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Effect of Task Complexity on Cognitive-Linguistic Processing in Elderly

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Abstract

The cognitive linguistic abilities is vulnerable to change with age. Many tasks based on different underlying theoretical principles have been used to assess the cognitive linguistic tasks. Task complexity tends to play a major role in determining the difference between the two age groups (if any). The current study used to tasks with different complexity levels to assess the cognitive-linguistic abilities in young and older adults. A total of 60 participants in the age range of 20-30 years and 55-65 years were considered for the study. The two groups were expected to represent the younger and older groups respectively. The list generation and delayed recall tasks were used to unveil the cognitive-linguistic abilities and he results showed that the two tasks revealed different results. The delayed recall task showed a mere distinction between the two groups showing that the task complexity is salient in determining the effect of age in cognitive linguistic processing.

Keywords: *Task complexity, processing distinction, senility, senescence.*

Background

Aging in simple terms is defined as the process of getting old or older. With advancement in medical technology, the mortality has increased. With increasing age progressive deterioration of physiological function, loss of viability and increase in vulnerability is expected. [1]. Elderly adults are at greater risk of neurologic disease than young people. The diagnosis of disease in elderly is often complicated because of the alterations in brain structure and function that may occur normally. Understanding the course of normal brain development during aging provides the foundation for the identification of pathologic brain development and decline. Advanced aging is often associated with changes in brain morphology and structure. [2] Post-mortem examinations of brain tissue have revealed a varied array of age-related changes in the brain. Raz et al. [2] examined patterns of change in brain structure with aging in 148 normal adults (48-77 years) using Magnetic Resonance Imaging (MRI). The prominent changes were reported in the Pre-Frontal Cortex (PFC) at a rate of 4.9% per decade. Shrinkage in the area of PFC is also reported which mediates the increase in perseveratory errors in older adults [3].

Theories of ageing explains decline in the performance across age in a variety of tasks, either with respect to a deficit in the core cognitive function, or according to deficits in small set of cognitive functions like processing speed, [4] inhibition, [5] working memory capacity, [6] and attention. [7] It is well known that ageing interacts with memory performance and among the memory processes recall is affected the most. The age-related decline can hamper the performance on various tasks and it can also alter the time consumption. With practice the performance is known to improve. The other hypothesis put forth in this direction is that the older adults develop problems in operating the inhibitory mechanisms

Cognition is considered one of the domains affected

by aging. This cognitive decline is marked by significant changes in the morphology of neurons.[8] Many studies have showed neuronal loss in the regions of cortex and hippocampus as a consequence of normal aging [8] [9]. They suggest that the age-related impairments that occur during normal aging are due to distinct processes. Most of the cognitive processes are known to deteriorate with aging and more difficulty is manifested with growing complexity. This reflects the general decline which can be attributed to aging again. The processing capacity is also assumed to come down with age so is the speed of processing.

Few major processes are affected as a consequence of aging. The processes include, attention, working memory comprehension, the ability in deducting inferences, the ability in encoding information and also the ability in retrieving things. Few other substrates may show resistance to aging. These substrates include the ability to recognize things, pictures etc, implicit memory and also the ability to remember things saved on the long-term memory. [10]

Linguistic tasks or activities with a strong overlaid of cognitive functions are called cognitive linguistic functions. These cognitive linguistic domains are also compromised as a consequence of aging. The use of language is highly dependent on the cognitive processes. Of the different cognitive processes regulating language, memory plays a prime role. It plays instrumental role in both language comprehension as well as production. The memory store may shrink with age but the memory essential for performance on a single word task such as word association or confrontation naming would often stay intact. However, the speed of retrieval is found to be compromised as the other tasks. The older adults can have problems in retention of information presented at sentence level.

