© Journal of the Indian Academy of Applied Psychology
Jan 2019, Vol. 45, No. 1, 105-116

Measuring the Verbal Reasoning Abilities in Indian Adolescents across 10–16 Years of Age: Using Fable Comprehension

Rini Elsa Jacob and Sudhin Karuppali
Manipal Academy of Higher Education, Manipal.

Verbal reasoning is a form of inductive reasoning skills, comprising of planning, prediction, constructive thinking, problem solving, and hypothesis. These skills are found to play a major role in school-going children, helping them in the better understanding of new topics that have been introduced by teachers. Thus, the present study aimed to measure the development of verbal reasoning skills in developing Indian adolescents between 10-16 years of age. Ninety-six regular school going adolescents were included and were divided into 6 groups based on their age varying with one-year age intervals. The study consisted of 3 phases – Phase I comprised of the development of the stimuli (fable) including the multiple-choice probe questions; phase II included the task administration on each of the participants across the 6 groups; while phase III involved the data and statistical analysis. Parametric analysis was done to determine the level of significance across the groups and between the age groups. The results of one-way ANOVA revealed a significant difference ($p<0.05$) across the age groups for the verbal reasoning skills. Post hoc results indicated a statistically significant difference ($p<0.05$) between the 10-11-year-olds and 12-13-year-olds for the overall development of verbal reasoning skills. Thus, verbal reasoning skills exhibit a developmental trend in adolescents, which begins to achieve a plateau from 13 years of age..

Keywords: Adolescent, Development, Fable, Inductive, Reasoning

Reasoning is the ability of an individual to extract the existing knowledge from previous situations and apply this knowledge to novel situations. According to Piaget (1970), reasoning skills does require the capacity for logical thinking, which does not become apparent until the age of seven years, after which there is an on-going development of reasoning skills throughout adolescence. The period of adolescence marks a time of rapid and extensive growth and development in cognitive, psychological, emotional, and physical maturation. Compared to children, adolescents are provided with more opportunities to make decisions in a wide range of areas such as friendships, social activities, academics, extracurricular involvement, and consumer choices.

Verbal reasoning is a form of inductive reasoning skills, comprising of planning, prediction, constructive thinking, problem solving, and hypothesis. These skills are found to play a major role in school-going children, helping them in the better understanding of new topics that have been introduced by teachers (Masterson & Perrey, 1999). It facilitates one's cognitive skills, as well as knowledge about the world, which is essential for one's well-being (Tidwell, Sadowski, & Pate, 2000). The language of thinking, used to solve problems, to plan, predict, speculate, and hypothesize becomes a major function of communication during the adolescent years and well throughout their adulthood. Though there exists a progressive change in verbal reasoning skills with age, the development has been unique when considering the parameters under verbal reasoning. During middle childhood, children become better at distinguishing reasoning from guessing or acting on a hunch (Amsterlaw, 2006). By second grade, learners are capable of limited scientific thinking, the ability to generate, test, and evaluate hypothesis against data. However, this ability tends to grow substantially

over the next few years, as they still struggle with systematically controlling variables (Koerber, Mayer, Osterhaus, Schwippert, & Sodian, 2015). Children during middle childhood also get better at counter factual reasoning, which involves imagining what the world would be like now, if things were different in the past. This type of reasoning is important for life success. Younger learners can reason from what they know and experience, but adolescents can suspend what they know and reason from data (Legare, 2014). Even though initially adolescents struggle to design a study, collect and analyze data, and draw conclusions, some individuals did come to use effective strategies more frequently, suggesting that practice can cause strategy change. With better performance in scientific thinking, adolescents continue to struggle with two other types of reasoning which includes, argumentation (presenting evidences to support one's position and counter opposing positions), and reasoning with abstract premises (such as proving a mathematical theorem). This ability to reason with abstract premises emerges during late adolescence (Markovits & Lortie-Forgues, 2011)but is very difficult. In 3 studies, the hypothesis that alternatives generation required for conditional reasoning with false premises facilitates abstract reasoning is examined. Study 1 (n = 372. The extent of reasoning abilities is different in certain individuals, with few of them finding it easier to solve difficult problems than others. Individuals who are specialists in a domain have greater facility in reasoning about problems relating to that aspect than one who is a novice to it.

