This would decrease the likelihood of experiencing a TOT. The definition remained on the screen until the experimenter made the corresponding key press based on the participant's response.

After reading the definition, participants could respond in one of three ways. If they knew the word that went with the definition, they were to say the word aloud. If they did not know the word that went with the definition, they were to say "don't know." Finally, if the participant felt that they were experiencing a TOT, as described as 'the feeling that one knows the word but cannot say it right now,' then they should say "tip-of-the-tongue." Depending on their response, the experimenter would input their corresponding answer on a keypad.

For each trial to which a participant responded DON'T KNOW or TOT, the word was randomly assigned to either a 0- or 20-second delay before the target word appeared. During the delay, participants were encouraged to continue to search for the word. After the delay, the target word appeared on the screen for two seconds. Participants were then prompted with a screen that asked, "is this the word you were thinking of?" For those who provided the

DON'T KNOW response, the experimenter pressed the NO button unless the participant was able to generate the correct word before the end of the delay, in which case the experimenter would press the YES button to end the prompt screen. The experimenter would also press the NO button if the participant came up with a wrong answer during the delay.

For those in the TOT condition, the prompt screen aimed to assess whether the target word was the same as the word the participant had “on the tip-of-their-tongue.” If, during the delay, the participant was able to generate the correct word, the experimenter would press the YES button (if they came up with the wrong word, the experimenter would press the NO button). However, if the participant was unable to find the word during the delay despite attempts to retrieve it, they were instructed to answer honestly if the target word was the word that they indeed had in mind. Warriner and Humpreys (2008) explained, “it was assumed that those participants still in an unresolved TOT state would recognize whether or not the word displayed was the same as the one they were trying to articulate” (p. 258). Based on the participant’s response, the experimenter would indicate this accordingly on the keypad. Each trial proceeded the same way, including the “false” definitions in which the target word was replaced with a series of asterisks to indicate that it was not a real definition.

During sessions 2 through 8, participants saw the same 90 definition-word pairs as in session 1. In order to analyze the effect of remaining in a TOT state for a short (0-second) versus a long (20-second) delay, participants received the same duration of delay that was randomly assigned the first time they reported a TOT or DON'T KNOW for any given word. For example, if a participant responded ‘don’t know’ for a given word and was randomly assigned a delay of 20 seconds, the next time they responded TOT or DON'T KNOW for that word (on any of the eight sessions regardless of whether or not the sessions were consecutive), they would receive a 20-second delay again. This delay consistency was carried

throughout all eight sessions. Note that a first occurrence of a TOT or DON'T KNOW response could occur on any of the eight sessions, and the assigned delay would continue for the remainder of the sessions in the event of another TOT or DON'T KNOW on the same word.

Scoring TOT task. For KNOW responses, only those responses that matched the target word were counted. If a participant provided a word that did not match the target word, it was not included in our analyses because this was not considered a successful trial. TOT responses were only counted if the participant was able to produce the target word before time ran out, or if they responded “yes” when prompted with the inquiry, “was this the word you were thinking of?” In comparison, DON'T KNOW responses were separated into “produced” and “never produced.” Participants who originally responded DON'T KNOW after seeing the definition but were able to come up with the correct target word before time ran out were classified as “produced.” Those who were unable to come up with the word before time ran out were labeled as “never produced.” Given that the “never produced” reflects a true DON'T KNOW response in that the word was never provided, only these responses were included in the calculations. Unlike the TOT condition, I did not count the responses to the prompt “is this the word you were thinking of?” for those who originally responded DON'T KNOW. The reason for this is because participants in the DON'T KNOW condition were not remaining in the same TOT state as those who believed they knew the word but just could not say it right away. Those who responded DON'T KNOW believed they did not have access to the word whatsoever.

Neuropsychological test battery. The following test battery was designed to tap skills related to naming and nonverbal intelligence. This battery was included to confirm that participants scored in the normal range for healthy adults. Also, it is of interest to look at

possible cross-domain effects from the TOT task, even though this was not the purpose of the current study.

Naming. The *Boston Naming Test* (Kaplan, Goodglass, & Weintraub, 1983) measures participants' abilities to identify black and white drawings of objects, which range in familiarity. Participants are shown a drawing one at a time and are asked to name the object that corresponds to the picture. If unsure, participants are first given a short semantic cue of the pictured object. If they are still unsure, they are given the first syllable of the target word. Points are deducted based on the nature of the cues that were provided.

The *Peabody Picture Vocabulary Test* (PPVT – 4) (Dunn & Dunn, 1997) is a standardized test that measures single-word receptive vocabulary. On each trial, the experimenter says a word that corresponds to one of four black and white stylized drawings of the item. The participant must then select the picture that goes with the corresponding spoken word.

In the *verbal fluency task*, participants were given 60 seconds to name as many words as they could think of for each of the following letters: F, A, and S. Participants were instructed to avoid naming proper nouns as well as modifying the same root words with different prefixes and suffixes.

The *category fluency task* requires participants to name as many animals as they can in 60 seconds. Water, land, and air animals are all acceptable. Both of the latter tests are part of the Controlled Oral Word Association (COWA) Test (Benton & Hamsher, 1976).

Nonverbal intelligence. The *Matrix Reasoning* subtest of the *Wechsler Abbreviated Scale of Intelligence* (WASI) (Wechsler, 2008) requires participants to select the missing pattern that best completes the matrix from five possible options that are provided.

The *Block Design* subtest (Wechsler, 2008), also from the WASI, times participants as they build a design using a series of blocks based on pictures of increasing difficulty.

All participants completed the same battery of tests at their first and final session. Raw and standard scores for the initial battery are located in Table 1 along with age descriptors for both the young and old participants. Complete standardized scores or T-scores for the age groups included in the present study were only available for the PPVT and WASI, respectively. At initial testing, significantly higher scores were achieved by the younger than older group for category fluency, $t(14) = 3.63, p < .05$, Matrix Reasoning, $t(14) = 7.03, p < .05$, and Block Design, $t(14) = 8.66, p < .05$. However, significantly higher scores were observed for the older group on the PPVT-4, $t(14) = -3.53, p < .05$. There were no significant differences in raw scores between the two age groups for verbal fluency, $t(14) = 1.48, p > .05$, or Boston Naming test, $t(14) = -0.73, p > .05$.

Table 1

Session 1 raw and standard scores for the neuropsychological test battery.

Subtest	Raw Score		Standard Score ^a	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
	Young			
PPVT	210.73	8.53	109.80	10.12
Verbal Fluency	49.07	8.43	-	-
Category Fluency	24.47	4.49	-	-
Matrix Reasoning	30.80	2.21	61.33	4.85
Block Design	63.53	5.90	63.67	4.47
BNT	55.27	3.65	-	-

Age	24.33	3.48	-	-
Old				
PPVT	219.53	3.02	115.13	6.39
Verbal Fluency	43.40	9.73	-	-
Category Fluency	18.87	3.80	-	-
Matrix Reasoning	20.27	5.54	56.73	8.50
Block Design	33.33	11.15	54.93	8.36
BNT	56.20	2.98	-	-
Age	71.73	6.04	-	-

a – Standardized scores for the PPVT ($M = 100$; $SD = 15$) and T-scores for Matrix Reasoning and Block Design ($M = 50$; $SD = 10$).

Results

Overall Response Rates for Young and Old Adults

Table 2 presents the number of KNOW, TOT, and DON'T KNOW responses across all sessions for each age group. Overall and regardless of the delay condition to which the word was assigned, 3.27% (324/9923) of all responses over the eight sessions were TOTs for the young participants and 2.65% (258/9736) of all responses were TOTs for the old participants. For the young participants, 13.66% (1355/9923) were DON'T KNOW responses and 14.82% (1443/9736) were DON'T KNOW for the old participants. Finally, KNOW responses accounted for 83.08% (8244/9923) of responses for the young participants and 82.53% (8035/9736) of responses for the old participants. In all cases, rates across age groups were similar. With regards to individual data, the number of reported TOT responses on Day 1 ranged from 2 to 15 for both the young and old participants. Over the complete 8

sessions, the number of reported TOT experiences ranged from 4 to 85 for the young participants and 6 to 28 for the old participants.

