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Healthy Aging & Clinical Care in the Elderly

Self-efficacy and Verbal Fluency—Does Age Play a Role?

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ABSTRACT: Self-efficacy refers to the beliefs that one possesses about his/her ability to achieve specific targets in a certain context. It is one of the important aspects of metacognitive processes. There are emerging evidences that most of the cognitive processes decline with age but the kind of trajectory metacognitive ability, like self-efficacy, follows as a function of age is yet researchable. The present study aimed at assessing how self-efficacy related to one's ability on the cognitive process of verbal fluency changes with age. For this purpose, three groups with 12 participants in each group ie the young adults, middle-aged adults, and old-aged adults were subjected to letter fluency (LF)-flexibility and category fluency (CF)-flexibility tasks. In addition to performing the tasks, the participants of all groups did a pre-task prediction and a post-task judgment of their respective performances. The differences between predictions, judgments, and actual performances of all subjects were subjected to repeated measure ANOVA and post hoc paired *T*-test for each group. The results obtained revealed that the verbal fluency performance declined with the age. However, the self-efficacy for verbal fluency, measured by predictions and judgments, revealed that as the individuals grow old, they seem to become more aware of their limited performances. These results open the scope of studying metacognitive processes like self-efficacy on larger samples and variety of cognitive processes that may be significant for cognitive communicative assessment and intervention.

KEYWORDS: self efficacy, verbal fluency, aging, melacognition, cognitive communication

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Introduction

Self-efficacy beliefs have received increasing attention in educational research, primarily in studies of academic motivation and self-regulation.[1] Individuals vary in their beliefs about their cognitive abilities. This concept is derived from self-efficacy theory.[2] The theory argues that individual's beliefs about their ability to achieve desired goals in specific contexts have a major influence on their behavior and ultimate success. These self-efficacy beliefs are conceived as context-specific beliefs about the performance from a broad construct of self-concept in cognitive domains,[3] when an individual is asked to make context-independent ratings (example: I am good at remembering names of cartoon that I recently read in books). This basically taps the cognitive self-concept. This differs totally from self-efficacy, which elicits predictions and confidence in predictions in specific tasks (example: I will be able to remember 20 words from the list). Self-efficacy has been argued to be a critical variable in both exerting positive influence on performances (example: persistence on task) and avoiding negative influence on performances (example: anxiety). High self-efficacy has been related to complex skill acquisition and successful memory performance.[4] Self-efficacy is very important for understanding goal-setting behavior and adjustment to performance outcomes relative to goal states. Beliefs in personal control over cognition have been shown to correlate with cognitive performance.[5] In general, researchers have provided a view of human behavior in which the beliefs that people have about themselves are key elements in the exercise of control and personal agency, and in which individuals are viewed both as products and producers of their own environments and their social systems.[2]

Self-efficacy beliefs provide the basis for human motivation, well-being, and personal accomplishment. This is because unless people believe that their action can produce the outcomes they desire, they have little motivation to act.

Specifically, self-efficacy reflects individuals' judgments in their capabilities to successfully execute courses of action.[6] Self-efficacy has been positively associated with cognitive performance.[3,7,8] Success requires persistent effort, so low self-efficacy becomes a self-limiting process. To succeed, people need a sense of self-efficacy, strung together with resilience, to meet the inevitable obstacles and inequities of life.[2]

The assessment of cognitive communication, in clinical setup, involves evaluations in linguistic and non-linguistic dimensions. One of the most intensely studied linguistic aspects in cognitive communication is verbal fluency.[9] Verbal fluency is a popular neuropsychological test in which participants are typically asked to generate as many words as possible from a specific semantic or phonemic category (ie "animals" or "words that start with a designated letter").[10] Verbal fluency involves not only the semantic knowledge of lexical items and the ability to search semantic memory using phonological or categorical rules but also "executive" skills required to track prior responses and block intrusions from other semantic categories. Researchers have identified verbal fluency as the best neuropsychological measure of executive functioning.[11] The tasks in verbal fluency are generally divided into category fluency (CF) and letter fluency (LF). They assess language functions (vocabulary size, naming), speed of response, mental organization, search strategies, and long-term memory.[12] It is a popular measure owing to the ease and speed of administration, not requiring reading or writing skills, and sensitivity to tap cognitive impairment from various etiologies. Verbal fluency deficits have been observed in individuals with frontal lobe damage,[13] Parkinson's disease,[14] schizophrenia,[15] subcortical dementia,[16] head injury,[17] Huntington's disease,[18] vascular dementia,[16] and Alzheimer's disease.[19]