Prevost, Bronson, and Casey (1995) investigated the planning skills in children between five to seven years of age and found these skills to develop in the later stage of life. Research has found these skills to develop primarily between 9-10 years of age (Radziszewska & Rogoff, 1988), with the older adolescents outperforming the younder ones (Cao, Schüz, Xie, & Lippke, 2013; Luciana, Collins, Olson, & Schissel, 2009). Children below 10 years of age were found to have reduced predictive abilities (Garrett, Mazzocco, & Baker, 2006), than adolescents. Leon-Carrion, García-Orza, and Pérez-Santamaría (2009) found constructive thinking to have a linear relationship with the progression of age in individuals between 6-17 years of age. This ability of a person to think about the world in a constructive manner and to respond without harming self, tend to emerge in childhood and master in adolescent age (Anderson, 2010; Brocki & Bohlin, 2004). The development of these skills does facilitate verbal reasoning skills (Richland & Burchinal, 2013) as well as the scholastic performance (Zorza, Marino, & Acosta Mesas, 2016). Problem solving (Hooper, Luciana, Conklin, & Yarger, 2004) and hypothesizing (Zelazo, Helwig, & Lau, 1996) are abilities found to have a developmental sequence throughout the adolescence period.

Verbal reasoning skills are intricately related to the comprehension of metaphors, similes (Karuppali & Bhat, 2014), idioms, proverbs, and fables. Researchers have argued that the comprehension of these aspects develops during adolescence indicating that the reasoning skills are not present for children. Acquisition of metaphoric comprehension follows a developmental trend which is more evident in adolescents (Carriedo, Corral, Montoro, Herrero, & Rucián, 2016) resulting in the development of verbal reasoning skills. Nippold and Taylor (1995) studied the idiom comprehension in 150 participants of 11, 14 and 17 years of age, wherein the participants were given a brief story with an idiom of both high and low familiarity with the story. The results did reveal a progressive increase in the comprehension of idioms with age. On a similar note, Nippold, Allen, and Kirsch (2000) studied the comprehension of proverbs (concrete and abstract) in 150 participants of 12, 15 and 18 years of age, and found adolescents to use a bottom up approach for the comprehension of the same which helped them in better performance. Though a peak in the performance was observed during adolescence and early adulthood, there was a decline in the performance observed during the geriatric period (Uekermann, Thoma, & Daum, 2008). Fable comprehension is found to facilitate verbal reasoning skills as well. Stein and Glenn (1975) examined the story comprehension abilities in children and adolescents, asking the participants to recall the story after a counting task. The

results indicated adolescents tended to recall the story better than younger children, indicating adolescents to have better story comprehension abilities than their younger peers.

At the initial stages of the development, verbal reasoning skills remain almost constant among individuals from different cultures, living styles, and academic situations. These skills depends on the relational knowledge, ability to integrate multiple relations, and control over feature distractions (Richland, Morrison, & Holyoak, 2006). The development of these skills are affected by stress (Dubow & Tisak, 1989), psychological mindedness (Hatcher, Hatcher, Berlin, Okla, & Richards, 1990), parental expectations (Mau, 1995), reading skills (Cain & Oakhill, 1999), knowledge and cognition (Tidwell et al., 2000), academic situations, culture and age (Willbrand & Rieke, 1991), good mentoring (Lau, Zhou, & Lai, 2017), socio economic status and educational status of parents (Klenberg, Korkman, & Lahti-Nuuttila, 2001).

With the period of adolescence acting as a bridge between childhood and adulthood, a successful attainment of social and linguistic skills does facilitate this healthy transition. These skills that become proficient during the period of development are primarily concerned with language which is essential for more intensive social interaction. Verbal reasoning skills has become a crucial part of social development, with a considerable variability seen across childhood through adolescence. With the assessment of the development of verbal reasoning abilities becoming a major area of concern, the present study was planned. This study used fables which are short stories consisting of imaginary characters, with the story theme implying moralistic values tapping upon planning, inferring, problem solving, prediction, and constructive thinking. Such descriptive fables which are found to often appear in the school curriculum, does help improve the social and moralistic values of children. Since the use of oral tasks (Cain & Oakhill, 1999) does facilitate verbal reasoning abilities in adolescents, the present study was planned on similar lines. As these cognitive abilities are highly influenced by academic situations and culture (Willbrand & Rieke, 1991), using the available western standardized reasoning tests in the Indian context may have serious limitations. Therefore, the present study aimed to examine the verbal reasoning abilities in typically developing Indian adolescents between 10 through 16 years of age using fables. The objectives of the study were to develop suitable items targeting verbal reasoning skills in adolescents between 10 and 16 years of age; to administer the developed stimuli on the adolescent group of focus; and to analyze their responses.