Table 2

Overall number of responses for young and old adults over the eight sessions.

Responses	Young	Old
Know ^a	8244	8035
TOT	324	258
Don't Know	1355	1443
Total	9923	9736

a – For participants who met criterion before the complete eight sessions, full credit was given to “KNOW” responses on all remaining sessions.

Session 1 and 2

Results comparing Day 1 and Day 2 performance exclusively for our young and old participants are presented first. These results represent performance after one day of the delay condition and correspond most closely to the results reported by Warriner and Humphreys (2008). Responses after any initial TOT occurrences and over the full eight sessions are presented in the next session.

Table 3 summarizes the cross-tabulation of responses on Day 2 given a particular response and delay condition on Day 1 for the young and old participants. Conditional probabilities are provided for (a) the probability of experiencing a TOT on Day 2 given the Day 1 condition, (b) the probability of reporting a DON'T KNOW response on Day 2 given the Day 1 condition, and (c) the probability of a correct response (i.e., a KNOW response) on Day 2 given the Day 1 condition.

Table 3

Cross-tabulation of day 1 and day 2 responses for young and old.

Day 1 Responses		Day 2 Responses							
		Know	TOT	Don't Know		Total	Conditional Probability		
				Produced	Never Produced		a	b	c
Young									
Know		445	10	1	9	465	.02	.02	.96
TOT	Delayed for 0s	45	12	0	6	63	.19	.10	.71
	Delayed for 20s	30	3	0	2	35	.09	.06	.86
Don't Know	Delayed for 0s	202	8	0	112	322	.03	.35	.63
	Delayed for 20s	203	7	4	106	320	.02	.33	.63
Total		925	40	5	235	1205			
Old									
Know		402	9	2	16	429	.02	.04	.94
TOT	Delayed for 0s	49	7	0	12	68	.10	.18	.72
	Delayed for 20s	38	5	2	2	47	.11	.04	.81
Don't Know	Delayed for 0s	196	3	2	101	302	.01	.33	.65
	Delayed for 20s	176	10	6	77	269	.04	.29	.65
Total		861	34	12	208	1115			

a – conditional probability of experiencing a TOT on Day 2.

b – conditional probability of reporting DON'T KNOW on Day 2.

c – conditional probability of reporting KNOW on Day 2.

Young participants. Of particular interest to the present study were the TOT responses on Day 2 based on the delay condition to which words were assigned. For young

participants, the conditional probability of experiencing a TOT on Day 2 was .19 for the no delay condition and .09 for the 20-second delay condition, yielding a moderate likelihood ratio of 2.11. Therefore, participants who had been in a TOT state for a shorter period of time on Day 1 were 2.11 times more likely to experience a TOT on the same word on Day 2 than were participants who had been in a TOT state for a longer period of time, a pattern opposite to that reported by Warriner and Humphreys (2008). Similar to Warriner and Humphreys (2008), Wilcoxon signed-rank tests were completed to compare the conditional probabilities of individual participants' Day 2 TOT responses given either a no delay or 20-second delay on Day 1 TOT responses. As was conducted by Warriner and Humphreys, I only included participants in our analysis who had at least one TOT experience on Day 1 in both the no delay and 20-second delay condition. However, all of our young participants met this criterion. The results revealed that the young participants were no more likely to experience a TOT on Day 2 if they had received no delay ($Mdn = .14$) on Day 1, compared to the long delay ($Mdn = .07$), $z = -1.12$, $p > .05$, $r = -.31$.

The effect of delay duration on Day 2 DON'T KNOW responses when participants experienced a TOT on Day 1 also was examined. In this way, the effect of delay time on failure to retrieve the target word can be examined. The conditional probability of a Day 2 DON'T KNOW response was .10 after the 0-second delay and .06 after the 20-second delay, yielding a largely equivalent likelihood ratio of 1.67. The Wilcoxon signed-rank tests revealed that the young participants were not significantly more likely to respond DON'T KNOW on Day 2 if they had experienced a TOT on Day 1 and received no delay ($Mdn = .14$), compared to the long delay ($Mdn = .04$), $z = -1.05$, $p > .05$, $r = -.29$.

Another way of looking at the data is to analyze how successful participants are on Day 2 at resolving the TOTs they experienced on Day 1. In other words, the KNOW

responses on Day 2 were of particular interest. Recall that only those responses that were correct were included in the KNOW column. By looking at the data in this alternative way, it is possible to examine the effect that delay length has on successful resolution on Day 2 from a different perspective.

For the young participants, the conditional probability of resolving (giving a KNOW response) on Day 2 was .71 for the no delay condition and .86 for the 20-second delay condition, yielding a likelihood ratio of .83. Results of the Wilcoxon signed-rank test revealed that the young participants were not significantly more likely to resolve on Day 2 if they had a TOT on Day 1 and received no delay ($Mdn = .72$), compared to the long delay ($Mdn = .89$), $z = -1.78$, $p > .05$, $r = -.49$. This means the delay length (20 vs. 0) on Day 1 did not have an effect on the likelihood that the young participants would resolve on Day 2.

To summarize these findings for the young participants, TOT delay length on Day 1 did not have an effect on Day 2 TOT, DON'T KNOW, or KNOW responses as reflected by nonsignificant Wilcoxon signed-rank tests for all comparisons. In broad agreement, the likelihood ratios were between 0.5 and 2.0 in all cases except one where the young participants were 2.11 times more likely to experience a TOT on Day 2 after no delay than a 20-second delay in response to a TOT on Day 1, a pattern opposite to that of Warriner and Humphreys (2008). Given the small numbers of TOT occurrences in these data, it is possible that the Wilcoxon signed-rank test for this analysis was underpowered.

Old participants. With regards to delay conditions, the conditional probability of experiencing a TOT on Day 2 was .10 for the no delay condition and .11 for the 20-second delay condition, yielding a likelihood ratio of .91 for the old adults. This likelihood ratio between the two delay conditions indicates that neither condition is any more likely. For the Wilcoxon signed-rank tests, data from all participants were included as all of the old

participants experienced at least one TOT on Day 1. For the old participants, there was no significant difference between the 0-delay ($Mdn = .09$) and the 20-second delay conditions ($Mdn = .10$), $z = -0.51$, $p > .05$, $r = -.14$. Once again, this pattern of results differs from that reported by Warriner and Humphreys (2008) of fewer TOT experiences after a short-delay condition.

The effect of delay duration on Day 2 DON'T KNOW responses when participants experienced a TOT on Day 1 are presented next. For the old participants, the conditional probability of experiencing a DON'T KNOW response after a TOT experience was .18 for the no delay condition and .04 for the 20-delay condition, yielding a likelihood ratio of 4.5. This means participants were 4.5 times more likely to indicate that they did not know the word on Day 2 if they had experienced no delay on Day 1 compared to remaining in a 20 second TOT state. However, the Wilcoxon signed-rank test revealed that the old participants were not significantly more likely to respond DON'T KNOW on Day 2 if they had responded TOT on Day 1 and received no delay ($Mdn = .14$), compared to the long delay ($Mdn = .10$), $z = -0.68$, $p > .05$, $r = -.18$.

With respect to resolution on Day 2, our older participants performed similarly to our young participants. For the old participants, the conditional probability of resolving (KNOW) on Day 2 after a TOT experience on Day 1 was .72 for the no delay condition and .81 for the 20-delay condition, yielding a likelihood ratio of .89. However, there was no significant difference between the no delay ($Mdn = .77$) and the 20-second delay ($Mdn = .78$) for the old participants, $z = -0.05$, $p > .05$, $r = -.01$.

To summarize these findings for the old participants, TOT delay length on Day 1 did not have an effect on Day 2 TOT, DON'T KNOW, or KNOW responses as reflected by nonsignificant Wilcoxon signed-rank tests for all comparisons. In broad agreement, the

likelihood ratios were between 0.5 and 2.0 (i.e., low) in all cases except one. The old participants were 4.5 times more likely not to know a word on Day 2 after no delay than a 20-second delay in response to a TOT on Day 1. This pattern would suggest that the 0-delay condition did not improve the naming pattern, a pattern that could be considered opposite to that of Warriner and Humphreys (2008). Once again, the small numbers of TOT occurrences in these data may mean that the Wilcoxon signed-rank test for this analysis was underpowered.

