Development and Adaptation of Cognitive Linguistic Assessment Protocol in Tamil (T-CLAP)

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ABSTRACT

The present study aimed at adapting the Cognitive linguistic assessment protocol for Adults (CLAP) in Kannada by Kamath, 2001 to Tamil speaking population. Normal adults and elder persons (40 males and 40 females) in the age range of 24-75+ years were considered as the participants. Content validation was done with the help of five Speech language pathologist (SLPs) and one Tamil teacher also pilot study was carried out and final T-CLAP was formed which was administered on eight participants across the four domains which includes, Attention, Perception and Discrimination, Memory, Reasoning and Problem solving and Organization. Statistical analysis was carried out using SPSS software (version 25) to find significant difference in all four domains as age increases to check for the effect of age, gender and age*gender interactions. Result revealed that as age increases a general trend of declined cognitive performance was noted across the various test items in each domain. On comparing male and female participant performance across the age group, predominantly male participants performed better than female participants however no significant difference seen. Overall Domain IV (Organization) was observed to be more sensitive to detect cognitive decline whereas domain I (Attention, perception and discrimination) was least sensitive.

Keywords: CLAP, Domain, Aging, Gender, protocol.

INTRODUCTION

Language is the expression of human communication through which knowledge, belief and behavior can be experienced, explained and shared. Cognition refers to a set of mental abilities and processes which are related to knowledge and production of language. Cognitive linguistics serve as an approach to study language as a mental phenomenon and focus on receiving and processing of linguistic information and the associated cognitive mechanism that possess with language. [1]

The various cognitive processes includes memory, organization of knowledge, language, reasoning, problem solving, classification, concepts and categorization however attention, perception, discrimination, memory, reasoning, problem solving, and organization were taken up as the core cognitive abilities supporting the language. [2]

Attention. Among attention types, sustained and selective attentions are exclusively linked with aging. Sustained attention capacity was examined for younger (21-29 years) and older adults (65-78 years) and result reveals that sustained attention reflects temporal changes in sensitivity and it operates similar both in young and older adults. [3] However selective attention is compromised in older adults due to impaired inhibitory control [4]

and due to the modulation of auditory cortex. [5] Results from the longitudinal study revealed that the perceived discrimination is associated with poor physical and psychological health leading to poor cognitive functioning [6]

Memory allows us to code, store, and recover information from the past. Episodic, working and semantic memories are associated with aging process. Episodic word memory benefit was studied by in older adults (mean age of 25) and younger adults (mean age 72) and the results concluded that younger and older adults showed similar level of memory performance for word list study context whereas in sentence study context, older adults elicited superior performance due to greater experience with sentence processing. [7] Storing general knowledge about the world (Semantic memory) has been reported to have no significant impairments due to aging, although access to information may be somewhat slower (particularly for words and names), the organization of the knowledge system seems unchanged with age [8]

The speed of processing might be a reason for age-related deficits in working memory and decline in other cognitive tasks can be explained in terms of a general slowing of information processing. [9] Long-term memory for older adults have shown to present deficits occurring at three distinct stages namely encoding, retention and retrieval of information.

The older subjects universally perform poorer on problem solving tasks than the younger subjects and the decline is a linear function with respect to age. [10] Elderly people were examined in a free sorting paradigm and the result reveals that they were less likely to use taxonomic organization as criteria for grouping when compared to younger people [11] and the decline start appearing after 60 years of age [12] Word finding difficulties and tip of tongue experiences (TOTs) are most severe cognitive problems which are affected by aging. [13]

There is a growing appreciation that everyone does not age in the same way or at the same rate. Many of these changes that occur result from a gradual loss which may often begin in early adulthood. American Speech and Hearing Association [14] defined the role of Speech-Language Pathologist in the evaluation and management of individuals with communication disorders associated with cognitive impairments which may occur due to acquired etiologies, non-degenerative and degenerative neurologic disorders. As there are interactions among various cognitive domains and cognitive processes are susceptible to aging in individuals, a cognitive assessment protocol which account for this variability is very essential.