Method

The present study followed a cross-sectional design adopted from a study (Nippold et al., 2015) focusing on the assessment of the verbal reasoning skills in English using fables. The participants were selected from regular English medium schools in Mangalore taluk of the Dakshina Kannada district, that followed Karnataka Secondary Education Examination Board. The sample size was calculated using the formula: $n= Z\alpha^2pq/E^2$; wherein $Z\alpha= 1.96$ at 95% confidence, p=50%, q=50%, and E=80% power. A random convenient sampling procedure was adopted using a lottery method. The research was conducted between December 2016 and January 2018. The protocol was reviewed by Institutional Ethical Board and ethical approval was obtained before initiation of the study.

Participants

A total of 96 developing school going adolescents between 10-15.11 years of age participated in the present study. The participants were divided into six groups based on their age varying with one-year age intervals (Group I: 10-10.11 years; Group II: 11-11.11 years; Group III: 12-12.11 years; Group IV: 13-13.11 years; Group V: 14-14.11 years; and Group VI: 15-15.11 years). Each group comprised of 16 participants each. Since gender has no major influence on verbal reasoning skills (Hyde & Linn, 1988)indicating a slight female superiority in performance. The difference is so small that we argue that gender differences in verbal ability no longer exist. Analysis of tests requiring different cognitive processes involved in verbal ability yielded no evidence of substantial gender differences in any aspect of processing. Similarly, an analysis of age indicated no striking

changes in the magnitude of gender differences at different ages, countering Maccoby and Jacklin's (1974, the current study did not focus on gender comparisons.

Prior to the commencement of the study, school authorities were explained about the purpose of the research, and an informed consent was obtained from all the participants prior to their inclusion in the research. The inclusion criteria included participants attending regular English medium school in and around Mangalore, and those within the desired range. The exclusion criteria included those with a history of speech, language and hearing problems, cognitive issues, uncorrected visual or hearing impairment, history of transfer from one medium of instruction in the school to another, and history of any academic failures. The school teachers played a major role in determining academic potential of the child. Participants, who fitted the selection criteria based on the report from the school teachers, were recruited for the research.

Procedure

The present study was carried out in three phases. Phase I comprised of the development of the stimuli; phase II included the task administration; while phase III involved the data and statistical analysis.

Phase I consisted of the development of stimuli (fable) which assessed the verbal reasoning abilities in adolescents. For the present study, fables were selected from story books which were available in the Indian market pertaining to the appropriate age range. Such story books were designed for pre-school and middle school going children as part of improving their moral values. Fables such as 'The Wolf and the Crane', 'The Woodcutter and the Axe', 'The Ant and the Dove', 'The King and the Sage', 'The Four Smart Students', and 'The Jackal and the Elephant' were initially identified. With the objective of the present study being to tap upon various reasoning skills such as planning, prediction, problem solving, constructive thinking and hypothesis, a corresponding fable 'The King and the Sage' was selected. Content validation was done on the selected fable, with 10 speech language pathologists having more than five years of experience scrutinizing the fable for its effectiveness in tapping upon the verbal reasoning skills. The judges assessed the fable, based on the structure of the story, grammar as well as the flow of information, after which the fable was ready for test administration.

Ten comprehension questions were framed to ascertain the participant's comprehension of the fable. The comprehension questions targeted were based on the characters present in the story, events encountered in the story, plans for a particular response, attempts initiated by the characters, responses and their consequences of the fable. The comprehension questions did not follow any scoring system. Following this, 10 multiple choice questions were formulated which targeted the five parameters (planning, prediction, problem solving, constructive thinking, and hypothesis) of verbal reasoning. Each parameter was targeted using two multiple choice (probe) questions. The present study incorporated the use of multiple-choice questions with four choices per question as mentioned in the Functional Assessment of Verbal Reasoning skills and Executive functions (FAVRES) developed by MacDonald (1998). The target (permissible) responses for each multiple choice question were randomly placed to avoid bias. The probe questions followed a standard binary scoring system, where the most appropriate response was assigned a score of 2, while responses which were not appropriate, but permissible was assigned a score of 1. Any inappropriate response was assigned a score of 0. Two permissible responses under each question were formulated, as the chance of occurrence of both responses which were deemed to be correct. A maximum total score of 20 could be attained by an individual.