Aged adults commonly report word-finding difficulties.[20] Verbal fluency is often used to examine access to phonemic and semantic information.[21] The processes suggested as important for verbal fluency performance are monitoring, inhibition of previously recalled words, and self-generation of cues to produce new words.[22] Other cognitive variables proposed are processing speed,[23] switching between two mental sets,[24] and retrieval from long-term memory and short-term memory.[12] All of these cognitive processes could explain age-related differences in verbal fluency task performance. However, the extent to which these processes are associated with verbal fluency performance in healthy aged adults also depends on the verbal fluency task.

Self-efficacy beliefs are an important aspect of human motivation and behavior influencing the actions that can affect one's life. The beliefs that individuals have about cognition in general and their own cognition, in particular, may or may not be accurate. Performance in real-life situations depends not only on the integrity of a person's cognitive functions but also on an accurate estimation of the strengths and weaknesses of one's own functioning. Accurate performance monitoring is critical for learning about one's own cognitive strengths and weaknesses. The verbal fluency is frequently used in cognitive aging research.[25] Literature quotes ample of work in the past that shows age-related trends across multiple verbal fluency tasks. However, there is dearth of literature that has explored the success with which one can measure the self-efficacy in relation to the verbal fluency task.

The aim of the study was to measure the self-efficacy for verbal fluency as a function of age. The objectives of the study were to study the verbal fluency for letter and categorical fluency and estimate the magnitude of the self-efficacy across the different age groups.

Method

This study was conducted in various community settings at Mangalore. The study protocol was approved by Institutional Ethical Board Committee of Kasturba Medical College (Manipal University), Mangalore. A consent form was obtained from all the participants.

Participants. The participants for this study were considered under three age groups: healthy young adults (18–30 years) (mean age = 21.08 years, SD = 1.08 years), middle-aged adults (35–55 years) (mean age = 43.08 years, SD = 6.34 years), and old-aged adults (60 years and above) (mean age = 71.3 years, SD = 7.77 years) as per the Erickson's psychosocial classification, with n = 12 (males = 6, females = 6) in each group. The younger and middle-aged adults were recruited from the university campus, and older adults from old age home in Mangalore. All the participants possessed minimum a graduation degree from universities where the medium of instruction was English. All participants are either employed or were employed in regular jobs, and they belonged to the middle class of economic status. The exclusion criteria considered for the study were sensory deficits, complicated medical problems, and long course of medications.

Stimuli. The present study involved letter and semantic categories that were further classified into simple and complex items. Based on the number of words a letter possesses, the complexity of letters was decided using an Indian English dictionary. The cutoff word limit considered was 500, with simple letters (SLs) greater than 500 and complex letters (CLs) less than 500. Thus, the SLs included were "A, B, D, P, S, R, T, etc." and the CLs included were "J, K, I, O, U, V, E, etc." The complexity of categories was decided on the basis of common lexical items each category possesses under it. Categories having less than 20 items under them were identified as being complex and more than 20 were considered as simple category (SC). As per this criterion, the categories that were identified as simple were names of countries, languages, vegetables, vehicles, etc., and the complex categories (CCs) were names of currencies, stationeries, banks, flowers, etc.

Procedure. The developed stimulus was administered under three tasks. In the first task, the participants were asked to generate as many items as possible in one minute, for a SL and SC, respectively. The second task required them to generate

as many items as possible for a CL and CC, respectively. The third task involved alternate paradigm. The participants were asked to produce as many pairs as possible in one minute for two SLs, two CLs, and one SL–one CL, and for semantic categories, they had to produce as many pairs as possible in one minute for two SCs, two CCs, and one SC–one CC.