The cognitive linguistic tool can be used as an assessment tool for identifying cognitive deficits in person with cognitive communication disorders and this tool would also help in planning intervention programs for person with cognitive communication disorders. There are several tools which assess the cognitive linguistic abilities. Some of the screening tools include Mini Mental Status Examination (MMSE) [15] Addenbrookes Cognitive examination revised (ACE-R); [16] and Montreal Cognitive Assessment (MoCA). [17] Cognitive linguistic tools includes measures of Cognitive-Linguistic Abilities (MCLA); [18] Ross Information Processing Assessment (RIPA-2) [19]

In Indian context, very few studies have explored the cognitive linguistic abilities both in adults and elderly population. Cognitive-Linguistic Assessment Protocol for Adults (CLAP) was developed in Kannada on normal young elderly subjects in the age range of 40-70 years [20] Later it has been adapted in Malayalam, [21] Telugu [22] and in Hindi. [23] Recently Manipal University have done a research for developing Manipal Manual for Cognitive Linguistic Abilities [24]

Thus it is evident that most of the test tools available to differentiate individuals with cognitive linguistic

disorders and normal aging are available in English and are standardized in western population. Especially in South India, there are no available tools to assess cognitive communication abilities in Tamil speaking population. Therefore there is a need of an indigenous tool to assess cognitive linguistic abilities in Tamil speaking adult population across different age, gender and across various cognitive linguistic aspects. Keeping this in mind the present study is attempted to fulfill the need of an indigenous tool to assess cognitive linguistic abilities in Tamil speaking adult population by adapting CLAP in Kannada to Tamil language.

MATERIALS AND METHODS
The study was carried out in 3 phases which is depicted in the table 3.1

Table 3.1 The Different Phase of Procedure

S.No	Phases	Procedure
1	Phase I	Development of T-CLAP Step 1: Adaptation Step 2: Content validation
2	Phase II	Pilot study
3	Phase III	Administration and checking reliability of T-CLAP

Phase I- Development of T-CLAP
Phase I was carried out in a two-step procedure. Step1 involves adaptation of CLAP-K in Tamil language by reviewing the literature in Tamil from books, journals and web-based sources. After adaptation suitable modifications were carried out in certain aspects such as in domain I including word cancellation and word pair discrimination. In domain II, digit backward, super ordinate naming, word naming fluency and generative naming. Sentence disambiguation, predicting outcome and predicting cause in domain III and in domain IV categorization, analogies and sequencing events respectively.

Step 2 involves content validation by five experienced Speech Language Pathologist (SLP) and one Tamil teacher. They were asked to rate the material on "Feedback Questionnaire for Aphasia Treatment Manuals" [25] which included 17 parameters which were rated from very poor

to excellent for each of the test item in the four domains. Suggestions and modifications provided by the judges were carefully considered and required changes were incorporated to prepare the final T-CLAP protocol. Table 3.2 depicts the task and scoring for each domains.

Table 3.2 Task under each domain and their scorings

Domain	Test Item	Maximum score
I. Attention, Perception and Discrimination		
Visual	Letter Cancellation	10
	Contingent Letter Cancellation	10
	Word Cancellation	10
	Sound count	10
Auditory	Letter-Pair discrimination	5
	Word –Pair discrimination	5
	Months-backwards naming	10
II. Memory		
Episodic Memory	Orientation and recent memory questions	10
Working Memory	Digit Forward	5
	Digit backward	5
Semantic Memory	Co-ordinate naming	5
	Super ordinate naming	5
	Word-naming fluency	5
	Generative naming	5
	Sentence repetition	10
	Carry out commands	10
III. Reasoning &Problem Solving		
	Sentence disambiguation	10
	Sentence formulation	5
	Predicting outcome	10
	Compare and contrast	10
	Predicting cause	10
	Why Questions	5
	Sequential Analysis	10
IV. Organization		
	Categorization	10
	Analogies	10
	Sequencing events	40

Phase II-Pilot study
The final T-CLAP was piloted on eight participants, two in each group. The content validation and pilot study resulted in modification to the prototype test battery. These modifications were in the form of changing the sentence formulation, modifying the items in the task, changing correct response criterion. This resulted in the formulation of final test protocol, T-CLAP (Appendix).