The Consecutive Session After an Initial TOT

As reviewed above, the small number of TOT occurrences in the Day 1 to Day 2 data may have resulted in the statistical tests being low powered and may be one reason for the nonsignificant results despite one likelihood ratio of moderate size. However, the current study employed a unique design in which participants completed up to eight testing sessions. Therefore, it was possible to extend the analysis of what happened on the next session immediately after the first occurrence of a TOT by considering the first occurrence of a TOT on a word regardless of the session on which it first occurred. For this analysis, a consecutive response refers to the response in the next session immediately following the first occurrence of a TOT. That is, if a first TOT on a word occurred in session 3, then the response in session 4 was considered. One advantage of analyzing the data in this way is that it maximized the number of responses in each condition. However, only those participants who had data for all conditional probabilities were included in this analysis (young: $n = 5$; old: $n = 6$). Table 4 summarizes the cross-tabulation of responses on the session after an initial TOT experienced within sessions 2 through 8, for both the young and old participants. These data may still be compared to Warriner and Humphreys (2008) because they included only those responses occurring in the session immediately following an initial TOT experience.

Table 4

Cross-tabulation of next-session responses after an initial TOT anywhere in sessions 2 through 8 for participants with responses in each condition.

First occurrence of TOT	Response in the next consecutive session				Total	Conditional Probability		
	Know	TOT	Don't Know			a	b	c
			Produced	Never Produced				
<i>Young (n = 5)</i>								
Delayed for 0s	51	24	0	11	86	.28	.13	.59
Delayed for 20s	32	8	0	14	54	.15	.26	.59
Total	83	32	0	25	140			
<i>Old (n = 6)</i>								
Delayed for 0s	34	8	0	13	55	.15	.24	.62
Delayed for 20s	31	6	0	4	41	.15	.10	.76
Total	65	14	0	17	96			

a – conditional probability of experiencing a TOT on a consecutive session.

b – conditional probability of reporting DON'T KNOW on a consecutive session.

c – conditional probability of reporting KNOW on a consecutive session.

Young participants. For young participants, the conditional probability of experiencing a TOT on the consecutive session after an initial TOT was .28 for the no delay condition and .15 for the 20-second delay condition, yielding a likelihood ratio of 1.87. A Wilcoxon signed-ranks test to compare the conditional probabilities of individual participants' TOT responses on the consecutive session given either a no delay or 20-second

delay on the first occurrence revealed that the young participants were significantly more likely to report a TOT on the consecutive session if they had received no delay ($Mdn = .25$) after the TOT, compared to the long delay ($Mdn = .12$), $z = -2.02$, $p < .05$, $r = -.90$. This pattern is inconsistent with Warriner and Humphreys' (2008) results.

The condition in which participants had a first occurrence of a TOT and then responded DON'T KNOW on the consecutive session also was examined. Recall, in doing so, it is possible to examine the effect of delay time on failure to retrieve the target word. For young participants, the conditional probability of experiencing a DON'T KNOW on the consecutive session after an initial TOT was .13 for the no delay condition and .26 for the 20-second delay condition, yielding a likelihood ratio of .50. A Wilcoxon signed-ranks test to compare the conditional probabilities revealed that the young participants were no more likely to respond DON'T KNOW on the consecutive sessions after an initial TOT if they had received no delay ($Mdn = .13$) compared to the long delay ($Mdn = .27$), $z = -1.75$, $p > .05$, $r = -.78$.

As before, another way of looking at the data is to analyze how successful participants are at resolving on the consecutive session following an initial TOT experience. For young participants, the conditional probability of experiencing a KNOW response on the consecutive session after an initial TOT was .59 for the no delay condition and .59 for the 20-second delay condition, yielding a likelihood ratio of 1.00. Results of the Wilcoxon signed-ranks test revealed no significant difference between the no delay ($Mdn = .62$) and the 20-second delay ($Mdn = .61$) for the young participants, $z = 0.00$, $p > .05$, $r = 0$.

In summary, young participants were significantly more likely to experience a TOT on the consecutive session following an initial TOT if they had experienced no delay compared to the 20-second delay, a finding that is opposite to Warriner and Humphreys

(2008). However delay length did not have an effect on DON'T KNOW responses as well as KNOW responses after an initial TOT experience in any of the eight sessions.

Old participants. For the old participants, the conditional probability of experiencing a TOT on the consecutive session after an initial TOT was .15 for the no delay condition and .15 for the 20-second delay condition, yielding a likelihood ratio of 1.00. A Wilcoxon signed-ranks test to compare the conditional probabilities of individual participants' TOT experiences on the consecutive session given either a no delay or 20-second delay on the first occurrence revealed that the old participants were no more likely to experience a TOT on the consecutive session if they had received no delay ($Mdn = .15$) after a TOT, compared to the long delay ($Mdn = .16$), $z = -0.31$, $p > .05$, $r = -.13$.

With respect to the DON'T KNOW responses following a TOT experience, the conditional probability was .24 for the no delay condition and .10 for the 20-second delay condition, yielding a likelihood ratio of 2.40. Therefore, participants who had been in a TOT state for a shorter period of time on an initial TOT were 2.4 times more likely to respond DON'T KNOW on the consecutive session. Correspondingly, the Wilcoxon signed-rank test revealed that the old participants were significantly more likely to respond DON'T KNOW on the consecutive session following a TOT experience if they had received a no delay ($Mdn = .23$), than if they had received the long delay ($Mdn = .09$), $z = -2.03$, $p < .05$, $r = -.83$.

For resolution after the first occurrence of a TOT for the old participants, the conditional probability of resolving on the consecutive session after a TOT was .62 for the no delay condition and .76 for the 20-delay condition, yielding a likelihood ratio of .82. Results of the Wilcoxon signed-ranks test revealed no significant difference between the no delay ($Mdn = .63$) and the 20-second delay ($Mdn = .75$) for the old participants, $z = -1.78$, $p > .05$, $r = -.73$.

In summary, delay length did not have an effect on TOT and KNOW responses on the consecutive sessions following an initial TOT experience for the old participants. However, delay length did have a significant effect on the likelihood that participants would respond DON'T KNOW after a preceding TOT. More specifically, the older participants were more likely to respond DON'T KNOW if they had remained in a TOT state for a short delay compared to a long delay, on the previous session.

To review, there was no significant effect of delay length for both our young and old adults on any response in the Day 1 and Day 2 data that corresponded closely to the results reported by Warriner and Humphreys (2008). However, it was possible to increase the power in these analyses by examining responses occurring immediately after an initial TOT anywhere within sessions 2 through 8. In these analyses, young participants were significantly more likely to experience a TOT on the consecutive session when they had remained in a TOT state on the previous session for 0 seconds compared to 20 seconds on the previous session. This result is consistent with the Day 1 - 2 likelihood ratio data that showed that young participants were 2.11 times more likely to TOT on Day 2 following a 0- than 20-second delay in a TOT state on Day 1. For the old participants, results showed they were significantly more likely to respond DON'T KNOW on the consecutive session when they had remained in a TOT state on the previous session for 0 seconds compared to 20 seconds. This finding is consistent with the Day 1 - 2 likelihood ratio data illustrating that the old participants were 4.5 times more likely to respond DON'T KNOW on Day 2 if they remained in a TOT state on Day 1 for 0 seconds compared to 20 seconds. By maximizing the number of responses, it was possible to reconcile moderately sized likelihood ratios (which did not reach significance in the Day 1 to Day 2 data, most likely because the study was

underpowered) with statistically significant results found for consecutive sessions over the eight sessions.