The entire experiment was conducted in three phases. In the first phase, all the participants were enquired about how many items they felt they could generate (pre-judgment). The second phase involved execution of the three verbal fluency tasks (actual performance). The final phase involved them to judge as to how many items for each of the tasks and subtasks they had generated (post-judgment). A digital recorder was used to record the verbal responses that were later transcribed and analyzed. A stop watch was used to monitor the time duration throughout the experiment. Total time duration of 40–45 minutes each were required to execute the entire process with each participant.

The differences in verbal fluency abilities of the three groups were evaluated using one-way ANOVA and Games Howell's post hoc analysis. The number of items predicted, generated, and judged for each stimuli for all the three groups was subjected to repeated measure ANOVA, paired *T*-test (with Bonferroni corrections), and descriptive statistics, through SPSS version 15.0, to evaluate the interaction effect between measurements and groups and also the presence of significance difference across the three groups, if any.

Results

Verbal fluency and aging. The results of the descriptive statistics showed that the mean performance of the young adults was higher than the other two groups across all the tasks and modalities. The performance of middle-aged adults was higher than the older adults for all the tasks. Therefore, young adults generated the highest responses followed by middle-aged adults and old-aged adults as depicted in the following Figure 1.

The results from one-way ANOVA revealed that there were significant differences between and within the groups for all the tasks. The results of one-way ANOVA have been briefed in Table 1. Further to this, Games Howell's post hoc analysis was performed to understand the pairwise comparisons. The results of the pairwise comparisons have been summarized in Table 2. As can be observed and noted from these results, the differences between young- and old-aged adults were significant for 9 out of the 10 tasks ie SL, CL, SC, CC, alternating between two SLs (SL–SL), alternating between SL and CL (SL–CL), alternating between two CLs (CL–CL), alternating between two SCs (SC–SC), alternating between SC and CC (SC–CC), and alternating between two CCs (CC–CC). The differences between middle-aged and old-aged adults were significant for 4 out of the 10 tasks ie SL, SC, SC–SC, and SC–CC. The differences between the young and old middle-aged adults were significant for only the SL–SL task.

Self-efficacy for verbal fluency and aging. The descriptive analyses performed across the three phases of the experiment for all the three groups revealed that the participants always underestimated their true verbal fluency abilities before and after the task. However, the magnitude of underestimation varied across different age groups. The young adult's judgment (pre-verbal fluency mean = 7.1, actual verbal fluency mean = 9.8, post-verbal fluency judgment = 7.6) was most distant with respect to the actual performance when compared to middle-aged adults (pre-verbal fluency mean = 6.6, actual verbal fluency mean = 7.9, post-verbal fluency judgment = 6.7)