Phase III- Administration of T-CLAP
The final T-CLAP prepared was administered on a total of 80 participants, 40 males and 40 females above the age of 24 years were included in the study. The

participants were classified according to 'Development through life Classification' by Newmann and Newmann (1974). Table 3.3 depicts the information on distribution of participants into various groups based on the age range distribution.

Table 3.3 Age Range Distributed into four Groups

Group	Age Range	Newmann's Classification	Number of Males	Number of Females
1	24-34 years	Early Adulthood	10	10
2	34-60 years	Middle Adulthood	10	10
3	60-75 years	Later Adulthood	10	10
4	75+ years	Very old age	10	10

The participants were selected adhering to the appropriate ethical procedures. Participants were selected from the residential areas and old age homes in the city of Chennai, Tamilnadu.

Inclusion and Exclusion Criteria

The participants selected were native speakers of Tamil with minimum of primary schooling, no obvious or known history of neurological and/or psychological disorders, scoring greater than or equal to 25 points on the Mini Mental State Examination-MMSE (Folstein, Folstein & McHugh, 1975). Participants with h/o drug/alcohol abuse, hearing/ visual /communication problems and physically unfit during the test period were excluded from the study.

Procedure

The aim of the study, procedure and duration of testing were explained to the participants. Prior written consent was taken from the participants for the participation in the study. All the participants were tested in a quiet, noise free environment at home or clinical setting. The stimuli were presented in auditory/visual mode according to the need of test items in all 4 domains. Scores were tabulated for each test item in all domains.

Statistical Methods

The raw score obtained from each individual was subjected to descriptive and inferential statistical analysis which includes Mean and Standard Deviation (SD), One Way ANOVA, MANOVA and Independent T test to find out the significant differences across the age groups and genders if any using Statistical Package for the Social Science (SPSS) version 25.00.

RESULT

The study aimed on developing a test tool to assess the cognitive linguistic abilities in Tamil speaking adults by adapting the Cognitive Linguistic Assessment Protocol (CLAP- Kannada) into Tamil language and the findings of the study have been presented in the following order:

1. T-CLAP (Cognitive Linguistic Assessment Protocol in Tamil) scores across four domains.
2. Performance of males and females for all the task of four domains across the four age groups.

T- CLAP Scores across Domains

The mean and Standard Deviation (SD) values obtained from 80 participants (40 males & 40 females) for all domains and task were tabulated in table 4.1. Results revealed higher mean scores of 54.95 for domain I (Attention, perception and discrimination) and least mean scores of 46.81 obtained for the domain IV (Organization). Participants obtained mean score of 54.41 and 53.85 for domain III (Reasoning and problem solving) and domain II (Memory) respectively.

Table 4.1 Overall Mean and SD for each domain and subtest

Domain	Task	Mean	Std. Deviation
Domain I Visual	Letter Cancellation	9.32	0.97
	Contingent Letter cancellation	9.31	1.05
	Word Cancellation	9.66	0.77
	Visual_D1	**28.30**	**2.38**
Auditory	Sound Count	8.79	1.32
	Letter Pair discrimination	4.49	0.96
	Word Pair discrimination	4.63	0.62
	Month Backward Naming	8.75	2.23
	Auditory_D1	**26.65**	**2.89**
Total Domain 1		**54.95**	**4.77**
Domain II Episodic	Orientation and recent memory questions **Episodic_D2**	9.14	1.11
Working	Digit Forward	3.61	1.27
	Digit Backward	2.61	1.20
	Working_D2	**6.22**	**2.23**
Semantics	Coordinate Naming	4.35	0.98
	Superordinate Naming	4.64	0.68
	Word naming fluency	4.60	0.94
	Generative Naming	4.93	0.34
	Sentence Repetition	10.00	0.00
	Carry out Commands	9.98	0.22
	Semantic_D2	**38.49**	**2.11**
Total Domain 2		**53.85**	**4.35**
Domain III	Sentence disambiguation	7.68	2.11
	Sentence Formulation	3.91	1.38
	Predicting outcome	9.74	0.86
	Compare and Contrast	9.05	1.59
	Predicting Cause	9.59	0.97
	Why Questions	4.93	0.26
	Sequential Analysis	9.52	1.09
Total Domain 3		**54.41**	**5.74**
Domain IV	Categorization	8.90	1.51
	Analogies	8.61	1.68
	Sequencing Events	29.30	11.05
Total Domain 4		**46.81**	**12.68**

Performance of males and females for all the task of four domains across the four age groups.