TOT Stability (Two or More Occurrences)

Recall that one of the aims of the current study was to examine the stability of the learning effects over time. By including a total of eight sessions, our goal was to explore beyond the ‘next day’ findings of Warriner and Humphreys (2008). This analysis considered responses occurring in any one of the possible eight sessions completed by a participant that followed more than one occurrence of a TOT state in previous sessions. However, these previous TOT responses do not have to be sequential. For example, consider a pattern in which a participant responded with a TOT on sessions 3, 4, and 5, and then responded correctly on session 6 on a word. In this case, the first TOT response on the word occurred in Session 3, the consecutive TOT response on session 4 occurred after only one previous TOT response and was not included in the current analysis (note that responses of this type were included in the analysis of consecutive responses described above). The session 5 and 6 responses, however, occurred after two or more TOT responses and were each counted in the present analysis. These data reflect how likely participants are to persist in a TOT state after experiencing two or more TOTs on the same word. Only those participants who had data for all conditional probabilities were included in this analysis (young: $n = 5$; old: $n = 6$). Table 5 summarizes the cross-tabulation of responses after two or more occurrences of a TOT within the eight sessions, for both the young and old participants.

Table 5

Cross-tabulation of responses after two or more occurrences of a TOT for participants with responses in each condition.

Responses in subsequent sessions

Two or more TOTs	Know	TOT	Don't Know		Total	Conditional Probability		
			Produced	Never Produced		a	b	c
<i>Young (n = 5)</i>								
Delayed for 0s	30	19	0	7	56	.34	.13	.54
Delayed for 20s	13	8	0	6	27	.30	.22	.48
Total	43	27	0	13	83			
<i>Old (n = 6)</i>								
Delayed for 0s	10	7	0	4	21	.33	.19	.48
Delayed for 20s	8	0	0	1	9	0	.11	.89
Total	18	7	0	5	30			

a – conditional probability of experiencing a TOT on a subsequent session after two or more TOT responses.

b – conditional probability of reporting DON'T KNOW on Day 2 on a subsequent session after two or more TOT responses.

c – conditional probability of reporting KNOW on a subsequent session after two or more TOT responses.

Young participants. For young participants, the conditional probability of experiencing a TOT after two or more TOT responses was .34 for the no delay condition and .30 for the 20-delay condition, yielding a likelihood ratio of 1.13. The Wilcoxon signed-rank test revealed no significant differences between the no delay ($Mdn = .35$) or 20-second delay ($Mdn = .14$), $z = -1.75$, $p > .05$, $r = -.78$. This means, that when participants experienced a TOT on the same word over multiple sessions, the delay length (0 vs. 20) did not have an effect on the likelihood that they would experience a TOT again on following sessions.

For young participants, the conditional probability of experiencing a DON'T KNOW response after two or more TOTs was .13 for the 0-delay and .22 for the 20-delay, yielding a likelihood ratio of .59. The Wilcoxon signed-rank test revealed no significant differences between the no delay ($Mdn = .10$) or 20-second delay ($Mdn = .19$) for the young participants, $z = -0.73$, $p > .05$, $r = -.33$.

In order to examine resolution, KNOW responses occurring in a session immediately following two or more sessions with TOT responses on that word were counted. For young participants, the conditional probability of experiencing a KNOW response after two or more TOT's was .54 for the 0-delay and .48 for the 20-delay, yielding a likelihood ratio of 1.13. The Wilcoxon signed-rank test revealed that the young participants were no more likely to resolve after two or more TOT occurrences if they persisted in the TOT state for 20-seconds ($Mdn = .67$) compared to 0-seconds ($Mdn = .55$), $z = -1.10$, $p > .05$, $r = -.49$. To summarize, when the young participants repeatedly TOT on the same word, the delay length did not have an effect on the likelihood that they would experience a TOT again or respond KNOW or DON'T KNOW over multiple sessions.

Old participants. For the older participants, the conditional probability of experiencing a TOT after two or more TOT states was .33 for the 0-delay and 0 for the 20-delay, yielding a likelihood ratio of 0. The Wilcoxon signed-rank test revealed no significant differences between the no delay ($Mdn = .23$) or 20-second delay ($Mdn = .00$) for the old participants, $z = -1.60$, $p > .05$, $r = -.65$.

For DON'T KNOW responses after two or more TOT responses, the old participants were only minimally more likely to respond DON'T KNOW after the 0-delay with a conditional probability of .19 compared to the 20-delay, which had a conditional probability of .11. The likelihood ratio between the two conditions was 1.73. However, the Wilcoxon

signed-rank test revealed no significant differences between the no delay ($Mdn = .35$) or 20-second delay ($Mdn = .08$) for the old participants, $z = -1.46$, $p > .05$, $r = -.60$.

Lastly, by examining KNOW response after multiple TOT states, it is possible to see the effect of persistent delay length on resolution. For the old participants, the conditional probability of resolving after two or more TOT experiences was .48 for the no delay condition and .89 for the 20-second delay condition, yielding a likelihood ratio of .54. However, the Wilcoxon signed-rank test revealed that the older participants were significantly more likely to resolve after two or more TOT occurrences if they persisted in the TOT state for 20-seconds ($Mdn = .92$) compared to 0-seconds ($Mdn = .42$), $z = -2.20$, $p < .05$, $r = -.90$.

To summarize, delay length did not have an effect on TOT responses or DON'T KNOW responses after persisting in a TOT state for two or more sessions for the older participants. With respect to resolution, there was a significant effect of delay length. The older participants who experienced the 20-second delay were more likely to resolve after multiple TOT occurrences than those who experienced the 0-delay. The corresponding likelihood ratio (0.54) indicated that the older participants were half as likely to resolve after 0- than 20-second delay, or, said another way, were almost twice as likely to know the word after 20-seconds in a TOT state on at least two previous sessions than after 0-seconds in the TOT state. This finding is consistent with the previous results for the young adults, which suggested that remaining in a TOT state for a short delay leads to more TOT experiences on the consecutive session, whereas persisting in a TOT state for 20-seconds leads to a greater likelihood of resolving. Overall, the results of the current study are in opposition to findings from the Warriner and Humphreys (2008) study.

Pre-Post Neuropsychological Testing Results

The raw scores for the initial and final battery are located in Table 6, along with significantly different pairs identified. Paired sample *t*-tests were performed on the raw scores to examine changes in performance between the initial testing and the final testing on any of the tests in our neuropsychological battery. Note that S1 and S8 in the table refer more generally to the initial testing session and the final testing session because some participants completed the study before session 8, as mentioned previously.

Table 6

Raw scores for session 1 and session 8 for the neuropsychological test battery.

Subtest	Session 1		Session 8	
	M	SD	M	SD
Young				
PPVT	210.73	8.53	211.60	9.23
Verbal Fluency	49.07 ^a	8.43	52.27 ^a	8.82
Category Fluency	24.47	4.49	23.93	3.79
Matrix Reasoning	30.80	2.21	30.33	2.44
Block Design	63.53 ^b	5.90	66.40 ^b	3.92
BNT	55.27 ^c	3.65	56.93 ^c	3.28
Old				
PPVT	219.53	3.02	220.60	3.78
Verbal Fluency	43.40 ^d	9.73	47.53 ^d	9.91
Category Fluency	18.87	3.80	19.40	4.75
Matrix Reasoning	20.27 ^e	5.54	23.67 ^e	3.87
Block Design	33.33	11.15	35.07	12.58

BNT	56.20 ^f	2.98	57.20 ^f	2.14
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a – significantly different pair, $p = .009$

b – significantly different pair, $p = .016$

c – significantly different pair, $p = .007$

d – significantly different pair, $p = .022$

e – significantly different pair, $p = .002$

f – significantly different pair, $p = .023$

For the young participants, there were significant increases for two verbal tasks, verbal fluency, $t(14) = -3.04$, $p < .01$, and the BNT, $t(14) = -3.14$, $p < .01$, and one nonverbal measure, the block design test, $t(14) = -2.75$, $p < .05$. For the older participants, performance improved significantly on verbal fluency, $t(14) = -2.56$, $p < .05$, and the BNT, $t(14) = -2.56$, $p < .05$, as well as the matrix reasoning task, $t(14) = -3.72$, $p < .01$. I ran paired samples t -tests on the standard scores for the latter two tasks and found significant results again for the young participants on the block design, $t(14) = -2.79$, $p < .05$, and for the old participants on the matrix reasoning, $t(14) = -3.76$, $p < .01$. This is an interesting result because it may suggest that consistent and prolonged training on a verbal task may positively affect performance on nonverbal tasks. However, as this was not the research question for the current study, I will not go into further detail about this finding.