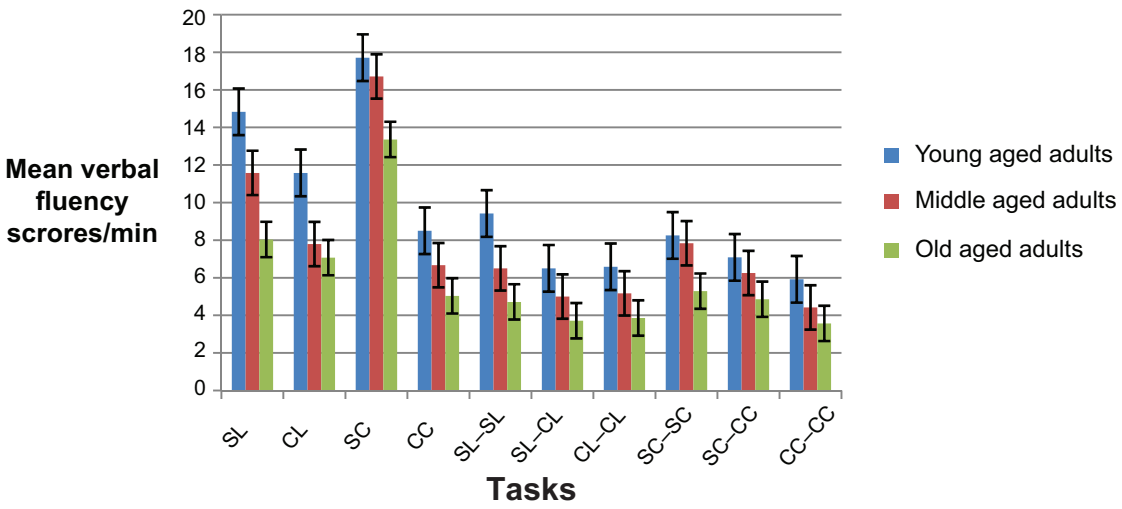

Figure 1. The mean values of verbal fluency across all the tasks between the three groups SL–SL alternating between two SLs, SL–CL alternating between SL and CL, CL–CL alternating between two CLs, SC–SC alternating between two SCs, SC–CC alternating between SC and CC, CC–CC alternating between two CCs. The error bars represent the standard error.
Abbreviations: SL, stands for simple letter; CL, complex letter; SC, simple category; CC, complex category.

Table 1. Significance values for within- and between-group differences, as revealed by the one-way ANOVA, across all the tasks between the three groups SL–SL alternating between two SLs, SL–CL alternating between SL and CL, CL–CL alternating between two CLs, SC–SC alternating between two SCs, SC–CC alternating between SC and CC, and CC–CC alternating between two CCs.

TASKS	F VALUE (df = 2)	P VALUE
SL	13.047	**0.000**
CL	7.369	**0.002**
SC	14.766	**0.000**
CC	7.574	**0.002**
SL–SL	8.553	**0.001**
SL–CL	3.389	**0.045**
CL–CL	6.739	**0.003**
SC–SC	11.613	**0.000**
SC–CC	9.843	**0.000**
CC–CC	6.222	**0.005**

Abbreviations: SL, stands for simple letter; CL, complex letter; SC, simple category; CC, complex category.

and old-aged adults (pre-verbal fluency mean = 5.4, actual verbal fluency mean = 6, post-verbal fluency judgment = 5.5).

Repeated measure ANOVA was applied to evaluate the significance of the interaction between the three measurements and the groups. The results of repeated measure ANOVA have been summarized in Table 3. Further paired *T*-test (with Bonferroni correction) was done to analyze if the differences in the estimation of performance across the age groups met the statistically significance criteria. The findings revealed that overall only the young adults and middle-aged adults were significantly different in their pre- and post-judgments and their actual performance ($P < 0.05$). The pre- and post-judgments about verbal fluency made by the older adults did not reach a statistically significant value when all tasks were considered together. An interesting observation was that with the increase in age, the pre- and post-task judgment of verbal fluency became closer to the actual fluency performance. However, when task-specific analysis was done, it was found that for 11 out of 20 comparisons young adults' pre- and post-task estimations were statistically similar to the actual performance. The same was found valid for 15 out of 20 tasks and 17 out of 20 tasks for the middle-aged adults and old-aged adults, respectively. In other words, middle-aged adults and older adults seem to be more aware of their verbal fluency competencies as compared to young adults. These results have been depicted in Figure 2 and Table 4, respectively.

Discussion

The present study does affirm that the verbal fluency decreased with the age, which is congruent to the results of the previous researchers.[26] This age-related reduction in verbal fluency performance could be associated with several cognitive processes that are required for successful verbal fluency performance and for which an age-related decrease has been reported. A decline in verbal fluency performance with advancing age has been reported for both letter and categorical fluency.[27] Although some studies suggested that categorical fluency is generally more affected by age,[27] there is also evidence for age-related differences in LF. Decreased performance in the verbal fluency tasks could be probably the result of an age-related decline in the speed of mental operations (slowing down principle).

The findings of the current study revealed that only the young adults were significantly different in their pre- and post-judgments in comparison with their actual performance. The pre- and post-judgments about verbal fluency made by the middle-aged adults and the old-aged adults did not reach a statistically significant value indicating that there pre-verbal fluency predictions and post-verbal fluency judgments were

Table 2. Significance values, as revealed by the post hoc analysis, across all the tasks between the three groups SL–SL alternating between two SLs, SL–CL alternating between SL and CL, CL–CL alternating between two CLs, SC–SC alternating between two SCs, SC–CC alternating between SC and CC, CC–CC alternating between two CCs.

