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The Effects of Aging and Mild Cognitive Impairment on the Tip-of-the-Tongue Phenomenon in People Naming Task

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Background and Purpose The tip-of-the-tongue (TOT) phenomenon refers to knowing the meaning of the desired information but being unable to produce the phonological information. This study induced the TOT phenomenon through a task involving naming famous people, compared and analyzed results by age, and examined the differences with effects from pathological aging [mild cognitive impairment (MCI)].
Methods Young (n=10), middle-aged (n=10), older (n=10), oldest (n=10), and MCI (n=10) subjects participated in this study. To examine TOT rate, rate of TOT response, voluntary TOT solution rate, and TOT solution rate after presenting syllabic cue, each group participated in the experiment through a task of naming famous people.
Results First, as subject age increased, TOT rate (the number of TOTs divided by total trials) increased. There was no significant difference with pathological aging. Second, normal aging and pathological aging had no significant effect on the rate of TOT response (the number of each response type divided by total response types). Third, the voluntary TOT solution rate (the number of voluntary TOT solutions divided by total TOTs) on occurrence of the TOT phenomenon was very low. Fourth, the TOT solution rate (the number of TOT solutions after presenting syllabic cue divided by total TOTs) had a negative correlation to normal aging. In examining pathological aging, the TOT solution rate of the MCI group was significantly lower than normal oldest people.
Conclusions Normal aging and pathological aging showed differences regarding TOT rate and TOT solution rate when naming famous individuals. The results of this study could be helpful as a differential tool between normal and pathological aging.

Key Words tip-of-the-tongue phenomenon, normal aging, mild cognitive impairment.

INTRODUCTION

With an increasing prevalence of dementia among elderly people, those suffering from cognitive-communication disorders associated with dementia are regarded as the most rapidly growing population in the speech therapy field.[1] Since language is one of the most important cognitive functions in humans, it is of great significance to discern the distinctive characteristics of expressive language among those in normal aging, mild cognitive impairment (MCI), and Alzheimer's disease (AD)

through careful review of preclinical and clinical stages.[2] In particular, early identification of patients with dementia should be preceded by careful observation of distinctively declining linguistic ability in the early stages of the disease to differentiate dementia from normal aging.[1]

Language retrieval function gradually declines with age, and declines in language production linked with age have been repeatedly demonstrated at both orthographic and phonological levels.[3] Further, the tip-of-the-tongue (TOT) phenomenon is universally experienced and increases in frequency with age.[4] The TOT phenomenon refers to the state in which a speaker is temporarily unable to retrieve a word from memory, while being sure that he/she knows the word. With age, one might not quite recall a familiar word but can recall words of a similar form.[5,6] This reflects phonological retrieval failure,[3] which is one of the

most serious problems associated with linguistic impairment in older people.[7]

Recovered partial information can consist of competing items that resemble the target word semantically or grammatically but do not give rise to phonological information completely or partially during attempts to resolve TOT.[8] The cause of TOT has been explained through two frameworks: the blocking hypothesis and the transmission deficit hypothesis.[9,10]

The blocking hypothesis states that retrieval cues elicit the retrieval of a word related to the target that then blocks the retrieval of the correct word resulting in the TOT phenomenon. In other words, TOT occurs when plausible but incorrect responses to a query come to mind quickly. The subject recognizes that the related words are incorrect but cannot retrieve the correct word. Older adults report TOTs more often than younger adults,[3] and based on the blocking mechanism, the cause of this relationship can be explained by the fact that the number of known related words tends to be higher in elderly people who have stored a greater number of words through direct or indirect experiences over a prolonged period of time, but their retrieval capacity of correct words seems to decline in the process. In contrast, the transmission deficit model posits that TOT occurs when there is activation of the semantic component of the target word memory, but this activation does not pass on to the phonological level of the memory of the target word. In other words, TOT is caused by a deficit in transmission of activation from semantic memory to phonological memory. Thus, TOT occurs when the connections between lexical and phonological nodes become weakened due to aging, causing a reduction in the transmission of information.