Discussion

The present study aimed to address the knowledge gap surrounding recurring tip-of-the-tongue states in healthy young and old adults. The goal of the study was to examine the impact of TOT states over the short-term and the influence of experiencing repeated TOT states over a period of time longer than 48 hours. Although there are researchers who have investigated TOT states over a longer duration of time (i.e., more than one day), these have taken place outside of the laboratory and have focused on the use of diaries (Heine et al., 1999; Reason & Lucas, 1984). Further, I was interested in the effect of remaining in a TOT

state or bringing a quick resolution to the TOT state on later word finding. Warriner and Humphreys (2008) suggested that remaining in a TOT state (i.e., in an error state) might reinforce incorrect neural pathways whereas a quick resolution of a TOT state would reinforce correct pathways. If this is the case, recalling a word on subsequent attempts should be more difficult after remaining in a TOT state on a previous occasion. By examining persistent and resolved TOT states over time in a more controlled laboratory setting, our findings might have important implications for treatment methods for individuals with word-finding difficulties, as in those with acquired neurogenic disorders such as aphasia.

In the present study, TOT states were either resolved immediately by providing the word (0-delay) or were persistent in that participants were asked to keep trying to find the word for 20 seconds (20-second delay). Word finding after these TOT states was examined in the short-term by considering responses at the second session after a previous TOT state on the first day (Day 1 to Day 2), or considering responses on any session immediately following the first occurrence of a TOT experience (consecutive session). With regards to the Day 1 to 2 results for both young and old participants, no significant differences were found between delay conditions for either experiencing another TOT state, not knowing, or knowing the word. Nevertheless, the young participants were more than twice as likely to experience a TOT on a word in the second session after experiencing prompt resolution of a TOT than spending 20 seconds in a TOT state on that word in the first session. As well, the old participants were 4.5 times more likely to not know a word on the second session after experiencing prompt resolution of a TOT than spending 20 seconds in a TOT state on that word in the first session. These likelihood ratios show an increased difficulty finding words after prompt resolution rather than remaining in a TOT state on the previous occasion. Further support for this pattern was observed in the analysis of consecutive sessions

involving the first occurrence of a TOT. In this analysis, young participants were significantly more likely to experience a TOT on the session following an initial TOT in which quick resolution rather than a 20-second delay was provided. Similarly, old participants were significantly more likely not to know a word after a quick resolution of a preceding TOT state rather than being delayed in a TOT for 20 seconds. Taken together, these findings suggest that word finding was more difficult after prompt resolution of a previous TOT state for both young and old adults, at least in the short term. This pattern is opposite to that reported by Warriner and Humphreys (2008), who reported that shorter TOT states on Day 1 led to better recall of those words on Day 2.

With regard to persistent TOT states, there was no relationship between time spent in a TOT state on two or more occasions and a recurrent TOT, not knowing, or knowing a word for the young participants. A different pattern emerged for the old participants. Although no relationship was found between experiencing repeated TOT states and a recurrent TOT or not knowing the word, knowing a word was significantly more likely if the old participants remained in a TOT state for 20 seconds rather than not remaining in the TOT state. Interestingly, both groups showed a significant increase in scores on two independent naming measures: naming items starting with a given letter and a picture-naming task. These results provide some preliminary suggestion that remaining in a TOT state and engaged in purposeful searching may be associated with more successful word finding, at least in some cases.

The findings related to Day 1 to Day 2 responses are most comparable to those reported by Warriner and Humphreys (2008). Based on Warriner and Humphreys' (2008) TOT study, it was predicted that a quick resolution to a TOT state would reinforce correct pathways leading to a reduction in the probability of a recurring TOT state. Recall that

participants in Warriner and Humphreys' study who responded TOT on Day 1 and were stuck in a long delay were *more* likely to experience a TOT on Day 2 than those who were stuck in a short delay. The current study however, did not replicate these findings—delay length on Day 1 did not have a significant effect on TOT states on Day 2. This held true for both our young and old participants. Other findings confirm a lack of replication of the Warriner and Humphreys' findings. For example, patterns based on likelihood ratios suggested better word recall after the 20-second delay condition with young participants being twice as likely to experience a TOT on Day 2 after a short than long delay, and old participants being 4.5 times more likely not to know a word on Day 2 after a short than long delay. Results across consecutive days provided further evidence, with young participants being significantly more likely to experience a TOT and old participants being more likely not to know a word after a short than long delay. Thus, there was no reduction in the probability of experiencing a TOT after the short delay. Indeed, there was evidence that finding words was more difficult after a short than long delay for both young and old participants.

One reason for the difference in results may be explained by the difference in delay duration between the two studies. Although the testing paradigm in the present study was almost identical to that of Warriner and Humphreys', one major modification implemented was changing the long delay from 30- to 20-seconds and the short delay from 10- to 0-seconds (or no delay). Our purpose for shortening the delay length of the current study was twofold. First, shortening the delay length from 10 seconds to 0 seconds was done to test whether immediate resolution of the TOT state facilitates later recall. The reasoning for this was that even a short delay of 10-seconds could reinforce incorrect pathways, and the only way to examine immediate resolution of incorrect searching would be to provide the correct

word without delay as soon as the participant declared that the word could not be found. The second purpose was to make our testing sessions more aphasia-friendly. A future goal is to run this study including participants with aphasia, who inherently have word-finding difficulties. By reducing the time spent in delay conditions, I hoped to achieve a timely session length that is manageable for individuals with aphasia. Results under these conditions may explain why the findings of Warriner and Humphreys (2008) were not replicated.

How can the results of the present study and those of Warriner and Humphreys (2008) be reconciled? One possibility is that results for the 10-second delay in the Warriner and Humphreys study is comparable to those for the 20-second delay in the current study. In both of these cases, the participant remained in a TOT state searching for the correct word. If this were the case, the Warriner and Humphreys study did not include a condition that provided immediate resolution of the TOT state unlike the no delay condition in the present study. As such, only the present study provided a direct comparison between immediate resolution and remaining in a TOT state. On the other hand, it is also possible that the 0-second delay condition was too short to engage the word retrieval system at all. What about the 30-second delay condition included in the Warriner and Humphreys study? If remaining in a TOT state facilitates recall, one may expect recall to improve after longer delays but this did not occur in the Warriner and Humphreys study. It may be, however, that remaining in a TOT state for 30 seconds was just too long for productive searching leading to distraction/inattention. Further research is needed to address this question and to determine if there is an optimal duration for searching in TOT states.

Consider now the concepts of errorful and errorless learning. According to errorful learning accounts, learning occurs when participants are encouraged to make errors. In the present study, errorful learning maps onto the 20-second delay condition. During the 20

seconds in which participants remained in the TOT state, they continued to search for the word. However, during the delay, errors did not always occur. Therefore, one can argue that the term ‘effortful’ better describes the cognitive processes in which the participant is engaged during the 20-second delay. In contrast, errorless views hold that learning takes place when immediate resolution occurs. Therefore, errors are discouraged and ideally eliminated. In the present study, errorless learning occurred in the 0-second delay condition. In this case, errors were prevented by immediately resolving the TOT state by providing the correct target word. The pattern of results in the present study suggests positive results through effortful learning over time. Recall, the older participants were more likely to know the word after two or more sessions spent in a 20 second TOT state as compared to no delay. Additionally, young participants were *more* likely to experience a TOT on the consecutive session after experiencing no delay (errorless learning) and the old participants were more likely to indicate that they did not know the target word after a previous TOT when they had experienced no delay (errorless learning). In fact, none of the findings in the present study favoured the no delay/errorless learning condition. Results were either equivocal (KNOW and DON’T KNOW responses) or favoured effortful learning as described above. This finding is consistent with the comprehensive review of treatment research by Middleton and Schwartz (2012) who found that “taken together, the reviewed studies hint at greater efficacy potential of EF [errorful] treatments over EL [errorless] methods, particularly when long-term treatment effects are considered” (p. 159).