TASKS	YOUNG AGED–MIDDLE AGED ADULTS	MIDDLE AGED–OLD AGED ADULTS	OLD AGED ADULTS–YOUNG AGED ADULTS
SL	0.085	**0.025**	**0**
CL	0.052	0.678	**0.019**
SC	0.874	**0.042**	0.118
CC	0.197	0.208	**0.003**
SL–SL	**0.009**	0.096	**0**
SL–CL	0.142	0.121	**0.005**
CL–CL	0.058	0.161	**0.001**
SC–SC	0.822	**0.001**	**0.001**
SC–CC	0.281	**0.016**	**0.002**
CC–CC	0.083	0.4	**0.008**

Abbreviations: SL, stands for simple letter; CL, complex letter; SC, simple category; CC, complex category.

Table 3. Significance values of within-group effects for three measurements and interaction effect between measurements and groups, as revealed by the repeated measure ANOVA, across all the tasks SL–SL alternating between two SLs, SL–CL alternating between SL and CL, CL–CL alternating between two CLs, SC–SC alternating between two SCs, SC–CC alternating between SC and CC, CC–CC alternating between two CCs.

TASKS	F VALUE (WITHIN GROUP EFFECT)	F VALUE (INTERACTION BETWEEN MEASUREMENT AND GROUPS)	SIGNIFICANCE (P VALUE) (WITHIN GROUP EFFECT)	SIGNIFICANCE (P VALUE) (INTERACTION BETWEEN MEASUREMENT AND GROUPS)
SL	F (2,70) = 22.5	F (4,70) = 3.22	**0.00**	**0.017**
CL	F (2,70) = 6.58	F (4,70) = 13.80	**0.002**	**0.006**
SL–SL	F (2,70) = 6.121	F (4,70) = 4.69	**0.004**	**0.002**
SL–CL	F (2,70) = 6.124	F (4,70) = 1.445	0.883	0.228
CL–CL	F (2,70) = 0.266	F (4,70) = 1.822	0.767	0.134
SC	F (2,70) = 56.81	F (4,70) = 1.081	**0.000**	0.373
CC	F (2,70) = 5.357	F (4,70) = 5.050	**0.007**	**0.001**
SC–SC	F (2,70) = 4.577	F (4,70) = 3.595	**0.014**	0.153
SC–CC	F (2,70) = 3.491	F (4,70) = 1.106	**0.036**	0.528
CC–CC	F (2,70) = 0.159	F (4,70) = 0.688	0.854	0.602

Abbreviations: SL, stands for simple letter; CL, complex letter; SC, simple category; CC, complex category.

in close proximity with their actual performance. In other words, middle-aged adults and old-aged adults seem to be more aware of their verbal fluency competencies as compared to young adults. But the ability to judge oneself before and after the task showed an improvement. It has been reported in the literature that the self-efficacy abilities, as in metacognitive knowledge, are spared in old-aged adults.[28] This further strengthens the findings of the present study. There is considerable evidence that tasks that require participants to prospectively rate the expected memorability of study items (ie judgments of learning) have generally found age-related sparing.[29–31] Contrary findings have been reported by some researchers, wherein they have examined and found that old-aged adults often overestimate their performance (ie predict they will remember more than they are actually able to) compared with younger adults in predicting later memory performance.[29,32,33] Related work on this aspect has also shown that old-aged adults are aware of their own memory capacity and under certain conditions, can accurately predict memory performance which is in line with our observation.[34,35]