Domain I (Attention, perception and discrimination)
Mean and SD was calculated for the two modalities namely visual and auditory in domain I and tabulated in table 4.2 to show the performance of males and females across all the task for four age groups.

Visual mode:
The findings obtained for domain I (Visual mode) reveals that as the age increases the mean scores showed a decline for all the task particularly greater reduction was observed for contingent letter cancellation task especially from group 3 (Above the age of 60 years). These findings have been supported by previous literature in CLAP test tool in Hindi (CLAP-H) and Malayalam (C*LAP-M), and Telugu (CLAP-T) where contingent letter cancellation had obtained poorer scores when compared to letter cancellation and word cancellation tasks. Letter and word cancellation was scored higher attributing to the requirement of selective attention which was reported to be least affected due to aging [21-23] Overall male participants scored better mean scores than females for the entire task in domain I which was in accordance findings with CLAP in Malayalam (CLAP-M) unlike in CLAP Hindi (CLAP-H) females performed better than males.

Table 4.2 Mean and SD for domain I (Both visual and auditory mode).

Domain	Task	Age	Males		Females	
			Mean	**SD**	**Mean**	**SD**
Domain 1 Visual	Letter Cancellation	1	9.90	0.31	9.60	0.51
		2	9.70	0.48	9.10	0.99
		3	9.40	0.84	9.00	0.94
		4	9.60	0.69	8.30	1.63
		Total	**9.65**	**0.62**	**9.00**	**1.15**
	Contingent Letter cancellation	1	10.00	0.00	9.50	0.70
		2	9.80	0.42	9.70	0.48
		3	8.40	0.96	9.50	0.97
		4	9.20	1.13	8.40	1.64
		Total	**9.35**	**0.97**	**9.27**	**1.13**
	Word Cancellation	1	10.00	0.00	9.90	0.31
		2	10.00	0.00	9.60	0.69
		3	9.60	0.69	9.70	0.67
		4	9.60	0.51	8.90	1.59
		Total	**9.80**	**0.46**	**9.53**	**0.98**
Auditory	Sound Count	1	9.90	.316	9.10	0.99
		2	8.90	1.524	9.10	0.99
		3	8.30	1.059	7.80	1.93
		4	8.80	1.476	8.40	0.96
		Total	**8.97**	**1.291**	**8.60**	**1.35**
	Letter Pair discrimination	1	4.70	.483	4.10	1.44
		2	5.00	.000	4.70	0.67
		3	4.10	1.370	4.00	1.05
		4	4.10	.738	4.20	0.63
		Total	**4.47**	**0.87**	**4.50**	**1.06**
	Word Pair discrimination	1	4.60	0.51	4.70	0.48
		2	5.00	0.00	4.80	0.42
		3	4.70	0.67	4.50	0.70
		4	4.30	.949	4.40	0.69
		Total	**4.65**	**0.66**	**4.60**	**0.59**
	Month Backward Naming	1	9.30	1.56	9.00	1.88
		2	9.70	0.48	9.30	0.82
		3	8.60	2.71	9.80	0.42
		4	7.30	3.43	7.00	2.98
		Total	**8.73**	**2.42**	**8.77**	**2.05**

Auditory mode

The finding obtained for domain I (auditory mode) reveals that as age advances only slight variations in mean scores was observed. However in sound count and month backward naming tasks mean scores were observed to have a steep decline as age progresses when compared to other task which is in accordance with previous literature findings in CLAP-H. [23] Overall when comparing the performance between male and female participants, males performed better than females except in month backward naming.