Content validation was done for the formulated probe questions, the designed scoring scheme, and the comprehension questions. Ten speech language pathologists with more than five years of experience scrutinized the stimuli based on a Likert rating system (appropriate, inappropriate, to be modified). Necessary modifications pertaining to the change in the story title was done as the word 'sage' was modified to 'priest'. There were no modifications present pertaining to

the comprehension questions. However, there were concerns in deciding whether the probe questions did tap upon its designated verbal reasoning. For example, for the probe question 1 which targeted the 'planning' skill, 80% of the judges rated it as the intended skill which was tested, while 20% indicated it to tap upon 'problem solving' skills. The below table (Table 1) illustrates the percentage of judges rating each probe question to designate its corresponding verbal reasoning skill. The targeted skill of each probe question was decided based on the majority of responses obtained by the judges. The final set of ten multiple-choice probe questions and the comprehension questions are mentioned in the Appendix.

Phase II began with each participant being comfortably seated on a chair in a quiet room within the school premises. The testing commenced with the examiner providing the participant with the test stimuli (fable). The participants were then asked to read the fable carefully. This was followed by the examiner asking the comprehension questions to the participants. The probe questions were provided only to the participants who were able to answer all comprehension questions. If the participant was unable to do so, then he/she was asked to read the fable again. Failure to yet answer the comprehension questions resulted in the elimination of the participant from the research. This was followed by the administration of the multiple-choice probe questions to the participants, wherein each of them was asked to choose from the appropriate set of multiple choices. Each participant received a duration of 10-15 minutes to complete the task.

In Phase III, the obtained data from each participant were assigned the appropriate scores. The data was then tabulated for the total scores under each parameter (VRplan, VRpred, VRconst-think, VRprob-sol and VRhypo) and the total verbal reasoning (Totalver-reason) scores. Statistical analysis was done using SPSS (16 version) to examine the developmental profile of the participants. Descriptive statistics was done in order to determine the mean and standard deviation of the responses under each parameter. The dependent variables included the verbal reasoning parameters (VRplan, VRpred, VRconst-think, VRprob-sol and VRhypo), while the age was the independent variable. One-way ANOVA was done to determine the level of significance across the groups (Group I - VI) for the Totalver-reason scores and the total scores per parameter. Bonferroni post hoc analysis was done to determine the level of significance ($p<0.05$) between the age groups.

Table 1. Percentage of judge's rating for the probe questions.

Probes	Targeted VR_{skill}	VR_{plan}	VR_{pred}	$VR_{const\text{-}think}$	$VR_{prob\text{-}sol}$	VR_{hypo}
Q1	VR_{plan}	80%	-	-	20%	-
Q2	VR_{plan}	80%	20%	-	-	-
Q3	VR_{pred}	-	60%	-	-	40%
Q4	VR_{pred}	-	70%	-	-	30%
Q5	$VR_{const\text{-}think}$	-	-	90%	-	10%
Q6	$VR_{const\text{-}think}$	10%	-	90%	-	-
Q7	$VR_{prob\text{-}sol}$	-	-	30%	70%	-
Q8	$VR_{prob\text{-}sol}$	-	-	30%	70%	-
Q9	VR_{hypo}	-	-	-	10%	90%
Q10	VR_{hypo}	-	-	20%	-	80%

Note: VR_{skill} = Verbal Reasoning skill; VR_{plan} = planning; VR_{pred} = Prediction; $VR_{const\text{-}think}$ = Constructive thinking; $VR_{prob\text{-}sol}$=Problem Solving and VR_{hypo}= Hypothesis

Table 2. Scores assigned for each of the multiple choices pertaining to the corresponding probe question.

Probes	Multiple choices	VR_{plan}	VR_{pred}	$VR_{const\text{-}think}$	$VR_{prob\text{-}sol}$	VR_{hypo}
Q1	A	1	-	-	-	-
	B	0	-	-	-	-
	C	2	-	-	-	-
	D	0	-	-	-	-
Q2	A	0	-	-	-	-
	B	2	-	-	-	-
	C	0	-	-	-	-
	D	1	-	-	-	-
Q3	A	-	2	-	-	-
	B	-	0	-	-	-
	C	-	1	-	-	-
	D	-	0	-	-	-
Q4	A	-	0	-	-	-
	B	-	0	-	-	-
	C	-	2	-	-	-
	D	-	1	-	-	-
Q5	A	-	-	0	-	-
	B	-	-	1	-	-
	C	-	-	2	-	-
	D	-	-	0	-	-
Q6	A	-	-	1	-	-
	B	-	-	2	-	-
	C	-	-	0	-	-
	D	-	-	0	-	-
Q7	A	-	-	-	0	-
	B	-	-	-	2	-
	C	-	-	-	1	-
	D	-	-	-	0	-
Q8	A	-	-	-	1	-
	B	-	-	-	0	-
	C	-	-	-	0	-
	D	-	-	-	2	-

Q9	A	-	-	-	-	0
	B	-	-	-	-	2
	C	-	-	-	-	0
	D	-	-	-	-	1
Q10	A	-	-	-	-	1
	B	-	-	-	-	0
	C	-	-	-	-	2
	D	-	-	-	-	0

Note: Choices receiving a score of 2 is deemed the correct response; choices receiving a score of 1 is permissible (but inappropriate); choices receiving a score of 0 is incorrect.