Regardless of whether TOT is caused by the blocking or transmission deficit hypotheses, it is evident that the TOT phenomenon causes retrieval failure of phonological knowledge, most commonly for proper nouns. Compared with younger adults, elderly people experience more TOT states for proper names.[11] Unlike common pronouns, proper nouns have one denotation with no other object having the same attribute. Thus, the set of objects called by the same name has no common, implicational attribute. For example, a female named 'Kim Mi-jung' has one denotation as a proper name. Even though another name 'Kim Mi-jung' might exist, there is no common implicational attribute between the two names. This one-to-one connection between semantic and phonological information makes it difficult to inhibit unnecessary knowledge and contributes to the weakening of the links with necessary information. Consequently, the TOT state regarding proper nouns is more visible, exhibiting retrieval failure of phonological knowledge, such as in the case of names.

Names of people comprise a large proportion of proper names.

Proper name anomia is more frequently found among MCI and/or AD patients than healthy elderly people.[12] In a people naming experiment, MCI patients performed significantly worse than unaffected older adults,[13] and the experiment has been used as a tool for discerning those with early stage AD.[14] When proper name anomia occurs, older adults or MCI patients perform semantic processing without difficulty, but they cannot phonologically retrieve the correct name of a person in whole or in part.[14]

In order to explore the impairment of phoneme production related to naming people, we induced the TOT phenomenon in a laboratory setting in order to examine the differences between effects of normal aging and pathological aging. We carried out the naming experiment with a total of 50 participants of different ages; 40 unaffected people (young, middle-aged, older and oldest adults) and 10 MCI patients according to the following steps.

First, we compared the rates of TOT among the groups by examining partial and total retrieval failure in face naming (study task 1). Second, we analyzed the rate of TOT response among participants (study task 2). Third, we examined the voluntary TOT solution rate following the TOT state (study task 3). Last, we reviewed the TOT solution rate after presenting the first or last syllabic cue in the event that the TOT state was not voluntarily solved (study task 4). Study task 4 was based on the findings of earlier studies[12,15] that instead of semantic cues, syllabic cues helped to correct the anomia for naming people or the TOT state.

The present study was designed to compare the effects of normal aging and pathological aging on the TOT state when naming people by examining different age groups and the differences between the oldest unaffected adults and MCI affected individuals. The results of this study could be used as a discriminative tool for normal and pathological aging in the TOT state.

METHODS

Participants

A total of 50 participants took part in the study and were divided into five groups, each consisting of 10 people; young adults (20−29 years), middle-aged adults (30−49 years), older adults (50−64 years), oldest adults (65 years or older) and MCI adults (50 years or older).

The designation of age groups was based on criteria from the Ministry of Health and Welfare (2011), and only individuals with no medical history of neurological or psychological disorders were enrolled in this study. Participants were asked to describe their education and health during a brief interview before the experiment. All participants were native speakers of

Korean and reported normal visual and hearing functions before performing the naming task. MCI patients were recruited based on the diagnostic criteria suggested by Petersen[16] and Winblad et al.[17]

Criteria for inclusion were as follows: 1) participants whose scores in the Korean Mini-Mental State Examination (K-MMSE)[18] were in a normal range (higher than 16th percentile), when age and years of education were considered, 2) participants with no evidence of hypertension or diabetes that do not require medication through a cognition battery questionnaire proposed by Christensen et al.,[19] 3) oldest adults and MCI patients having less than moderate depression according to the Geriatric Depression Scale,[20] 4) MCI patients aged 50 years or older with complaints of memory loss by themselves or their legal guardians, and 5) participants with evidence of cognitive decline (less than 16th percentile) were classified as MCI patients for delayed recall based on the Seoul Neuropsychological Screening Battery.[21]

One-way analysis of variance (ANOVA) was performed to verify the differences of age and years of education among normal age groups. There was no significant difference in gender among the four normal age groups (younger, middle-aged, older and oldest adults) ($p>0.05$), but these groups differed significantly in years of education ($p<0.05$) (Table 1). Student's t-test was performed to verify the differences of K-MMSE scores, age and years of education between normal oldest adults and MCI patients, but all of them were statistically insignificant ($p>0.05$) (Table 1).

Materials

Production of materials for naming task

When compiling the materials for the naming task in the study, we selected famous people with whom all subjects were familiar according to time period and category. We divided time periods into 1970s, 1980s, 1990s, and 2000s (or thereafter). We created 3 categories; politics/economics, popular culture, and other fields (society, arts, and physical training).

The selection procedures for famous people were conducted in a stepwise fashion.