Positive agerelated changes pertaining to cognitive linguistic abilities are also stated. Vocabulary advancement is one of the most common advantages. This opinion is made by considering the size of the vocabulary which is assumed to be more in adults. Some researchers view this phenomenon as a negative one as they strongly believe that this problems would lead to word finding difficulty and naming difficulty such as the tip of tongue phenomenon where the person may know the word but is not able to retrieve as that juncture. Thus language and cognition share a strong bondage.[11]

Clinical assessment of aged individuals has been a challenging task over years. It is challenging owing to factors like sensory impairments, decreased stamina, unavailability of norms etc. A variety of neuro psychological assessment protocols are designed exclusively for the aged individuals. The neuro psychological protocols follow both formal and informal assessment procedures. Neuro psychological assessment targets various cognitive, intellectual and cognitive linguistic domains. Recall and list generation are two commonly used tasks for tapping the cognitive linguistic domain on a neuro-psychological assessment.

Recall is a task used to assess memory. Memory is a cognitive domain vulnerable to decline. These changes in cognitive functions impinge on the linguistic abilities leading to word retrieval difficulties [12] and also in the ability to carry out discourse processes that are complex. Hence the manifestation becomes cognitive linguistic. Recall practically means remembering and recollecting a list of names immediately after the stimulus presentation (immediate recall) or after a lapse of time (delayed recall). Recall further has two variants: serial order recall which involves recalling a list of items in the same order of presentation and free recall which involves recalling the items regardless of the order of presentation. Cheung [13] indicated that with aging the recitation rate slows down and hence will have difficulty in rehearsing leading to poor recall. Certain authors like Broadbent [14] argued that this is because of the limitation in the capacity to hold information and others like Cowan [15] hypothesized that it could be due to difficulties in the process of chunking information. He also stated that older adults make weaker item-to-item associations compared to younger individuals and this in turn leaves the elderly at a disadvantage in being able to use these associations in forming multiple chunks in serial order recall. Further, delayed serial order recall is more commonly used in neurological assessment as it imposed more constraint on the cognitive linguistic domain.

List generation or generative naming is another the other commonly used task in neuro psychological assessment of aging, it involves listing of a list of lexical items belonging to a particular lexical category. The choice of the lexical category lies with the investigator. The investigator may either choose a lexical category like ‘animals’ which has both frequent and infrequent exemplars or a lexical category like ‘fruits’ which has more infrequent exemplars compared to frequent examples. List generation imposes demand on the memory and as the person is constrained to name lexical items pertaining to one

lexical category, it imposes load on the linguistic system concerning word retrieval. The delayed variant of recall and list generation are viewed as equivalents in tapping cognitive linguistic domains and are parts of neuro psychological test batteries. Very less studies have compared the efficacy of these tools. In regard to time economy, list generation task is considered to be superior over recall and as far as comprehensiveness is concerned, recall is considered superior compared to list generation. The present study aims at comparing list generation and recall abilities in older and younger neurotypical individuals. Few neuropsychological test batteries adapt list generation task as a part of cognitive assessment. While few other test batteries employ delayed recall. The two tasks are assumed to impose load on memory and word retrieval. The present study attempts to compare these two measures in young and older neurologically healthy individuals to verify if both these measures and one of these measures vary among the aged or in other words which task would reflect cognitive linguistic decline in aging.wherein the study aims to compare two tasks assessing Cognitive linguistic abilities in younger and older individuals.This study has following objective to measure firstly, to study the performance on list generation task across younger and older individual groups secondly to study the performance on serial recall task across younger and older individual groups.

Method

The present study included two groups of subjects, based on the age. The first group of individuals comprised of 30 male adults in the age of 20-30 years while the second group comprised of 30 male adults in the age range of 55-65 years. All the participants were native speakers of Kannada from Mysuru district of Karnataka state. Participants selected for the study were screened from any speech, language, neurological deficits and hearing problem. These participants had completed a minimum of 10 years of formal education.

The participants were assessed across two tasks namely, list generation and delayed serial recall task. In the list generation task, each participant was asked to list down the members of respective category verbally in a stipulated duration of 2 minutes. Animals, fruits and common objects were the lexical categories used for this task.