Results

The present study focused on assessing verbal reasoning skills in adolescents between 10-16 years of age using fables. When considering the results of each parameter, the VRplan showed an increasing trend in development across the age groups, wherein Group IV (13 year-olds) and VI (15 year-olds) attained a maximum score of 4, while Group V (14 year-olds) showed a reduced score. Similarly, the VRhypo attained a maximum score of 4 by Group V (14 year-olds), while Group VI (15 year-olds) showed a subtle decline in the mean value. Considering the mean scores of VRpred, Group II (11 year-olds) and III (12 year-olds) attained a score of 3.43, while Group IV (13 year-olds) and Group V (14 year-olds) attained a score of 3.75. When considering all the six groups, Group VI (15 year-olds) attained a score of 3.62, which was a lower score than that of Group V (14 year-olds). The results of VRconst-think revealed, Group I (10-year-olds) and II (11-year-olds) to have attained a score of 2.31, while Group V (14-year-olds) and VI (15-year-olds) attained a score of 3.87. Considering VRprob-sol, none of the groups attained the maximum score of 4, however Group IV (13-year-olds) and VI (15-year-olds) received a mean score of 3.93, while Group V (14-year-olds) obtained a lower mean score than Group IV (13-year-olds). Considering the TOTALver-reason, an upward developmental trend was observed across the age groups, wherein Group I (10-year-olds) attained the

Table 3. Mean and SD of the verbal reasoning parameters of each age group

Group	VR_{plan}		VR_{pred}		$VR_{const-think}$		$VR_{prob-sol}$		VR_{hypo}		$TOTAL_{ver-reason}$	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
I	2.87	1.02	2.68	1.25	2.31	0.79	1.56	0.72	2.06	0.57	11.56	2.09
II	2.37	1.02	3.43	0.51	2.31	0.47	2.75	0.77	2.68	1.07	13.56	1.78
III	3.18	0.98	3.43	0.51	3.25	1.00	2.25	1.23	2.50	0.81	14.62	2.06
IV	4.00	0.00	3.75	0.44	3.75	0.57	3.93	0.25	3.68	0.70	19.12	0.95
V	3.93	0.25	3.75	0.44	3.87	0.34	3.81	0.40	4.00	0.00	19.37	0.80
VI	4.00	0.00	3.62	0.50	3.87	0.34	3.93	0.25	3.93	0.25	19.37	0.71

Note: VR_{skill} = Verbal Reasoning skill; VR_{plan} = Planning; VR_{pred} = Prediction; $VR_{const-think}$=Constructive thinking; $VR_{prob-sol}$=Problem Solving; VR_{hypo}= Hypothesis; and $TOTAL_{ver-reason}$ = Verbal reasoning skills

Table 4. The level of significance for each verbal reasoning parameters between the groups based on post hoc analysis

Age groups	Level of significance					
	VR_{plan}	VR_{pred}	$VR_{const\text{-}think}$	$VR_{prob\text{-}sol}$	VR_{hypo}	$TOTAL_{ver\text{-}reason}$
I-II	0.797	0.034	1.000	0.000	0.152	0.00
II-III	0.030	1.000	0.001	0.700	1.000	0.77
III-IV	0.030	1.000	0.429	0.000	0.000	0.00
IV-V	1.000	1.000	1.000	1.000	1.000	1.00
V-VI	1.000	1.000	1.000	1.000	1.000	1.00

Note: VR_{skill} = Verbal Reasoning skill; VR_{plan} = Planning; VR_{pred} = Prediction; $VR_{const\text{-}think}$ = Constructive thinking; $VR_{prob\text{-}sol}$ = Problem Solving; VR_{hypo} = Hypothesis; and $TOTAL_{ver\text{-}reason}$ = Overall verbal reasoning. The level of significance is maintained at $p<0.05$

lowest mean value. The mean scores varied drastically changing from Group I through IV (10 through 15 years), following very subtle changes evident till Group V (14-year-olds). Both Group V (14-year-olds) and VI (15-year-olds) obtained a score of 19.37 which was the maximum score received in the total domain. The following table (Table 3) illustrates the mean and SD attained by each of the age groups for each of the verbal reasoning parameters.