The results of our older participants may also lend support to Pyc and Rawson’s (2009) retrieval effort hypothesis in which they argue that retrievals have different levels of success. More specifically, the more difficult the retrieval is, the better it will be for memory. Remaining in a TOT state for 20 seconds over multiple sessions, while continually searching

for the target word, is arguably more difficult than being provided immediately with the target word, in which no extra effort is required. Recall, the older participants were more likely to resolve after persisting in a TOT state for 20 seconds on multiple sessions compared to 0 seconds. In addition, our results suggest better word recall after the 20-second delay condition as both our young and old participants were more likely to experience a TOT again and indicate they did not know the word when they experienced a 0-second delay on the previous trial. These results are consistent with the notion that engaging in purposeful searching facilitates word finding.

One major improvement to the current study was the inclusion of an older participant population. The purpose of including older adult participants in addition to our young participants was to see how TOT states are affected by age. Generally speaking, TOT rates were largely similar across the young and old participants in the present study. This is consistent with a study by Juncos-Rabadan, Facal, Rodriguez, and Pereiro (2010) in which no significant difference was found between older and younger adults in the naming of common nouns. Interestingly, the older group in the Juncos-Rabadan et al. study did have significantly more difficulty recalling personal names. Stimuli in the current study consisted of nouns, and this could be one reason why a discrepancy in the amount of TOT states reported by our young and old adults was not observed.

Another important innovation in the present study was to examine word finding after recurrent TOT states past 48 hours. For both our young and old adults, there were no significant differences between the two delay conditions for reoccurring TOT states over time. This means, that when participants continually entered a TOT state on the same word over multiple sessions, the delay length (20 vs. 0) did not have an effect on the likelihood that they would TOT again on the following session. However, this non-significant result

may be underpowered as fewer and fewer TOT experiences occurred as the sessions progressed.

Although I was interested in reoccurring TOT states, it is the successful resolution of the TOT state (a KNOW response) that has implications for treatment with individuals with word-finding difficulties. Therefore, it is possible to look at how successful participants were at resolving their TOT states after two or more occurrences. For our young adults, there was no significant difference between the two delay conditions. This suggests that over time, delay length does not have an effect on successful resolution. On the other hand, significant results revealed that the older participants were more likely to resolve (KNOW) after two or more TOT occurrences if they persisted in the TOT state for 20 seconds compared to 0 seconds. One possible reason for this pattern of results is that there may be more of a cognitive benefit to engaging in purposeful processing and searching for the older adults. Although not comparing young and old groups specifically, results consistent with this suggestion were provided by Ball et al. (2002), in which 65-94 year olds received memory and reasoning strategy training. Results of the 10-session intervention showed improvements in both the reasoning and memory groups, which lasted two years, post training. Nevertheless, cautious interpretation of the different pattern of results across the age groups and across multiple sessions in the current study is needed as the findings are based on a small set of data.

Results from the pre-post neuropsychological testing battery revealed some interesting findings. For both the young and old participants, there were significant increases in scores at post testing for two independent naming measures: naming items starting with a given letter and a picture-naming task. Although it is not possible to attribute these findings to the TOT delay conditions specifically, these results may suggest some carry over effects

from the TOT task to untrained naming behavior. It may be that more time spent in purposeful word finding has a more general impact on word finding abilities. Alternatively, the significant improvements may be related to a learning effect.

Our findings suggest that remaining in a TOT state for 20 seconds before resolution is better for subsequent recall compared to immediate resolution. This does not follow the reasoning that more time spent in an unresolved TOT state would lead to greater reinforcement of incorrect search pathways (Warriner & Humphreys, 2008). If this were true, one would expect participants to be most successful after the 0-delay, as they would spend the least amount of time reinforcing incorrect pathways. Recall that a TOT occurs because we have partial but not complete activation of the word. Perhaps during the 20 seconds when participants are persisting in the TOT state, they are reinforcing the partially activated pathway. Then, when the delay ends and the target word is presented, there is reconciliation of the TOT state so that on subsequent trials this reinforced pathway leads more directly to the target word. In contrast, during the no-delay condition, there is no opportunity for reinforcement of the partial activation as resolution occurs instantaneously. Therefore, when the word is encountered again, those who previously spent 20 seconds reinforcing the partially activated pathway are more likely to resolve their TOT state than those who did not have a chance to strengthen this partial pathway.

One major limitation of the current study was the limited number of TOT responses on any given session. Recall over the eight testing sessions only 2.65% of responses were TOTs for the old participants and 3.27% for the young participants. This small percentage could be attributed to the fact that it is very difficult to provoke TOT states in a laboratory setting. Although low frequency words were selected (as they are more likely to evoke TOT states than common words), the TOT occurrences in the current study were very limited.

Even with a stimuli list of 90 word-definition pairs, TOT occurrences were minimal as it is impossible to predetermine what words will arouse a TOT state. As mentioned previously, the limited number of TOT responses occurring in the data may have lead the Wilcoxon signed-rank test to be underpowered in certain analyses. In fact, this problem could be considered to reflect more of an issue with the sensitivity of the measure than power associated with the study. For example, a measure that could more successfully elicit TOTs may improve the available dataset in this study.

Another modification that was made was to follow participants over eight testing sessions to observe persistent TOT states. However, as participants became more and more familiar with the words at each session, the number of TOT occurrences decreased and the KNOW responses increased. This was especially true for the young participants, as nearly half of them responded with 100% accuracy before the final sessions. Nevertheless, these practice effects could not be avoided as the study was designed to follow TOT states over time. Lastly, another limitation to the current study was the sample size. The current study included 15 young and 15 old participants, whereas the Warriner and Humphreys' study included 30 young participants. In addition, data were available for some of the analyses in the present study for only a subset of participants. It would be worthwhile to test an additional 15 participants in each age condition in order to compare findings from equal sample sizes.

Conclusion

Although frustrating, TOT occurrences are common in healthy individuals, across languages, and in various language domains (Thompson, Emmorey, & Gollan, 2005). Results from the current study found no significant effect of delay time on any Day 2 responses for either young or old adults. However, looking beyond Day 1 and Day 2 revealed significant

results – young participants were significantly more likely to experience a TOT on the consecutive session following an initial TOT in which a 0-delay rather than a 20-second delay occurred. Additionally, the old participants were significantly more likely to not know a word after remaining in a TOT state for 0-seconds on a previous session, compared to 20-seconds. Finally, when examining persistent TOT states over time, results showed no relationship between time spent in a TOT state on two or more occasions and the subsequent response for the young participants. However, the old participants were significantly more likely to know a word if they continuously persisted in a TOT state for 20 seconds compared to 0 seconds. These findings suggest that engaging in a purposeful cognitive search for an elusive word may facilitate word finding, at least in the short term. Therefore, when an individual is experiencing a TOT or difficulty finding a particular word, it may be in their best interest to continue to try and search for the word on their own, rather than being provided with the word from a helpful friend.

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Appendix A

Target definition	Target
A device for making calculations and counting in which beads are slid along rows of wires	abacus
Become accustomed to a new climate or environment	acclimate
Of or being an instrument that does not produce or enhance sound electronically	acoustic
A person who compiles and analyzes statistics and uses them to calculate insurance risk and premiums	actuary
A device for connecting pieces of equipment that cannot be connected directly	adapter
Someone who supports a particular party, person, or set of ideas	adherent
The autoimmune disease which causes partial or complete absence of hair from areas of the body where it normally grows	alopecia
A character or symbol for 'and'	ampersand
The maximum absolute value reached by a waveform	amplitude
A word, phrase, or name formed by rearranging the letters of another	anagram
The absence or inability to feel pain without loss of consciousness	analgesia
A word opposite in meaning to another	antonym
Ornamentation, as a cutout design, that is sewn on to or otherwise applied to a piece of material	applique
The wasting away of the body or of an organ or part	atrophy
A close fitting, knitted cap that covers the whole head leaving only part of the face showing	balaclava
A person who engages in the exchanging of goods and services for other goods and services without using money	barterer
A person whose job is to do hair styling, manicures, and other treatments	beautician
The 200th anniversary of a significant event	bicentennial
A pair of glasses having two portions, one for near and one for far vision	bifocal
The act of going through a marriage ceremony while already married to another person	bigamy
A curved flat piece of wood that can be thrown so as to return to the thrower	boomerang
A person who studies the science and practice of drawing maps	cartographer
A yacht or other boat with two parallel hulls or floats	catamaran
A device in which accumulated tension is suddenly released to hurl an object some distance	catapult
Abstaining from sexual relations, especially by reasons of religious vows	celibate