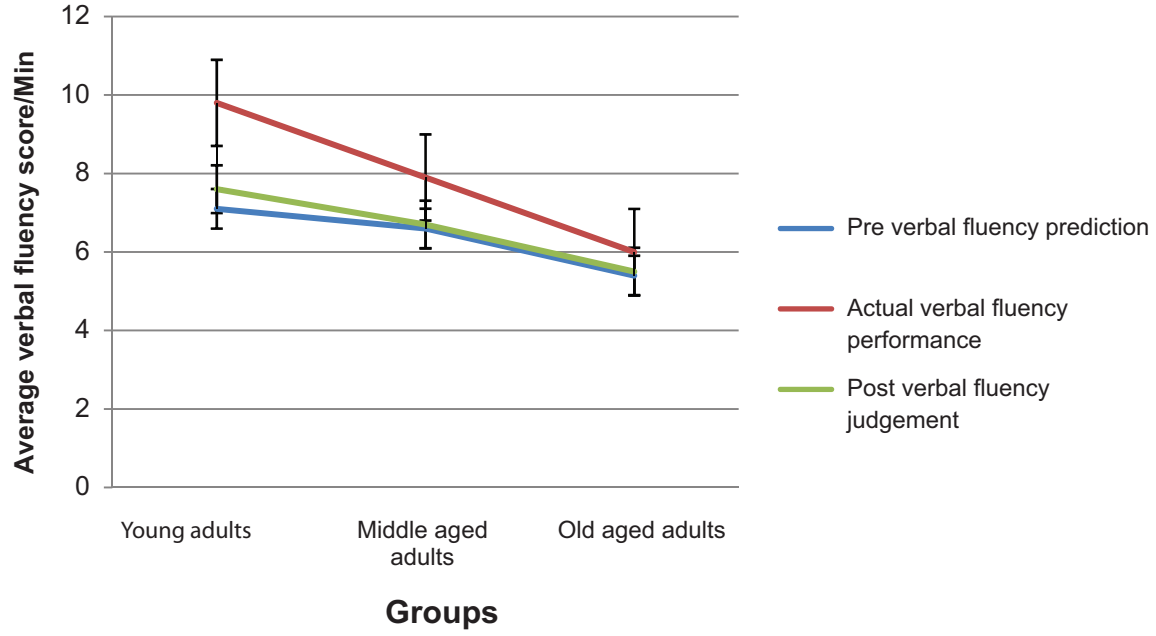

Figure 2. Magnitude of self-efficacy and verbal fluency with error bars representing standard error.

Table 4. Post hoc paired *T*-test results (with Bonferroni correction) for the three measurements by participants of three groups across all the tasks SL–SL alternating between two SLs, SL–CL alternating between SL and CL, CL–CL alternating between two CLs, SC–SC alternating between two SCs, SC–CC alternating between SC and CC, CC–CC alternating between two CCs.

	YOUNG AGED ADULTS		MIDDLE AGED ADULTS		OLD AGED ADULTS	
	T (df = 11)	P VALUE	T (df = 11)	P VALUE	T (df = 11)	P VALUE
Pre SL–SL	3.958	**0.002**	3.290	**0.007**	2.801	**0.015**
SL-Post SL	3.787	**0.003**	1.528	0.155	1.570	0.147
Pre CL–CL	2.731	**0.020**	−0.175	0.864	1.266	0.228
CL-Post CL	3.195	**0.009**	−0.221	0.829	2.121	0.054
SLSL-Pre SLSL	4.476	**0.001**	1.359	0.209	−0.319	0.755
SLSL-Post SLSL	1.908	0.083	1.849	0.292	−1.375	0.192
SLCL-Pre SLCL	1.372	0.197	0.000	1.000	−1.194	0.254
SLCL-Post SLCL	1.173	0.266	−0.788	0.447	−1.552	0.145
CLCL-Pre CLCL	1.583	0.142	−1.340	0.207	−0.821	0.426
CLCL-Post CLCL	1.121	0.286	0.699	0.499	−0.858	0.407
SC-Pre SC	3.282	**0.007**	8.540	**0.000**	5.809	**0.000**
SC-Post SC	2.768	**0.018**	12.776	**0.000**	5.056	**0.000**
CC-Pre CC	2.701	**0.021**	1.770	0.104	0.063	0.951
CC-Post CC	3.753	**0.003**	−1.153	0.273	0.718	0.486
SCSC-Pre SCSC	1.773	0.104	1.088	0.119	0.637	0.535
SCSC-Post SCSC	1.732	0.111	4.706	**0.001**	−0.279	0.785
SCCC-Pre SCCC	1.359	0.201	1.968	0.075	−0.130	0.899
SCCC-Post SCCC	1.876	0.087	2.600	**0.025**	1.075	0.302
CCCC-Pre CCCC	1.023	0.328	−0.2333	0.820	−0.606	0.555
CCCC-Post CCCC	1.318	0.214	−0.220	0.830	0.000	1.000
Overall Pre task estimation-Actual task performance	−4.965	**0.000**	−5.385	**0.000**	−2.058	0.060
Overall task performance-post task judgment	4.387	**0.001**	3.258	**0.008**	1.421	0.179

Abbreviations: SL, stands for simple letter; CL, complex letter; SC, simple category; CC, complex category.