One-way ANOVA results of each parameter showed a significant difference across the groups ($p<0.05$). A good level of significance was received for the parameter of planning [$F(84.95) = 14.624$, $p<0.05$], prediction [$F(53.74) = 5.557$, $p<0.05$], constructive thinking [$F(80.95) = 22.062$, $p<0.05$], problem solving [$F(125.833) = 33.186$, $p<0.05$] and hypothesis [$F(95.95) = 24.387$, $p<0.05$]. In addition, a main significance level was obtained for the total verbal reasoning skills [$F(954.08) = 82.219$, $p<0.05$] indicating an increasing developmental trend with age.

The results of Bonferroni's post hoc analysis revealed a main significant difference ($p<0.05$) between Group I-II (10-11-year-olds) and Group III-IV (12-13-year-olds). However, a poor level of significance was obtained between Group II-III (11-12-year-olds) ($p=0.77$), Group IV-V (13-14-year-olds) ($p=1.00$) and Group V-VI (14-15-year-olds) ($p=1.00$). When comparing age groups with two-year intervals, a significant difference ($p<0.05$) was observed when comparing between the Group I-III (10-12-year-olds), Group II-IV (11-13-year-olds), Group III-V (12-14-year-olds) and Group IV-VI (13-15-year-olds). The following table (Table 4) illustrates the significance values for each verbal reasoning parameter between subsequent age groups based on Bonferroni's post hoc analysis.

Discussion

The present study focused on assessing the verbal reasoning skills in adolescents from 10 through 15.11 years. The objectives of the study were to develop a suitable stimulus that targeted the verbal reasoning abilities in adolescents, and to administer the developed stimuli on the selected participants; and to analyze the responses from the administered task. The results of the present study are discussed as follows. While considering the mean values of the planning parameter, there was a progressive growth seen across 10 through 15 years of age, with the ANOVA results indicating a good level of significance ($p<0.05$) across the six groups.

These are in accordance with the study done by Luciana et al. (2009), who suggested an age wise improvement in planning. However, when considering the mean values (planning parameter) obtained between the two consecutive groups, a gradual (10 to 11-year-olds) and sudden (11 to 12-year-olds, and 12 to 13-year-olds) increase in the scores were observed, with a plateau seen from the 13-year-olds onwards. This subtle decline exhibited by the 14-year-olds can be attributed to the lack of attention and motivation (Cao et al., 2013) in reading the fable and thereby executing the desired response. The 10-year-olds attained the

least score indicating planning skills to manifest an explicit development only after 10 years of age (Prevost et al., 1995). Radziszewska and Rogoff (1988) did reveal planning skills to be reduced in 10-11-year-olds, supporting the results of the present study. Though the post hoc results did reveal a good level of significance ($p<0.05$) between the 11 and 12-year-olds, and between 12 and 13-year-olds, there was a poor significance ($p>0.05$) observed between the other groups. This can be attributed to the fact that successive group comparisons showed reduced differences in performance, when compared to comparisons which were made with larger group intervals (Nippold, Schwarz, & Undlin, 1992). The 13 and 15-year-olds which attained a maximum mean score of 4, lead to an assumption that, planning skills are completely developed during the adolescent years.

Considering, the prediction parameter, descriptive analysis of the data revealed a developmental progression across age with the analysis showing a good level of significance ($p<0.05$). This findings is in congruence with other reports (Otten & Van Berkum, 2009) which stated prediction skills to be completely developed when an individual reaches adolescence, while these skills are underdeveloped in individuals below 10 years of age (Garrett et al., 2006). However, the descriptive results did not show any variations in the mean scores obtained by the 11 through 14-year-olds, except for the 15-year-olds showing a subtle decline in mean scores when compared to its preceding group. These results were not in line with the reports that suggested the development of prediction skills to begin from childhood (Garrett et al., 2006). None of the participants in the groups achieved the maximum score of 4, indicating that the development of hypothesis skill is ongoing throughout adulthood.

The constructive thinking parameter showed a gradual improvement in performance with age. The ANOVA results indicated a good level of significance ($p<0.05$) in the development across the groups, with the post hoc analysis showing a good level of significance only between the 11 and 12-year-olds. The descriptive results revealed the 10 and 11-year-olds to have attained a similar score of 2.31 with the 14 and 15-year-olds getting a score of 3.87. This suggested an age-related progression in the overall ability with the attainment of plateau from 15 years onwards. Studies have attempted to support this developmental trend, by revealing that the constructive thinking ability improves as an individual reaches his adolescence (Leon-Carrion et al., 2009); in turn facilitating the social as well as emotional abilities resulting in the betterment of life (Giancola, Shoal, & Mezzich, 2001). Since none of the groups had obtained the maximum score of 4, it was assumed that the development continues throughout adulthood.