A perforated bowl used to strain off liquid from food	colander
Goods that have been imported or exported illegally, such as drugs	contraband
A binding agreement or contract between parties to do or not do something specified	covenant
A wide sash worn at the waist, especially a horizontally pleated one worn with a tuxedo	cummerbund
Government by two independent authorities and is one of the oldest forms of government	diarchy
A person or company that manufactures liquor	distiller
A statement of a point of view as if it were an established fact	dogmatism
A type of person who derives ideas, style, or taste from a broad and diverse range of sources	eclectic
A series of marks, usually dots, indicating the omission of one or more words from a sentence	ellipsis
The person who treats dead bodies so as to preserve them using chemicals and drugs	embalmer
Causing vomiting, as a medicinal substance	emetic
A disease or condition regularly found among particular people or in a certain area	endemic
The outer layer of cells covering an organism, also known as the skin	epidermis
A name of a person or thing after which a particular place, discovery, or other item is named or thought to be named	eponym
Of or relating to horseback riding or horseback riders	equestrian
The time or date, occurring twice a year, at which the sun crosses the earth's equator and day and night are of equal length	equinox
The process of eliminating or expelling waste matter in living organisms and cells	excretion
An interjectory word or expression, frequently profane, usually a swear word	expletive
A substance applied to a finished product to preserve it and prevent loss or change	fixative
The process of taking possession of a mortgaged property as a result of failure to keep up with payments	foreclosure
The point at which a plan or project is realized	fruition
A roofed pavilion that offers an open view of the surrounding areas	gazebo
A device for beheading a person by means of a heavy blade that is dropped between two posts	guillotine
An apparatus for measuring orientation of a wheel or disk mounted so that it can spin rapidly about an axis	gyroscope
A small rectangular wind instrument held against the lips and moved from side to side to produce different notes	harmonica
A person who is abnormally anxious about their health	hypochondriac

Done in a spontaneous or improvised way without being planned, organized, or rehearsed	impromptu
The mating of closely related people or animals, especially over many generations	inbreeding
The inability to sleep	insomnia
To join two or more things by the fitting together of projections and recesses	interlock
A shy person who is concerned primarily with his or own thoughts and feelings	introvert
A style of font or print in which the letters slope to the right	italic
An irresistible impulse to steal, typically without regard for need or profit	kleptomania
A short stop or break in a journey, usually imposed by scheduling requirements	layover
A drink of wine or other liquid poured in honor of a deity	libation
A thread, wire, or cord used in surgery to bind or connect, similar to stitches	ligature
A surgical operation involving cutting into the prefrontal lobe of the brain	lobotomy
A painful condition of the muscles and joints in the lower back	lumbago
An aquatic mammal with a rounded tail flipper who lives in shallow coastal waters and resembles a whale	manatee
A seasoned liquid typically made of oil, vinegar, or spices, and herbs in which food is soaked before cooking	marinade
A person who hates, dislikes, mistrusts, or mistreats women	misogynist
A railroad in which the track consists of a single rail which is usually elevated	monorail
A picture or pattern produced by arranging together small coloured pieces of hard material such as tile or glass	mosaic
The number above the line in a common fraction	numerator
The study or collecting of coins, medals, and paper currency	numismatics
The twenty-fourth and last letter of the Greek alphabet	omega
The formation or use of a word such as <i>buzz</i> that imitate the sounds associated with the objects or actions they refer to	onomatopoeia
One of several persons who carry or attend the coffin at a funeral	pallbearer
The principles, practice, or profession of teaching	pedagogy
To take the word or an idea of someone else and pass it off as one's own	plagiarism
A building in which images of stars, planets, and constellations are projected on the inner surface of a dome	planetarium
A mixture of dried petals and spices placed in a bowl or small sack to perfume clothing	potpourri
Spending money or resources freely and recklessly, being wastefully extravagant	prodigal

A soft boggy area of land that gives way underfoot	quagmire
A period of isolation or detention, especially of persons or animals arriving from abroad to prevent the spread of disease	quarantine
A tool with a broad, flat, usually flexible blade, used for blending foods or removing them from cooking utensils	spatula
A condition, demand, or promise typically used as part of a bargain or agreement	stipulation
A large hairy spider found chiefly in tropical and subtropical America	tarantula
The branch of science concerned with classification, especially of organisms	taxonomy
A device used in television and moviemaking to project a speaker's script out of sight of the audience	teleprompter
A dictionary of synonyms and antonyms	thesaurus
A person who can speak or utter sounds so that they seem to come from somewhere else	ventriloquist
Salad dressing of olive oil, vinegar, and seasoning	vinaigrette
A musical instrument played by striking a row of wooden bars of graduated length with one or more small wooden or plastic mallets	xylophone
A variety of summer squash that is shaped like a cucumber and has smooth dark-green skin	zucchini
Practice definition	Practice words
The dividing of a state, county, etc., into election districts so as to give one political party a majority	gerrymander
A tropical American pepper plant of the nightshade family with fruits containing many seeds	capsicum
The criminal act of deliberately setting fire to buildings or other property	arson
A utensil with two or more prongs, used for eating or serving food	fork
False definition	No target word (****)
Of or pertaining to a high degree of hedonistic enthusiasm	
A group or committee venture spending the majority of its time together in nonproductive argument	
Predicting future outcomes based on limited understanding of the cause	
The amount of carbonation evident in a soda; used as a good indicator of freshness	
A boisterous parade	
Silent hope that a prior act or oversight will be forgotten	
To obsessively calculate weights and liquid measures	
The act of nay saying without cause or explanation	
The act of waffling between two points of view without committing fully	

committing to either

Unintelligible operating or assembly instructions

The study of computer viruses

An operated device for cleaning tables

A person who studies paper weights

A type of food that is consumed only once a week

A period of time in which talking is forbidden

A device used to move fish from one aquarium to another

The act of slipping, tripping, or falling on ice

The inability to fill up a water bottle on one's own

A mammal with three legs common in Antarctica

A dessert made of chocolate, flour, and lemon

An instrument used for making beds

A common clothing item which is worn over knee's and ears

A loud sound which comes from a cars seat belt

A large, hairy bird which hibernates for 9 months of the year

A type of shoe in which the sole is made of feathers

A type of car in which the front seat is also the back seat

A building in which the doors are located on the second floor

The name for a joint hardware store and pharmacy

The art of making snowmen

Running with one foot

The bitter remnants of a pot of tea

The name of a flower pestle containing three colors

The name for a grouping of garden gnomes

The youngest adult member of a family

The act of mailing a postcard

The act of pushing a broken car

A medical procedure which leaves one double jointed

The name for a person who has an extensive collection of magazines

A type of seasonal watermelon grown in Cuba

The name for a glass faucet

A word for a suggestion deemed to be a good new course of action

The lowest shelf on a bookshelf

The word for running a plane's fuel tank dry

A bunk bed consisting of three layers

The word for sending transmissions between planets
A body of water which is bigger than a lake but smaller than an ocean
The name for the second floor of a double Decker bus
The name for a pasta dish that doesn't actually include pasta
The act of jogging with your leashed dog
The name for a flower arrangement made of lilies
The name given to those who can balance a spoon on their nose
The smallest unit located in a bowl of cereal
The inability to stop oneself from doing jumping jacks
A type of jewelry worn on the elbows
The word for flipping a calendar's page at the end of the month
The word for a broken link in a chain
The word for feeding non-domesticated animals
The name for someone who crafts walking sticks
The word for tying a bow tie
The act of grocery shopping
A type of pillow filled with pine needles
The medical term for a paper cut
A tool used for pulling apart post-it-notes
The name for ice skates with two blades per skate
When a bookshelf breaks under the pressure of excessive weight
The act of flattening a wrinkled piece of paper
The act of emptying a garbage can of its contents
The act of scanning a bar code
When a radio is slightly out of tune from a station
The name for handwriting that is comprised of both printing and cursive writing styles
The name for the second highest button on a shirt
The act of turning a necklace into a bracelet
The name for a card missing from a standard deck of cards
The act of cleaning out one's hairbrush
A freshly cut blade of grass
Describing something that is both undocumented and unmentionable
A mediator who suddenly takes sides in a dispute
A type of pen that never runs out of ink
An unnecessary or wasteful peripheral device