1) We conducted a survey of 22 older people (mean age: 55.8 years) who were asked to record the names of famous people (people who were thought to be the most active or influential during each time period per category), and compiled a total of 123 celebrity names in the first stage.

2) Of those 123 names, we selected a total of 100 celebrities based on a survey of frequently used proper nouns from "Frequent Use in Korean Research"[22] published by the National Institute of the Korean Language.

3) Of the resulting 100 people, we selected a total of 48 celebrities in the third stage by referring to a list of Korea's top 10 influential figures spotlighted in renowned magazines (Newsweekly, Sisa Journal and Forbes Korea). We exempted foreigners and other Korean people whose names exceeded 3 syllables in the screening process.

4) We produced photographs of all 48 celebrities selected and carried out a survey of 33 younger adults (mean age: 28.1 years) and 27 older adults (mean age: 55.3 years), asking them to assess the suitability of the photographs. Some famous people whose photographs did not meet the selection criteria were excluded from the selection list. Criteria for the photographs included: 1) famous people could be identified by photographs only, 2) a photograph should represent that famous person only, 3) no clothes or accessories to identify a specific celebrity should be present in a photograph, and 4) all figures in the past could be identified by people regardless of time period.[23] Through these procedures, a total of 40 well-known people were finally selected for this study. Their photographs were bust shots without a hat and in the same size (10.5 cm in length and 15 cm in width). During the naming experiment, we randomly presented the photographs to participants, disregarding the time period, categories, Korean language consonants or high naming frequency.

Procedure

The people naming experiment was carried out on each participant in a room preventing outside noise. The photographs were first presented on the screen of a laptop computer. When participants retrieved the correct name within a 15-second pause, they were regarded as in a non-TOT state. If partici-

Table 1. Characteristics of participants

Group	n	Gender (n)		K-MMSE	Age (yr)	Education (yr)
		Male	Female		Mean (SD)	
20−29 years	10	2	8	29.10 (1.10)	26.10 (2.18)	15.90 (1.37)
30−49 years	10	3	7	28.30 (1.70)	39.10 (6.40)	15.40 (1.34)
50−64 years	10	2	8	27.60 (0.96)	58.70 (4.39)	9.90 (3.17)
Older than 65	10	3	7	24.90 (2.28)	74.10 (4.53)	4.90 (3.47)
MCI (older than 50)	10	2	8	25.20 (2.61)	71.00 (7.87)	5.50 (3.43)

K-MMSE: Korean version of the Mini-Mental State Examination, MCI: mild cognitive impairment, SD: standard deviation.

pants did not accurately retrieve the name of a photograph even after a 15-second pause, we continued the test. Participants were then asked to answer the question "Have you seen this person?" If they answered "No" we exempted the corresponding items from the experimental items.

If they answered "Yes, I've seen this person", we recorded their responses on the questionnaire (study task 1). Then, participants were asked to answer the next question, "Please explain the characteristics of a related person", and if they provided an incorrect explanation, we also exempted the corresponding items from the experimental items (study task 2).

During or after the participants' explanation of the name of a famous person, we documented their voluntary attempts to resolve TOT (study task 3). With regard to voluntarily unresolved questions, we presented the first or last syllabic cue of the target name by saying, "The name cue is O", and recorded their responses (study task 4).

The effect of the first or last syllabic cues are still controversial according to earlier studies.[3] In the present study, therefore, the first syllabic cue was provided to half of the participants in each group while the remaining participants in each group were given the last syllabic cue. It took about 20 minutes to complete the test.

Data analysis

Analysis of TOT rate on partial and whole retrieval failure in face name

Since the TOT phenomenon reflects failure in retrieval of phonological knowledge, it is essential that participants should recognize or identify the famous person presented by a photograph. When participants answered "Yes, I've seen that person" to a specific celebrity but failed to retrieve the correct name by saying "I know the person, but don't know his/her name" or "I can hardly recall it," we recorded their responses in terms of partial or whole retrieval failure in face naming. Partial retrieval failure is defined as the retrieval of at least one syllable from the target name, and whole retrieval failure as a non-retrieval of all three syllables. The TOT rate in partial retrieval failure was calculated as the number of partial retrieval failure divided by the number of occurrences of "Yes, I've seen that person" ×100. In addition, the TOT rate in whole retrieval failure was calculated as the number of whole retrieval failures divided by the number of occurrences of "Yes, I've seen that person" ×100.