The problem-solving skills tended to follow a similar pattern of the planning skill. The ANOVA results indicated a significant difference ($p<0.05$) in development across groups. In consensus with this findings in this domain, studies have reported an upward trend in the development of problem solving skills; wherein adolescents were found to outperform younger children (Zorza et al., 2016). With increase in complexity of problem solving tasks, individuals of higher age groups tended to perform better than their younger ones (Nieto, Ros, Medina, Ricarte, & Latorre, 2016) there has been a growing interest in the study of the development of executive functions (EF. However, Holyoak, Junn, and Billman (1984)and the corresponding instruments were perceptually and functionally similar, even preschoolers were able to use the analogy to derive a solution to the transfer problem (Experiment 1 have reported 6-year-old children to exhibit performances in this domain to be similar to that of adults. The post hoc results revealed a good level of significance ($p<0.05$) only between 10-11-year-olds and 12-13- year-olds, when compared to the other group comparisons. This can be attributed to the fact that successive group comparisons showed reduced differences in performance, when compared to comparisons which were made with larger group intervals (Nippold et al., 1992). McCarty, Clifton, and Collard (1999) revealed that simple constructive thinking skills tended to develop in children of 2 years as well. None of the groups in the current study did attain a maximum score of 4 (in constructive thinking skills), indicating that the development of this ability in ongoing throughout adulthood (Hooper et al., 2004).

The mean scores of the hypothesis skills indicated a gradual increase from 10 to 11 years, followed by a subtle decline seen in the 12-year-olds. Attaining a maximum score of 4, there was a plateau that was achieved from the 13-year-olds when compared to its preceding groups. The ANOVA results did reveal a significant developmental change across age (Felton, 2004)more frequently, and more flexibly than do adolescents. The present study examines the development of argumentation skills during adolescence. Forty-eight seventh and eighth graders were assigned to one of two conditions. Both groups engaged in pretest and posttest measures of strategy use on two topics (capital punishment and abortion. However, the post hoc results revealed no significant difference ($p>0.05$) in the development between the 13-14-year-olds indicating the attainment of plateau from 15 years onwards. However, Cain and Oakhill (1999) did report this hypothesizing ability to be present in children as well.

When considering the total score attained in verbal reasoning skills (all skills), there was a developmental increase observed, with the least score obtained by the 10-year-olds and a maximum score by the 14 and 15-year-olds, which was also apparent in the results of ANOVA. This may be attributed to the academic situation of the individual, facilitating the development of verbal reasoning skills (Willbrand & Rieke, 1991). The drastic increment in the total scores observed from 12 through 13 years of age can be attributed to the beginning of the formal operational stage (12+ years), which is highly vulnerable to developmental changes. These findings were in consensus with other studies (Vetter, Leipold, Kliegel, Phillips, & Altgassen, 2013), which suggested verbal reasoning skills to improve with age. However, studies have also reported the emergence of verbal reasoning skill in children, contradicting the findings of present study, which does report its emergence in adolescence (Nippold & Sullivan, 1987). With the 14 and 15-year-olds attaining a maximum score of 19.37, this may indicate that either a plateau has been reached in the course of development of verbal reasoning skills, or that the development may begin to progress after 16 years of age (Vetter et al., 2013).

Conclusion

Adolescents become proficient in their social interactions with the development of verbal reasoning as one of the important process. The development of this skill is noted to be more evident during adolescence. The present findings do provide an insight into the various cognitive-linguistic aspects governing the social use of language in adolescents between 10-16 years of age. The findings from this research may also pave way to understanding adolescence with cognitive and/or language disorders. This may aid in developing custom-made therapeutic goals targeting the cognitive linguistic system.

References

Amsterlaw, J. (2006). Children's Beliefs About Everyday Reasoning. *Child Development, 77*(2), 443–464.

Anderson, P. (2010). Assessment and development of executive function during childhood. *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence, 8*(2), 71–82. https://doi.org/10.1076/chin.8.2.71.8724

Brocki, K. C., & Bohlin, G. (2004). Executive Functions in Children Aged 6 to 13: A Dimensional and Developmental Study. *Developmental Neuropsychology, 26*(2), 571–593.

Cain, K., & Oakhill, J. V. (1999). Inference making ability and its relation to comprehension failure in young children. *Reading and Writing, 11*(5–6), 489–503.