Significance value for effect of Age, Gender and Age* Gender

F value and p value was obtained for each task under Domain I (Attention, perception and discrimination) to see for the effect of age, gender, age* gender interaction and have been tabulated in table 4.3

Table 4.3 Significance value for effect of age, gender and age*gender interaction

Domain	Task	Age		Gender		Age* gender	
		F value	p value	F value	p value	F value	p value
I Visual	Letter Cancellation	2.87	**.04**	10.63	**0.00**	1.28	0.28
	Contingent Letter Cancellation	6.10	**.00**	0.13	0.71	4.10	**0.01**
	Word Cancellation	3.33	**.02**	2.78	0.09	1.12	0.34
Audition	Sound count	4.88	**0.00**	1.81	0.18	0.56	0.63
	Letter-Pair discrimination	4.81	**0.00**	0.01	0.90	0.53	0.66
	Word-Pair discrimination	2.69	**0.05**	0.13	0.71	0.39	0.75
	Months-backwards naming	5.28	**0.00**	0.01	0.91	0.67	0.57

Visual mode:

Significant value for effect of age was noticed in the entire task under visual mode which highlights the findings that as age increases performance in the task starts declining significantly. Statistical significant

value for effect of gender was observed only in letter cancellation, whereas in all other task males and females performed almost equal. Effect of age* gender interaction reveals significant difference only in contingent letter cancellation as it require selective attention. The present findings support the previous literature findings (CLAP-M and CLAP-T) where they obtained significant difference for effect of age whereas contradicted findings were noted in CLAP-H where significant difference was obtained only for word cancellation task

Auditory mode:
In auditory mode, significant value for effect of age was noticed in the entire task under auditory mode which indicates that as age increases performance in the task starts to decline. These findings also support the previous literature findings in CLAP-M and CLAP-T whereas in CLAP-H significant value was seen only for sound count task. Effect of gender and effect of age* gender reveals no significant value for entire tasks which is also in accordance with previous literature i.e., CLAP-H, CLAP-M and CLAP-T.

Table 4.4 Mean and SD for episodic, working and semantic memory

Domain	Task	Age	Males Mean	SD	Females Mean	SD
Domain II Episodic	Orientation and recent memory questions	1	9.80	0.42	8.90	1.85
		2	9.70	0.48	9.40	0.69
		3	9.30	0.94	8.60	0.96
		4	9.20	1.13	8.20	1.03
		Total	**9.50**	**0.81**	**8.77**	**1.25**
Working	Digit Forward	1	4.30	0.67	4.40	1.95
		2	4.20	1.13	3.90	0.87
		3	3.90	0.99	2.80	1.13
		4	2.80	0.91	2.60	0.69
		Total	**3.80**	**1.09**	**3.43**	**1.43**
	Digit Backward	1	3.10	1.10	3.50	1.50
		2	3.30	1.33	3.00	1.05
		3	2.50	0.52	2.00	0.66
		4	2.20	0.78	1.30	0.82
		Total	**2.78**	**1.05**	**2.45**	**1.33**
Semantic	Coordinate Naming	1	4.80	0.63	4.80	0.42
		2	4.80	0.63	5.00	0.00
		3	4.10	0.99	4.30	1.16
		4	3.70	1.05	3.30	1.05
		Total	**4.35**	**0.94**	**4.35**	**1.02**
	Superordinate Naming	1	4.90	0.31	4.90	0.31
		2	4.90	0.31	5.00	0.00
		3	4.50	0.70	4.40	0.83
		4	4.20	1.03	4.30	0.82
		Total	**4.63**	**0.70**	**4.65**	**0.66**
	Word naming fluency	1	4.70	0.67	4.90	0.31
		2	5.00	0.00	5.00	0.00
		3	4.70	1.07	4.60	1.26
		4	4.40	0.48	3.50	1.58
		Total	**4.70**	**0.68**	**4.50**	**1.15**
	Generative Naming	1	5.00	0.00	5.00	0.00
		2	4.90	0.31	5.00	0.00
		3	5.00	0.00	5.00	0.00
		4	4.50	0.85	5.00	0.00
		Total	**4.85**	**0.48**	**5.00**	**0.00**
	Sentence Repetition	1	10.00	0.00	10.00	0.00
		2	10.00	0.00	10.00	0.00
		3	10.00	0.00	10.00	0.00
		4	10.00	0.00	10.00	0.00
		Total	**10.00**	**0.00**	**10.00**	**0.00**
	Carry out Commands	1	10.00	0.00	10.00	0.00
		2	10.00	0.00	10.00	0.00
		3	10.00	0.00	10.00	0.00
		4	10.00	0.00	9.80	0.63
		Total	**10.00**	**0.00**	**9.95**	**0.31**

Domain II (Memory)

Mean and SD values were calculated for three types of memory namely episodic, working and semantic memory in domain II which is tabulated in table 4.4 to show the performance of males and females across the entire task for four age groups.