Consecutively, for the delayed serial recall task, 8 items of each lexical category namely; animals, fruits and common objects were prepared for presentation in audio mode. 10 stimuli sets were prepared in this manner. All the 10 sets were validated for equal word length and complexity by three experienced native Kannada speaking speech language pathologists.

In list generation task subjects were asked to name the lexical items related to animals, fruits and common objects. The numbers of items listed were noted. The scores on list generation were converted into percentage by employing reference values obtained for these lexical categories in an earlier study by Abhishek and Prema. [16]

In the delayed recall task, the stimulus was presented in auditory mode. The stimuli comprised of a string of 8 items. The inter-stimulus duration between the items was kept as 500 milliseconds. The participants were asked to listen to these items and recall them after a duration of 2 minutes (indicated by a buzzer tone). 10 such stimuli sets were presented. The participants were asked to adhere to the order as the task was delayed serial order recall task. Each correct response was given a score of 1 hence the maximum score was 80 (8*10). Since the unit of measurements were different for the two tasks, the scores were converted into percentage.

Results

The scores of each individual participant were computed for both list generation and serial delayed recall task and for group 1(20-30 years) and group 2 (55- 65 years). Further the mean percentage values of all 30 participants each in group 1 and 2 on list generation task and delayed serial tasks were computed. Subsequently, appropriate statistical measures were applied to verify for any significant differences across group and across the two tasks administered in the study.

The mean percentages scores for list generation task and delayed serial tasks across two groups are as shown in the figure 1 below.

From the above (figure 1), it can be noted that the group 1 had mean percentage score of 92% and 86% respectively for list generation.

Further in order to verify if there was any significant difference between the two groups, appropriate statistical measures were applied after verifying the data for properties of skewness. Since the data abided properties of normal distribution paired sample t- test was applied. The t values for list generation and delayed serial recall are as shown in the Table 1 below.

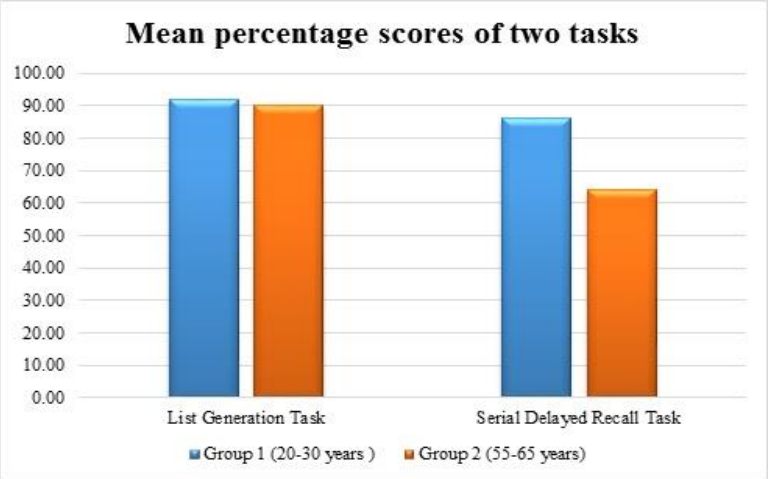

***Fig 1**:* Mean percentage scores of list generation and serial delayed recall tasks across group 1 and group 2.

***Table 1:** Results of paired sample t test comparison of list generation and delayed serial recall tasks across group 1 and group 2.*

Tasks	Mean difference	p value
List generation	-5.77	0.075
Serial delayed recall	-3.22	0.00*

Note: *p < 0.05

As noted from the above Table 1, the t values for list generation and delayed serial recall group 1 versus group 2 were -5.77 and -3.22 respectively. The corresponding p values showed significant difference between the two groups for the delayed serial recall task and on contrary, the p values were non-significant for list generation task. Hence, the performance of older individuals on list generation was in par with younger individuals. The list generation task did not demarcate between the younger and older individuals in terms of performance. Significant demarcation in performance was evident in serial delayed recall task, where, the younger individuals performed better compared to elderly.