Analysis of TOT response

When all responses of each participant in the study were documented after a tester asked them to explain the charac-

teristics of the target individuals, the response types could be classified into 5 groups—occupation, related person, related event, similar name, and others (attempts to retrieve the target name). The attempts to retrieve the target name included repeated enumeration of a partial target name (in an effort to retrieve the target name), citation of a personal experience (individual experience) and a repetition of "I know, but I can't recall it" (identification of TOT state). Each response was calculated as 1 point, and when two responses were observed on one famous person, 1 point per response was allocated. For example, if there were two responses about Park Tae-whan such as "swimmer" and "He won the gold medal", 1 point was given to each of the two evaluable items (occupation and related event). The rate of TOT response was calculated as the number of each response type divided by the total number of response types.

Voluntary TOT solution rate and TOT solution rate after presenting syllabic cue

We defined voluntary TOT solution rate as voluntary retrieval of a target name by a participant in TOT state before presenting a syllabic cue from the tester. We also defined TOT solution rate after presenting a syllabic cue as retrieval of a target name by a participant in the TOT state after presenting the syllabic cue. Voluntary TOT solution rate was calculated as the number of voluntary TOT solutions divided by total occurrences of TOT. The TOT solution rate after presenting a syllabic cue was calculated as the number of TOT solutions after presenting syllabic cue divided by total TOTs×100.

Statistical analysis

In order to examine significant differences between the TOT rate associated with inter-group TOT types (partial and whole retrieval failure in face naming) and response rates associated with TOT response types (occupation, related person, related event, similar name and attempts to retrieve the target name), each two-way ANOVA was applied between one inter-subject and one intra-subject. The TOT solution rate was analyzed with respect to the occurrence of the TOT phenomenon only. Since there were too few participants showing the TOT phenomenon in both young and middle-aged adults, the Kruskal-Wallis test (nonparametric test) was performed to compare the TOT solution rate among the four normal age groups. In contrast, all participants among both normal oldest adults and MCI individuals demonstrated a TOT state. Subsequently, Student's *t*-test was performed to compare the TOT solution rate between the two groups.

The number of years of education is commonly controlled in naming experiments. In this study, however, the naming experiment was conducted using the names of celebrities who

were well-known by the general public including the oldest adults, and the experiment was carried to completion only for those who answered with "I've definitely seen this person" on their own. The correlation coefficient between years of education and whole and partial retrieval failure as a dependent variable was -0.342 ($p>0.05$) and -0.525 ($p>0.05$) respectively, which was deemed insignificant. In contrast, the correlation coefficient between years of education and age bracket as an independent variable was -0.879 ($p<0.05$), which was statically significant. Therefore, the number of years of education was not deemed to be an extraneous variable as covariance in the inter-group analysis and was not controlled, although there were differences in the years of education among the four normal age groups.

Reliability

The first analyst (author of this study) and second analyst (professional Korean speech-language pathologist with a minimum of a master degree and license) collected random data from 10 participants that accounted for 25 percent of the total participants and evaluated their reliability. Prior to assessing the reliability of the data, the author provided the second analyst with a detailed explanation of the response criteria, and a practice assessment of data from one participant was made until the coincidence rate reached more than 90%. The reliability of the TOT rate, TOT response and TOT solution rate was more than 96% between the two analysts.

RESULTS

Comparison of age groups depending on normal aging

TOT rate depending on TOT types in four normal age groups

The mean TOT percentage for the four normal age groups was 7.87% [standard deviation (SD); 7.92%] in young adults, 19.85% (SD; 12.43%) in middle-aged adults, 22.60% (SD; 11.92%) in older adults and 25.80% (SD; 7.51%) in oldest adults, suggest-

ing that as aging progressed in normal aging, the mean TOT rate increased.

The mean percentage of partial retrieval failure in the four normal age groups was 3.85% (SD; 4.41%), which was lower than that of whole retrieval failure (15.18%) (SD; 9.66%), as shown in Table 2.