Episodic memory:

In episodic memory test, as age increases only a slight variations was observed in mean scores. On comparing males and female performance, result shows that male performed better across all age groups when compared to female participants. These findings are in accordance with previous literature CLAP-H, CLAP-M and CLAP-T.

Working memory:

Working memory test reveals that, steep decline in mean scores was evidently noticed as age increases. Male participants performed better across all age range when compared to females which is in accordance with previous literature CLAP-H and CLAP-T whereas in CLAP-M females performed better across ages.

Semantic memory:

In semantic memory test, as age increases only slight variation in mean scores was observed for generative naming task and gradual decline in mean scores was observed for orientation and recent memory questions, digit forward, digit backward, co-ordinate naming task, superordinate naming and word naming fluency task. However no decline in the mean scores was noted for sentence repetition and carry out command.

On comparing male and female performance, male participants performed better in orientation and recent memory question, digit forward, digit backward, word naming fluency and carry out commands. Whereas female participants performed better on superordinate naming and generative naming. Irrespective of age all participants got maximum scores for generative naming task, by females, sentence repetition task both by males and females and in carry out command task by males.

Significance value for effect of Age, Gender and Age* Gender for Domain II

F value and p value was obtained for each task under domain II (Memory) to see for the effect of age, gender, age* gender interaction and results have been tabulated in table 4.5

Table 4.5 Significance value for effect of age, gender and age*gender interaction

Domain	Task	Age		Gender		Age* gender	
		F value	P value	F value	P value	F value	P value
II Episodic	Orientation and recent memory questions	2.76	**0.04**	9.86	**0.00**	0.45	0.71
Working	Digit Forward	8.77	**0.00**	2.26	0.13	1.05	0.37
	Digit backward	10.37	**0.00**	2.00	0.16	1.40	0.24
Semantic	Co-ordinate naming	12.00	**0.00**	0.00	1.00	0.57	0.63
	Super-ordinate naming	5.76	**0.00**	0.03	0.86	0.11	0.95
	Word-naming fluency	4.05	**0.01**	1.05	0.30	3.00	**0.03**
	Generative naming	2.75	**0.04**	4.37	**0.04**	2.75	**0.04**
	Sentence repetition	NA	NA	NA	NA	NA	NA
	Carry out command	1.00	0.39	1.00	0.32	1.00	.39

Episodic:

In episodic memory, significant value was observed for effect of age and effect of gender across the ages which are in accordance with previous literature CLAP-H whereas in CLAP-M and CLAP-T significance value was observed for effect of age and not for gender. Effect of age* gender interaction reveals no significant difference observed in this memory type which is also in accordance with previous literature (CLAP-H, CLAP-M and CLAP-T).

Working:

Working memory results reveals that significant value was observed for effect of age and not for effect of gender which is in accordance with previous literature (CLAP-H, CLAP-M and CLAP-T). Effect of age* gender interaction reveals no significant difference observed in this memory type which is also in accordance with previous

literature (CLAP-H, CLAP-M and CLAP-T).

Semantics:

Significant value was observed for effect of age for four tasks namely co-ordinate naming, superordinate naming, word naming fluency and generative naming. Significant value for effect of gender was observed only in generative naming task. The results obtained in this present study is varying from previous literature findings where in CLAP-H significant difference for effect of age and gender was seen only for word naming fluency task and for co-ordinate naming, superordinate naming and word naming fluency task in CLAP-M.

Effect of age* gender interaction reveals significant difference observed for word naming fluency and generative naming in this present study, however in previous literature age*gender interaction reveals significant difference was observed only for superordinate naming in CLAP-H whereas no significant difference was noted in CLAP-M and CLAP-T.

Domain III (Reasoning and Problem solving)

The mean and SD values calculated for tasks in domain III are tabulated in table 4.6 to show the performance of males and females across the entire task for four age groups.