Self-efficacy is inevitable part of metacognitive judgment.[36] Other processes or phenomena that are part of metacognitive judgment are ease of learning judgment, judgment of comprehension, remembering or knowing judgment, and output or source monitoring.[37–40] Out of the many processes, self-efficacy with reference to the scope of the present study primarily seems to involve two important abilities. The former involves feeling of knowing that includes the judgment of likelihood of the performance by an individual on a task. The latter involves confidence judgments that are retrospective and involves the correctness of the answers that have been elicited during the task.

In the present study, the former parallels the verbal fluency predictions by the participants and the latter corresponds to the post-verbal fluency judgments. It might be interesting to understand the underlying phenomena of metacognitive judgments or self-efficacy. Literature has shown that the confidence judgment depends on the logical and analytical processes through which one evaluates and weighs the pros and cons in a given situation, whereas for the feeling of knowing one may be relying on educated guess about the likelihood of retrieving items that one may possess.[41–43] Therefore, it may not be incorrect to hypothesize, with reference to the results of the present study, that as the age increases one's ability to evaluate the analytic and logical processes and make educated guess becomes better. This could be the reason why older adults were closer in predictions and judgments with respect to the actual performance as compared to the middle and young adults.

However, it still remains a matter of discussion that why at all there exists dissociation between self-efficacy and actual performance on verbal fluency tasks for all the age groups. It must be acknowledged that the disassociation, observed in the present study, is not novel and has been reported in the past[44,45] for feeling of knowing for recall tasks and for confidence judgement[46,47] on the word and face recognition tasks. Two phenomena have been discussed in literature with respect to self-efficacy. The first is the process of calibration, which refers to the correspondence between mean metacognitive judgments of verbal

fluency and mean actual verbal fluency performance.[48] The second is the process of resolution, which refers to the extent to which metacognitive judgments are correlated with the verbal fluency across items.[49] With relation to the present study, all groups seem to exhibit a good sense of resolution because participants of all groups successfully weighed the complexity of letters and categories used in the study. That is, all groups were able to predict the easy and complex entities among the letters and the categories, respectively, and in turn, generate appropriate predictions. For the calibration process, the results of the present study revealed that an increase in age is characterized by increased abilities to calibrate our predictions and judgments to the actual performance of the verbal fluency tasks.

Conclusion

The findings of the present study seem to be conveying a sense that even though the cognitive abilities, as in case of verbal fluency, declined with age for the subjects but their self-efficacy associated with it showed a rising trend. However, whether this rising trend is associated with all the cognitive process is not within the scope of the present research as only verbal fluency has been targeted. One more significant application that the results of the present study may highlight is with respect to the identification of individuals at risk of cognitive impairment during the middle age. As the decline in cognitive process like verbal fluency during middle age can convey the information about the cognitive well-being and prospects of an individual, it may be worth to explore in future research if trajectories of metacognitive abilities like self-efficacy also possess similar diagnostic strength.

Authors' Contributions

GB and JSB were involved in the research idea, planning of the method, and result formulation. DD and PS were involved in data collection. GB, DN, and JSB were involved in manuscript preparation. All authors reviewed and approved of the final manuscript.

DISCLOSURES AND ETHICS

As a requirement of publication the authors have provided signed confirmation of their compliance with ethical and legal obligations including but not limited to compliance with ICMJE authorship and competing interests guidelines, that the article is neither under consideration for publication nor published elsewhere, of their compliance with legal and ethical guidelines concerning human and animal research participants (if applicable), and that permission has been obtained for reproduction of any copyrighted material. This article was subject to blind, independent, expert peer review. The reviewers reported no competing interests.

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