The two-way ANOVA applied to the differences of the TOT rate depending on TOT types for the four age groups indicated that the effect of age group was significant (F=5.88, $p<0.01$) and that the effect within the age group was significant (F=71.71, $p<0.01$). Further, the interaction effect between TOT types and inter-groups was also significant (F=3.00, $p<0.05$). Scheffe post-hoc comparison tests showing significant differences in TOT rate indicated that TOT rates in older and oldest adults were significantly higher than those seen in young adults ($p<0.05$). Since the effect on TOT types was significant, it was noted that the number of whole retrieval failures was significantly higher than that of partial retrieval failures, irrespective of any group. To investigate the interaction effect between TOT types and each group in more detail, paired t-test applied to inter-TOT types within each group indicated no significant differences between partial and whole retrieval failures in older adults, unlike other age groups ($p>0.05$).

Response types of TOT state in four normal age groups

Of the response types during the TOT state for the four age groups, the mean percentage of occupation-related responses was the greatest at 59.64% (SD; 26.20%) in the four normal age groups, followed by responses about related events at 19.79% (SD; 20.89%), other retrieval attempts at 9.82% (SD; 14.58%), similar name at 6.25% (SD; 10.43%) and related person at 5.71% (SD; 9.42%), as shown in Table 3.

Two-way ANOVA applied to the data indicated the effect of the response types was significant (F=44.36, $p<0.05$), but the interaction effect between each group and TOT response was insignificant (F=0.91, $p>0.05$). To investigate the differences of response types in more detail, a multiple comparisons test applied to the data indicated that the number of occupation related responses was higher than that of the other four response

Table 2. Mean and SD of TOT percentage in four normal age groups (%)

Group	n	Total TOT	Partial TOT	Whole TOT
		Mean (SD)		
20–29 years	10	7.87 (7.92)	1.06 (1.85)	6.80 (6.70)
30–49 years	10	19.85 (12.43)	3.84 (4.20)	16.01 (9.70)
50–64 years	10	22.60 (11.92)	6.08 (5.82)	16.52 (9.42)
Older than 65 years	10	25.80 (7.52)	4.41 (3.85)	21.37 (7.32)
Total	40	19.03 (11.96)	3.85 (4.41)	15.18 (9.66)

SD: standard deviation, TOT: tip-of-the-tongue.

Table 3. Mean and SD of response types of TOT states in four normal age groups (%)

Group	n	Occupation	Related person	Related event	Similar name	Other retrieval attempts
				Mean (SD)		
20−29 years	10	70.07 (27.50)	3.03 (7.42)	17.17 (28.27)	0.00 (0.00)	9.72 (15.28)
30−49 years	10	63.98 (27.75)	9.06 (12.54)	20.27 (13.33)	0.78 (2.20)	5.90 (11.11)
50−64 years	10	48.21 (23.82)	5.18 (8.31)	26.55 (27.43)	10.38 (12.66)	9.66 (16.09)
Older than 65 years	10	61.33 (26.33)	5.11 (9.37)	13.61 (11.76)	10.68 (12.17)	13.54 (16.57)
Total	40	59.64 (26.20)	5.71 (9.42)	19.79 (20.89)	6.25 (10.43)	9.82 (14.58)

SD: standard deviation, TOT: tip-of-the-tongue.

types, and the number of related event responses was significantly higher than that of similar name and related person responses ($p<0.05$).

Voluntary TOT solution rate in four normal age groups

Since the number of voluntary TOT solution was only 8 out of 289 TOT states in total, statistical analysis was not performed. By incidence in each group, there were 3 TOT solutions in young adults, 1 TOT solution each in middle-aged and older adults and 3 TOT solutions in oldest adults.

The mean percentage of voluntary solutions for the four age groups was 1.62% (SD; 1.06%), suggesting that the probability to voluntarily resolve a TOT state in a given time is quite low in the four age groups.

TOT solution rate after presenting syllabic cue in four normal age groups

At the conclusion of the experiment, there were 5 participants who did not reveal any TOT states; 4 in young adults and 1 in middle-aged adults. Thus, we analyzed the TOT solution rate after presenting syllabic cues in 6 young adults, 9 middle-aged adults and 10 older adults and 10 oldest adults. The TOT solution rate was 81.95% (SD; 21.34%) in young adults, 74.02% (SD; 20.54%) in middle-aged adults, 52.33% (SD; 22.08%) in older adults and 49.06% (SD; 18.27%) in oldest adults, showing the trend that as aging progressed in normal aging, the mean percentage of TOT solution after presenting a syllabic cue decreased.