Table 4.6 Mean and SD for task under domain III

Domain	Task	Age	Males Mean	SD	Females Mean	SD
Domain III	Sentence disambiguation	1	8.90	1.10	9.50	0.97
		2	8.20	1.93	8.50	1.71
		3	7.00	2.21	7.40	2.27
		4	5.90	1.66	6.00	2.00
		Total	**7.50**	**2.06**	**7.85**	**2.17**
	Sentence Formulation	1	4.30	0.67	4.70	0.48
		2	5.00	1.88	4.10	0.56
		3	4.10	1.10	3.30	1.41
		4	3.40	0.96	2.40	1.57
		Total	**4.20**	**1.32**	**3.62**	**1.39**
	Predicting outcome	1	10.00	0.00	10.00	0.00
		2	10.00	0.00	9.80	0.63
		3	9.30	1.63	9.00	1.41
		4	10.00	0.00	9.80	0.63
		Total	**9.83**	**0.84**	**9.65**	**0.89**
	Compare and Contrast	1	9.60	0.69	9.80	0.63
		2	10.00	0.00	9.50	0.85
		3	8.90	1.52	8.80	1.03
		4	8.40	2.50	7.40	2.31
		Total	**9.23**	**1.57**	**8.88**	**1.62**
	Predicting Cause	1	10.00	0.00	10.00	0.00
		2	10.00	0.00	9.80	0.42
		3	8.80	1.98	9.30	0.82
		4	9.30	1.16	9.50	0.85
		Total	**9.53**	**1.21**	**9.65**	**0.66**
	Why Questions	1	5.00	.000	5.00	0.00
		2	5.00	.000	5.00	0.00
		3	4.80	.422	4.90	0.31
		4	4.90	.316	4.80	0.42
		Total	**4.93**	**.267**	**4.93**	**0.26**
	Sequential Analysis	1	9.80	.632	10.00	0.00
		2	9.80	.632	9.80	0.63
		3	8.80	1.619	9.80	0.63
		4	9.30	1.636	8.90	1.37
		Total	**9.43**	**1.259**	**9.63**	**.89**

In domain III (Reasoning and problem solving), as age advances decline in mean scores was observed in sentence disambiguation, sentence formulation and carry out command whereas minimal variation was observed in why questions and sequential analysis task which highlights the fact that these tasks are least sensitive for detecting cognitive decline.

Current findings are supported by the results of CLAP-H and CLAP-M. On comparing the performance between the participants, males performed better in the tasks such as sentence formulation task, predicting outcome and carry out command task whereas in sentence disambiguation task, predicting cause task and sequential analysis task females performed better. However both males and females performed similar in why question task.

Significance value for effect of Age, Gender and Age* Gender for domain III

F value and p value was obtained for each task under Domain III (Reasoning and problem solving) to see for the effect of age, gender, age* gender interaction and have been tabulated in table 4.7.

Table 4.7 Significance value for effect of age, gender and age*gender interaction

Domain	Task	Age		Gender		Age* gender	
		F value	p value	F value	p value	F value	p value
III	Sentence disambiguation	12.44	**0.00**	0.76	0.38	.068	0.97
	Sentence formulation	8.66	**0.00**	4.71	**0.03**	1.53	0.21
	Predicting outcome	4.54	**0.00**	0.89	0.34	0.11	0.95
	Compare and contrast	7.29	**0.00**	1.17	0.28	0.64	0.58
	Predicting cause	4.59	**0.00**	0.36	0.54	0.51	0.67
	Why Questions	2.16	**0.01**	0.00	1.00	0.48	0.69
	Sequential Analysis	2.71	**0.05**	0.72	0.39	1.58	0.20

In domain III significant value for effect of age was observed in all tasks which are in accordance with previous literature CLAP-M. However, CLAP-H suggest that significant value for effect of age was observed in all task except for why questions and sequential analysis. Effect of gender reveals that significant difference was observed only in sentence formulation task in the present study whereas in previous literature, no significance value was obtained for effect of gender (CLAP-H, CLAP-M, CLAP-T). Effect of age* gender interaction reveals no significant difference observed in the present study which is also in accordance with previous literature (CLAP-H, CLAP-M and CLAP-T).