Further in order to verify if the tasks varied significantly within each group, Wilcoxon's signed test was used as the data did not abide the properties of normal distribution. The results of within group comparison are as tabulated in Table 2 below.

***Table 2:** Results of Wilcoxon's Signed Rank Test (Within group comparison across the two tasks.*

List generation versus delayed serial task	*|Z|*	*p value*
Group 1	1.16	0.087
Group 2	3.68	0.014*

Note: *p < 0.05

From Table 2, the Z scores for group 1 and group 2 were 1.16 and 3.68. The corresponding p values showed significant difference for group 2 alone. This suggested that in elderly, the performance across the tasks varied, wherein they performed better in list generation when compared to delayed serial recall task. Whereas, the younger group performed equally well in both the tasks. In gist, the results of the study revealed significant difference on serial delayed recall task across group 1 and 2, where the elderly performed poorer compared to younger participants. And further on comparing within group differences on task performance, significant deviancy was noted only in group 2, wherein the elderly performed poorer in delayed serial recall task.

Discussion

The study aimed to compare list generation and serial delayed recall tasks that assess cognitive linguistic abilities in younger and older individuals**.** Both the younger group (Group 1) and older group (Group 2) were examined for list generation and serial delayed recall tasks. The results of the study were analyzed based on two objectives. The first objective of the study was to compare the performance in list generation task and the second objective was to compare the performance of the same two groups on serial delayed recall task. The results suggested that there was no significant difference in list generation

task for both younger and older individuals. However, there was significant difference noted on serial delayed recall task wherein, the older adults performed poorer to younger aged adults and the difference was significant statistically. This suggests that the delayed serial order recall task was sensitive in identifying cognitive linguistic decline in aged individuals.

The younger group performed equally well in both the tasks, but the elderly performed poorer on serial delayed task. Thus, it can be inferred that the older individuals exhibited difficulty on the delayed serial order recall compared to list generation task. This could be attributed to decline in few cognitive processing abilities with aging. As stated earlier in addition to the physical changes, ageing also leads to alterations in the ability of an individual in processing, understanding and using language. There is deterioration in cognitive processes like attention, memory has been reported with increasing age [17]. One major process affected of these is memory and among the memory processes the most affected is recall. This is in consensus with study by Miller [18], who reported that older adults had poorer recall abilities when compared to younger adults. Yet another major factor contributing to poor delayed serial recall in elderly could be deterioration in episodic memory. Nilsson [19] reported that episodic memory which involves recall is primarily affected in normal aging processes. Another factor affecting serial delayed recall abilities could be slowing down in processing capacity.

The processing capacity would also reduce with age. According to Park [10], as a consequence of aging, the ability to retrieve the chunks of information would also reduce owing to which the recall would have been poorer on serial delayed recall task. Serial recall by the virtue of task complexity is assumed to be more complex compared to a free recall task regardless of the age of the participants. Poorer performance can also attribute to poor attention span often seen in the elderly population. Attention has a prime role to play in the encoding phase. The information for recall has to be encoded with preciseness and the order should also be preserved for a task like serial order recall,[20] as a result of poor attention in general or poor encoding in specific the performance on serial recall task would have been poorer. Also, in serial recall tasks active maintenance and monitoring of previous responses are also important, which is difficult as age increases, whereas in in free recall tasks or list generation task "on-line" storage and manipulation of the available information is required and is comparatively easier. Similar findings were obtained by Craik, Morris and Gick [21]. Thus the study reflected double dissociation i.e. aging imposed constraint on serial order recall and not list generation task.

Further, both the groups performed equally well in list generation task which can be attributed to ease of task in generating the words, since to there is no fixed set to recall. Individuals generate the most frequently used words and hence these words require less threshold of activation and are thus retrieved better and faster.