The Kruskal-Wallis test (nonparametric test) applied to the data indicated statistically significant differences among the four normal age groups (F=4.98, $p<0.05$). To investigate relevant groups showing significant differences in voluntary TOT solution rate, a multiple comparisons test was applied. To control the possibility of type 1 error associated with multiple comparisons, Bonferroni correction was applied and significance level was adjusted at 0.0083. The test results showed that TOT solution rate after presenting syllabic cues in young adults was significantly higher than that observed in oldest adults ($p< 0.0083$).

Comparison between normal oldest age group and MCI group

TOT rate depending on TOT types in two groups

We analyzed TOT rate as depending on TOT types between the normal oldest age group and the MCI group. The mean percentage of the TOT rate in the normal oldest age group is shown in Table 2. The mean percentage of the TOT rate in the MCI group was 5.43% (SD; 6.18%) for partial retrieval failure and 29.34% (SD; 17.20%) for whole retrieval failure. Two-way ANOVA applied to the data indicated that the effect on TOT rate was insignificant between the two groups (F=2.04, $p>0.05$). The effect of TOT type as an intra-group variable was significant (F=40.57, $p<0.05$), but the interaction effect between TOT types and inter-group was insignificant (F=1.17, $p>0.05$). This suggested that the number of whole retrieval failures was significantly higher than that of partial retrieval failures in both groups, but the difference was insignificant between the two groups.

Response types of TOT state in two groups

We analyzed the differences in terms of response types in both groups. The mean percentage of response types in the normal oldest age group is shown in Table 3. The mean percentage of response types in MCI groups was 74.42% (SD; 14.88%) in occupation, 9.12% (SD; 7.98%) in similar name, 8.11% (SD; 9.32%) in related event, 5.52% (SD; 5.50%) in related person and 2.82% (SD; 4.41%) in other retrieval attempts.

Two-way ANOVA applied to the data indicated that the effect between the groups was insignificant (F=0.895, $p>0.05$), but the effect on TOT response of the intra-group variable was significant (F=62.45, $p<0.05$). Further, the interaction effect between each group and TOT response was insignificant (F= 2.67, $p>0.05$). To investigate the differences of response types in more detail, a multiple comparisons test applied to the data indicated that the number of occupation related responses was higher than that of other four responses, and the number of related event responses was significantly higher than that of related person responses ($p<0.05$).

Voluntary TOT solution rate in two groups

The number of voluntary TOT solutions was 3 in the normal oldest age group, but no voluntary TOT solutions were observed in MCI group.

This suggested that the probability to voluntarily resolve the TOT state in a given time seemed to be quite low in the two groups.

TOT solution rate after presenting syllabic cue in two groups

The mean percentage of TOT solution after presenting a syllabic cue (first and/or last syllable) was 49.06% (SD; 18.27%) in the normal oldest age group and 29.07% (SD; 9.92%) in the MCI group, respectively. As a result of performing Student's t-test, such differences were statistically significant between the two groups (t=3.009, p<0.01). That is to say, the TOT solution rate after presenting a syllabic cue in the MCI group was significantly lower than that observed in the normal oldest age group.

DISCUSSION

The present study was designed to examine the differences between the effects of normal aging and pathological aging on TOT as occurs when naming individuals. To this end, we compared TOT rate covering TOT types, rate of TOT response associated with response types, voluntary TOT solution rate and TOT solution rate after presenting syllabic cue among four normal aging and between the normal oldest age group and an MCI group.

Significant differences in TOT rate were observed among the four normal age groups. More specifically, the TOT rates in older and oldest adults were significantly higher than those seen in young adults, which is consistent with previous research[21] that older adults report TOTs more often than young adults with regards to proper nouns. However, the differences in the TOT rate between the normal oldest age group and the MCI group were insignificant, revealing that though TOT rate increases with age, a marked elevation in TOT rate is not seen in the MCI group when compared to the normal oldest age group. In other words, oldest people tend to experience the TOT phenomenon to the same extent as MCI patients.

With regard to TOT types, the number of whole retrieval failures in face naming was significantly higher than that of partial retrieval failure, irrespective of normal aging and pathological aging. When interaction effects were analyzed between normal age groups and TOT types, however, significant differences in older adults were not observed between partial and whole retrieval failures, unlike other age groups.