A reminder of one's past brought on by a familiar or more recently unfamiliar smell

Appendix B

Participant Booklet**Background Information****Participant ID** _____

Date of birth (dd/mm/yyyy): _____

Age: _____

Sex: Male/Female

Handedness: Right/Left

Highest education level attained (please circle):

Elementary
Secondary
College
Undergraduate degree
Graduate degree

Vision status: Glasses/Contacts/None

Any known problems with:

i) Hearing: _____

ii) Speech and Language: _____

iii) Vision: _____

iv) Other: _____

Birthplace: _____

Date of Testing (dd/mm/yyyy)

Session 1: _____

Session 5: _____

Session 2: _____

Session 6: _____

Session 3: _____

Session 7: _____

Session 4: _____

Session 8: _____



Appendix C

Letter of Information and Consent Form
Investigating word finding difficulties in aphasia patients
Healthy 19 – 30 year olds

You are invited to participate in a study examining word finding difficulties in speech production for people with aphasia. We are asking 12 people with aphasia and 15 people between the ages of 19-30 and 15 people between the ages of 65-90 years to participate in this study. Testing sessions will take place at the H.A. Leeper Speech and Hearing Clinic. For this study, if you agree to participate you will be asked to complete some language and thinking tasks. You will also be given a computer task, during which you will be presented with word descriptions. After each description, you will be asked to indicate whether you know the word associated with the description, do not know the word, or do know the word but cannot say it out loud. You will then be given the correct word, and asked to indicate if this word matches the one you have in mind. In order to familiarize you with the procedure, you will be given a short practice session first. This session will take approximately 90 minutes to complete. You will also be asked to participate in 6 to 8 future sessions with the same testing procedure, and each will take approximately 30-40 minutes to complete.

There are no known physical or psychological risks associated with this research and no discomfort to you is expected during the session. Your participation in the study is voluntary. You can refuse to participate, refuse to answer any questions or withdraw from the study at any time. There are no direct benefits to the participants. Results from this study may better our understanding of word finding difficulties associated with many forms of aphasia, as well as word finding difficulties during speech production in general. Information about your performance will be kept strictly confidential. Participants' names will be retained in a Master list in order to allow us to locate individual participant data should the need arise (for example, if you were to request a copy of your data). A contact phone number will be collected for use during the study to allow us to schedule visits. The data that will be released will not include the identification of participants without specific consent. You will be informed about the experimental hypotheses and expected results upon completion of the experiment, and you will be given a copy of this Letter of Information to keep. Parking vouchers will be provided for all study visits.

If you have any questions now, please ask the researcher to answer them for you. If you have any further questions or concerns you may contact Allison Partridge at _____ or _____. If you have any questions about your rights as a research participant or the conduct of the study you may contact the Office of Research Ethics at _____ or by email at _____.

Representatives of The University of Western Ontario Health Sciences Research and Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

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V. 2. Sept 20, 2011

INIT



Appendix D

Letter of Information and Consent Form
Investigating word finding difficulties in aphasia patients
Healthy 65 – 90 year olds

You are invited to participate in a study examining word finding difficulties in speech production for people with aphasia. We are asking 12 people with aphasia and 15 people between the ages of 19-30 and 15 people between the ages of 65-90 years to participate in this study. Testing sessions will take place at the H.A. Leeper Speech and Hearing Clinic. For this study, if you agree to participate you will be asked to complete some language and thinking tasks. You will also be given a computer task, during which you will be presented with word descriptions. After each description, you will be asked to indicate whether you know the word associated with the description, do not know the word, or do know the word but cannot say it out loud. You will then be given the correct word, and asked to indicate if this word matches the one you have in mind. In order to familiarize you with the procedure, you will be given a short practice session first. This session will take approximately 90 minutes to complete. You will also be asked to participate in 6 to 8 future sessions with the same testing procedure, and each will take approximately 30-40 minutes to complete.

There are no known physical or psychological risks associated with this research and no discomfort to you is expected during the session. Your participation in the study is voluntary. You can refuse to participate, refuse to answer any questions or withdraw from the study at any time. There are no direct benefits to the participants. Results from this study may better our understanding of word finding difficulties associated with many forms of aphasia, as well as word finding difficulties during speech production in general. Information about your performance will be kept strictly confidential. Participants' names will be retained in a Master list in order to allow us to locate individual participant data should the need arise (for example, if you were to request a copy of your data). A contact phone number will be collected for use during the study to allow us to schedule visits. The data that will be released will not include the identification of participants without specific consent. You will be informed about the experimental hypotheses and expected results upon completion of the experiment, and you will be given a copy of this Letter of Information to keep. Parking vouchers will be provided for all study visits.

If you have any questions now, please ask the researcher to answer them for you. If you have any further questions or concerns you may contact Allison Partridge at

You may also contact Dr. Lisa Archibald at _____ or _____ If you have any questions about your rights as a research participant or the conduct of the study you may contact the Office of Research Ethics at _____ or by email at _____

_____. Representatives of The University of Western Ontario Health Sciences Research and Ethics Board may contact you or require access to your study-related records to monitor the conduct of the research.

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V. 2. Sept 20, 2011

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Appendix E



Use of Human Participants - Ethics Approval Notice

Principal Investigator: Lisa Archibald
File Number: 6872
Review Level: Delegated
Approved Local Adult Participants: 12
Approved Local Minor Participants: 0
Protocol Title: Investigating word finding difficulties in adults with aphasia. - 16879E
Department & Institution: Health Sciences/Communication Sciences & Disorders, Western University
Sponsor:
Ethics Approval Date: May 18, 2012 **Expiry Date:** August 31, 2013
Documents Reviewed & Approved & Documents Received for Information:

Document Name	Comments	Version Date
Revised Western University Protocol	We are requesting two revisions to this protocol: 1) Increase in the upper age limit of the older healthy group to 90 years. 2) Include posting of advertisements about the study in local homes for the aged.	
Revised Letter of Information & Consent	60-90 year olds	2011/09/20
Revised Letter of Information & Consent	19-30 year olds	2011/09/20
Advertisement		

This is to notify you that The University of Western Ontario Research Ethics Board for Health Sciences Research Involving Human Subjects (HSREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the Health Canada/ICH Good Clinical Practice Practices: Consolidated Guidelines; and the applicable laws and regulations of Ontario has reviewed and granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above. The membership of this REB also complies with the membership requirements for REB's as defined in Division 5 of the Food and Drug Regulations.

The ethics approval for this study shall remain valid until the expiry date noted above assuming timely and acceptable responses to the HSREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the University of Western Ontario Updated Approval Request Form.

Members of the HSREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the HSREB.

The Chair of the HSREB is Dr. Joseph Gilbert. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Signature

Ethics Officer to Contact for Further Information

The University of Western Ontario
Office of Research Ethics

Support Services Building Room 5150 • London, Ontario • CANADA - N6G 1G9
PH: 519-661-3036 • F: 519-850-2466 • ethics@uwo.ca • www.uwo.ca/research/ethics

Curriculum Vitae

Name: Allison Partridge

Post-secondary Education and Degrees: University of Western Ontario
London, Ontario, Canada
2011-2013 M.Sc. Health and Rehabilitation Sciences

The University of Western Ontario
London, Ontario, Canada
2005-2010 B.A. Honors Specialization in Psychology

Honours and Awards: Dean's Honor List
2008

Related Work Experience

Research Assistant
Dr. Penny MacDonald, The University of Western Ontario
2012-Present

Research Coordinator
Dr. Lisa Archibald, The University of Western Ontario
2010-2013

Teaching Assistant
Dr. Shauna Burke, The University of Western Ontario
Winter 2012

Research Assistant
Dr. Lisa Archibald, The University of Western Ontario
2010-2011

Presentations:

Archibald, L., & Partridge, A (2012, June). Longitudinal Follow up of Children Identified with Specific Impairments in Language and/or Working Memory. Poster presented at the Symposium for Research in Child Language Disorders, Madison, Wisconsin.