Domain IV (Organization)

Mean and SD was calculated for tasks in Domain IV which is tabulated in table 4.8 to show the performance of males and females across all the task for four age groups.

Table 4.8 Mean and SD for task under domain IV

Domain	Task	Age	Males		Females	
			Mean	SD	Mean	SD
Domain IV	Categorization	1	9.50	0.70	9.90	0.31
		2	9.40	1.35	9.60	0.96
		3	8.60	1.83	8.30	1.41
		4	8.30	2.11	7.60	1.35
		Total	**8.95**	**1.61**	**8.85**	**1.42**
	Analogies	1	9.60	0.84	9.70	0.67
		2	8.40	2.06	9.10	0.99
		3	8.80	1.39	8.60	1.35
		4	7.10	2.23	7.60	1.83
		Total	**8.48**	**1.89**	**8.75**	**1.46**
	Sequencing Events	1	37.00	2.74	37.20	3.01
		2	35.20	5.26	34.00	6.46
		3	29.50	8.75	26.80	12.1
		4	18.70	8.82	16.00	12.57
		Total	**30.10**	**9.80**	**28.50**	**12.26**

In domain IV (organization), as age increases mean scores showed steep decline for all tasks however sequencing events have more prominent decline which highlights that it is most sensitive for cognitive decline as age increases. Significant decline in mean scores was seen from age 60 years onwards. Across the age group, male and female participants performed almost similar in categorization and sequencing events task whereas female participants performed better in analogy task.

Significance value for effect of Age, Gender and Age* Gender in domain IV

F value and p value was obtained for each task under domain IV to see for the effect of age, gender, age* gender interaction and have been tabulated in table 4.9.

Table 4.9 Significance value for effect of age, gender and age*gender interaction

Domain	Task	Age		Gender		Age* gender	
		F value	p value	F value	p value	F value	p value
IV	Categorization	7.47	**0.00**	0.10	0.74	0.65	0.58
	Analogies	7.74	**0.00**	0.65	.042	0.35	0.78
	Sequencing events	22.7	**0.00**	0.74	0.39	0.14	0.93

In domain IV (Organization), significant value for effect of age was observed in all tasks which is in accordance with previous literature (CLAP-M, CLAP-H and CLAP-T) whereas effect of gender shows no significant value for all the task which is also in accordance with previous literature. However age*gender interaction effect revealed no significant difference for all task which is supported by CLAP-M and CLAP-T whereas in CLAP-H significant difference was obtained in all task.

DISCUSSION

On calculating overall mean scores across each domain, domain IV (Organization) has been observed to be most difficult, requiring higher cognitive load and thus can predict the cognitive linguistic changes across ages much better than memory, reasoning and problem solving, attention, perception, and discrimination domains. The reason for the difficulty has been quoted from the various studies [26, 27] that elderly subjects have greater difficulty in processing grammatically encoded information about relationships between events. However domain I (Attention, perception and discrimination) observed to be easiest and require least cognitive load among the other domains which is in accordance with previous literature [28] which stated that older adults performed better when compared to younger adults in assimilating information task even in presence of distractors since they tend to devote their exclusive attention to one stimulus and ignore another stimuli.

On comparing the performance of males and females across four domains, result reveals that males performed better than female in majority of task under each subtest however there was no statistical difference. Significant value was noted for effect of age, in all domains which highlight the need to device enrichment programs in individuals with pathological aging and preventive measures have to be taken in healthy aging.

Statistical significant value for effect of gender was observed in letter cancellation task (Domain I), orientation and recent memory questions and generative naming task (Domain II), sentence formulation task in domain III. On checking the effect of age and gender, results revealed no significant effect for the participants across the various age groups except for few tasks such as contingent letter cancellation in domain I, word naming fluency and generative naming task (domain II).

CONCLUSION

Thus to conclude, all four domains shows a general trend of decline with advancement in age and the decline is more evident from group III (60 years onwards). Also declination was seen more prominently noted in domain IV (Organization) than domain II (memory) and domain III (reasoning and problem solving) which revealed that it is highly sensitive to cognitive decline and domain I (Attention, perception and discrimination) observed to be least sensitive for cognitive decline. Thus T-CLAP can be used by the professionals to assess the cognitive decline across various age groups in the four domains.

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