Based on these results, we may draw the following conclusions: as people reach 50 years or more in age, they face age-related difficulty in the retrieval of phonological knowledge as

shown by TOT rates up to 20% in face naming (Table 2). Older adults showed significant increases in TOT rates, and the increased rate of partial retrieval failure is similar to that of whole retrieval failure. TOT experiences still occur in oldest adulthood, but the number of whole retrieval failures is markedly increased when compared to older adults. In other words, the total number of TOT phenomena is similar between older adults and oldest adults, but the number of whole retrieval failures in oldest adults is significantly higher than that of partial retrieval failures, when compared to the cases in older adults. A similar trend is seen in the MCI group in which whole retrieval failures more frequently occur than partial retrieval failures.

When examining response types of TOT among participants, similar results were observed between the four normal age groups and the MCI group. Among the five TOT response types, a great number of participants in normal age groups and the MCI group cited the occupation of target celebrities, which was closely correlated with the task to give the names of these individuals. In the present study, we self-manufactured the materials for the people naming experiment by selecting celebrities who were actively involved in 3 circles−politics/economics, popular culture and other fields (society, arts, and physical training). As each target word implied semantically, the occupations of chosen individuals were quite conspicuous, and a large number of participants showed an interest in the target's occupation in all groups.

As mentioned above, the tester in this study asked participants in TOT states to explain the characteristics of related famous people in order to analyze their TOT responses. The resulting TOT responses were not different in terms of quality between normal aging and pathological aging. Further, all participants endeavored to recall the names of famous people in the process of explaining them. Despite their efforts to resolve TOT, the voluntary TOT solution rate was extremely low in both the MCI group and the four normal age groups. We reasoned that such results were quite natural in that the TOT phenomenon is closely associated with failure to retrieve phonological information.

'To explain the characteristics of related famous people' was ultimately aimed at promoting the semantic representation of a target word,[22] and participants also showed their own responses by enumerating the semantic concepts of a target word such as occupation and related event. This is another process different from the participants' difficulty in the retrieval of phonological information, and the activated semantic representation was of little help in resolving the retrieval problem of phonological information.

The findings that voluntary TOT solution rate was extremely low support previous research[24] suggesting that recall may

be activated by retrieval cues that help the possible approach toward stored knowledge during the TOT phenomenon. In the present study, we analyzed the retrieval cue effect and concluded that the difference between TOT of normal aging and pathological aging could be explained by the retrieval cue effect. The TOT solution rate after presenting a syllabic cue was significantly low in more aging groups, and the rate in the MCI group was also lower than that observed in oldest adults. In other words, when one grows older, even syllabic cues provided during the TOT phenomenon could not effectively prevent declining retrieval capacity, and such capacity in the MCI group was significantly inferior to that of the normal oldest age group. Such results are in line with previous research[25] suggesting that a sound cue may be used as a barometer representing the degree of cognitive impairment.

The findings reported here could be summarized as follows:

TOT rate increased with normal aging, but TOT solution rate after presenting a syllabic cue decreased. TOT rate associated with pathological aging did not show any difference when compared to normal oldest adults, but TOT solution rate after presenting a syllabic cue was significantly lower, suggesting that TOT solution rate as well as TOT rate should be considered in discerning the early phase of dementia. The results of this study imply that TOT solution rate after presenting a syllabic cue may be a critical predictor in discerning the difference between normal aging and pathological aging. Based on previous research (Delazer et al.[12]) suggesting that AD patients are insensitive to syllabic cues, further research is needed to discern more differences between TOT solution rate of MCI and AD. Further research is also needed to understand both the TOT phenomenon and TOT solution in terms of severity of dementia, and further comparisons regarding these phenomena in normal oldest adults and MCI adults are required to draw conclusions.

The present study has some limitations in terms of methodological approaches. First, the experiment for naming famous people in this study is not standardized, so there is insufficient data for comparison along with restrictions from the viewpoint of reliability and feasibility. Second, as the sample size is relatively small, the findings reported here could not be significantly generalized. Therefore, further research is needed to secure the reliability and feasibility of an experiment task, and a more in-depth study should be conducted after recruiting a sufficient number of participants for each group.

Conflicts of Interest

The authors have no financial conflicts of interest.