Conclusion

The study aimed at comparing the performance of younger and older individuals on list generation and serial order recall. On comparing the two groups, statistically significant difference was seen for delayed serial order recall task only. Owing to all the above discussed factors, serial delayed recall is known is encompass processing speed, processing capacity, episodic memory ability, attention and monitoring and manipulation of available information. All these entail to basic component of cognitive linguistic processing. Hence, assessing serial delayed recall task is very well sensitive to cognitive linguistic decline and can thus be adapted in cognitive linguistic assessments.

References

1. Hayflick, L. (1994). All you ever wanted to know about aging but were afraid to ask: How and why we age.
2. Raz, N., Gunning, F. M., Head, D., Dupuis, J. H., McQuain, J., Briggs, S. D., ... & Acker, J. D. (1997). Selective aging of the human cerebral cortex observed in vivo: differential vulnerability of the prefrontal gray matter. *Cerebral cortex (New York, NY: 1991)*, *7*(3), 268-282.
3. Raz, N., Gunning-Dixon, F. M., Head, D., Dupuis, J. H., & Acker, J. D. (1998). Neuroanatomical correlates of cognitive aging: evidence from structural magnetic resonance imaging. *Neuropsychology*, *12*(1), 95.
4. Salthouse, T. A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological review*, *103*(3), 403.
5. Zacks, R. T., & Hasher, L. (1988). Capacity theory and the processing of inferences. *Language, memory, and aging*, 154-170.
6. Craik, F. I., Morris, R. G., & Gick, M. L. (1990). 10. Adult age differences in working

memory. *Neuropsychological impairments of short-term memory*, *247*.

7. West, R., & Bell, M. A. (1997). Stroop color—word interference and electroencephalogram activation: Evidence for age-related decline of the anterior attention system. *Neuropsychology*, *11*(3), 421.
8. Morrison, J. H., & Hof, P. R. (2002). Selective vulnerability of corticocortical and hippocampal circuits in aging and Alzheimer's disease. *Progress in brain research*, *136*, 467-486.
9. West, M. J., Kawas, C. H., Stewart, W. F., Rudow, G. L., & Troncoso, J. C. (2004). Hippocampal neurons in pre-clinical Alzheimer's disease. *Neurobiology of aging*, *25*(9), 1205-1212.
10. Park, D. C. (1992). Applied cognitive aging research.
11. Connor, S., Bosonnet, L., Ghaneh, P., Alexakis, N., Hartley, M., Campbell, F., ... & Neoptolemos, J. P. (2004). Survival of patients with periampullary carcinoma is predicted by lymph node 8a but not by lymph node 16b1 status. *Journal of British Surgery*, *91*(12), 1592-1599.
12. Kemper, S. (1992). Adults' sentence fragments: Who, what, when, where, and why. *Communication Research*, *19*(4), 444-458.
13. Light, L. L., Patterson, M. M., Chung, C., & Healy, M. R. (2004). Effects of repetition and response deadline on associative recognition in young and older adults. *Memory & cognition*, *32*(7), 1182-1193.
14. Broadbent, D. E. (2013). *Perception and communication*. Elsevier.
15. Cowan, N. (2001). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral and brain sciences*, *24*(1), 87-114.
16. Abhishiek& Prema. (2012). Development of norms for generative naming task in India. *Indian journal of Linguistic*. Vol 31, 2012-13.
17. Cerella, J. (1985). Information processing rates in the elderly. *Psychological bulletin*, *98*(1), 67.
18. Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological review*, *63*(2), 81.
19. Nilsson, L. G. (2003). Memory function in normal aging. *Acta Neurologica Scandinavica*, *107*, 7-13.
20. Craik, F. I., Naveh-Benjamin, M., Ishaik, G., & Anderson, N. D. (2000). Divided attention during encoding and retrieval: differential control effects?. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(6), 1744.
21. Craik, F. I., Morris, R. G., & Gick, M. L. (1990). 10. Adult age differences in working memory. *Neuropsychological impairments of short-term memory*, *247*.