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REFERENCES

1. Kim JW. Linguistic features of spontaneous speech production in normal aging and Alzheimer's Disease. *J Korean Gerontol Soc* 2012;32: 747-758.
2. Lee MS, Kim HH. Characteristics of expressive language in normal aging, mild cognitive impairment, and Alzheimer's disease. *Dement Neurocognitive Disord* 2011;10:69-79.
3. Park J, Lee JE, Lee HW. The effect of aging on retrieval of phonological knowledge in Korean: the tip-of the-tongue phenomenon in young and older adults. *Korean J Cognitive Sci* 2013;24:111-132.
4. Resnik K, Bradbury D, Barnes GR, Leff AP. Between thought and expression, a magnetoencephalography study of the "tip-of-the-tongue" phenomenon. *J Cogn Neurosci* 2014;26:2210-2223.
5. Lee KE, Lee HW. The effect of aging on retrieval of orthographic knowledge. *Korean J Cogn Biol Psychol* 2011;23:549-564.
6. MacKay DG, Abrams L. Age-linked declines in retrieving orthographic knowledge: empirical, practical, and theoretical implications. *Psychol Aging* 1998;13:647-662.
7. Ryan EB, See SK, Meneer, WB, Trovato D. Age-based perceptions of conversational skills among younger and older adults. In: Hummert ML, Wiemann JM, Nussbaum JN, editors. *Interpersonal Communication in Older Adulthood*. Thousand Oaks: Sage Publication, 1994;15-39.
8. Miozzo M, Caramazza A. Retrieval of lexical-syntactic features in tip-of-the-tongue states. *J Exp Psychol Learn Mem Cogn* 1997;23:1410-1423.
9. Jones GV, Langford S. Phonological blocking in the tip of the tongue state. *Cognition* 1987;26:115-122.
10. Burke DM, Mackay DG, Worthley JS, Wade E. On the tip of the tongue: what causes word finding failures in young and older adults? *J Mem Lang* 1991;30:542-579.
11. Evrard M. Ageing and lexical access to common and proper names in picture naming. *Brain Lang* 2002;81:174-179.
12. Delazer M, Semenza C, Reiner M, Hofer R, Benke T. Anomia for people names in DAT--evidence for semantic and post-semantic impairments. *Neuropsychologia* 2003;41:1593-1598.
13. Ahmed S, Arnold R, Thompson SA, Graham KS, Hodges JR. Naming of objects, faces and buildings in mild cognitive impairment. *Cortex* 2008; 44:746-752.
14. Semenza C, Zettin M. Evidence from aphasia for the role of proper names as pure referring expressions. *Nature* 1989;342:678-679.
15. Kim MJ. *Famous people naming and identification ability depending on severity in Alzheimer's Disease.* Seoul: Ewha Womans University, 2009. [Unpublished master's thesis]
16. Petersen RC. Mild cognitive impairment as a diagnostic entity. *J Intern Med* 2004;256:183-194.
17. Winblad B, Palmer K, Kivipelto M, Jelic V, Fratiglioni L, Wahlund LO, et al. Mild cognitive impairment--beyond controversies, towards a consensus: report of the International Working Group on Mild Cognitive Impairment. *J Intern Med* 2004;256:240-246.
18. Kang Y, Na DL, Hahn S. A validity study on the Korean Mini-Mental State Examination (K-MMSE) in dementia patients. *J Korean Neurol Assoc* 1997;15:300-308.
19. Christensen KJ, Multhaup KS, Nordstrom S, Voss K. A cognitive battery for dementia: development and measurement characteristics. *Psychol Assess J Consult Clin Psychol* 1991;3:168-174.
20. Jung IK, Kwak DI, Shin DK, Lee MS, Lee HS, Kim JY. A reliability and validity study of Geriatric Depression Scale. *J Korean Neuropsychiatr Assoc* 1997;36:103-112.
21. Kang YW, Na DL. *Seoul neuropsychological screening battery*. Incheon: Human Brain Research & Consulting Co., 2003.
22. Cho NH. *The study of word frequency in modern Korean language*. Seoul: National Institute of Korean Language, 2002.
23. Lee EY, Ha JW. Semantic representation in children with specific lan-

guage impairment. *Commun Sci Disord* 2015 (in press).

24. Reed SK. *Cognition: theories and applications.* Belmont, CA: Cengage Learning, 2012.

25. Kim HJ. *A Comparison on the performances of confrontation naming and naming by verbal definition in patients with Alzheimer's disease.* Cheonan: Korea Nazarene University, 2012. [Unpublished master's thesis]