Cao, D.S., Schüz, N., Xie, G.R., & Lippke, S. (2013). Planning Skills Moderate the Intention–Planning Cognitions–Behaviour Relation: A Longitudinal Study on Physical Activity in Chinese Adolescents. *Research in Sports Medicine, 21*(1), 12–23. https://doi.org/10.1080/15438627.2012.738441

Carriedo, N., Corral, A., Montoro, P. R., Herrero, L., & Rucián, M. (2016). Development of the updating executive function: From 7-year-olds to young adults. *Developmental Psychology, 52*(4), 666–78.

Dubow, E. ., & Tisak, J. (1989). The relation between stressful life events and adjustment in elementary school children: the role of social support and social problem-solving skills. *Child Development, 60*(6), 1412–1423.

Felton, M. K. (2004). The development of discourse strategies in adolescent argumentation. *Cognitive Development, 19*(1), 35–52. https://doi.org/10.1016/j.cogdev.2003.09.001

Garrett, A. J., Mazzocco, M. M., & Baker, L. (2006). Development of the Metacognitive Skills of Prediction and Evaluation in Children With or Without Math Disability. Learning Disabilities Research & Practice : A Publication of the Division for Learning Disabilities, *Council for Exceptional Children, 21*(2), 77–88. https://doi.org/10.1111/j.1540-5826.2006.00208.x

Giancola, P. R., Shoal, G. D., & Mezzich, A. C. (2001). Constructive thinking, executive functioning, antisocial behavior, and drug use involvement in adolescent females with a substance use disorder. *Experimental and Clinical Psychopharmacology, 9*(2), 215–227.

Hatcher, R., Hatcher, S., Berlin, M., Okla, K., & Richards, J. (1990). Psychological mindedness and abstract reasoning in late childhood and adolescence: An exploration using new instruments. *Journal of Youth and Adolescence, 19*(4), 307–326.

Holyoak, K. J., Junn, E. N., & Billman, D. O. (1984). Development of analogical problem-solving skill. *Child Development, 55*(6), 2042–55.

Hooper, C. J., Luciana, M., Conklin, H. M., & Yarger, R. S. (2004). Adolescents' Performance on the Iowa Gambling Task: Implications for the Development of Decision Making and Ventromedial Prefrontal Cortex. *Developmental Psychology, 40*(6), 1148–1158.

Hyde, J. S., & Linn, M. C. (1988). Gender Differences in Verbal Ability: A Meta-Analysis. *Psychological Bulletin, 104*(1), 53–69.

Karuppali, S., & Bhat, J. (2014). Efficacy of using simile completion tasks as a measure to evaluate the figurative language abilities in adolescents aged between 10-15 years. *Nepal Journal of Medical Sciences, 3*(2), 110–115. https://doi.org/10.3126/njms.v3i2.13454

Klenberg, L., Korkman, M., & Lahti-Nuuttila, P. (2001). Differential Development of Attention and Executive Functions in 3- to 12-Year-Old Finnish Children. *Developmental Neuropsychology, 20*(1), 407–428. https://doi.org/10.1207/S15326942DN2001_6

Koerber, S., Mayer, D., Osterhaus, C., Schwippert, K., & Sodian, B. (2015). The development of scientific thinking in elementary school: a comprehensive inventory. *Child Development, 86*(1), 327–36.

Lau, W. S., Zhou, X. C., & Lai, S. M. (2017). The development of mentoring-relationship quality, future-planning style, and career goal setting among adolescents from a disadvantaged background. *PsyCh Journal, 6*(1), 76–82.

Legare, C. H. (2014). The Contributions of Explanation and Exploration to Children's Scientific Reasoning. *Child Development Perspectives, 8*(2), 101–106. https://doi.org/10.1111/cdep.12070

Leon-Carrion, J., García-Orza, J., & Pérez-Santamaría, F. J. (2009). Development of the inhibitory component of the executive functions in children and adolescents. *International Journal of Neuroscience, 114*(10), 1291–1311. https://doi.org/10.1080/00207450490476066

Luciana, M., Collins, P. F., Olson, E. A., & Schissel, A. M. (2009). Tower of London Performance in Healthy Adolescents: The Development of Planning Skills and Associations With Self-Reported Inattention and Impulsivity. *Developmental Neuropsychology, 34*(4), 461–475. https://doi.org/10.1080/87565640902964540

MacDonald, S. (1998). *Functional Assessment of Verbal Reasoning and Executive Strategies.* Guelph, Canada.: Clinical Publishing.

Markovits, H., & Lortie-Forgues, H. (2011). Conditional Reasoning With False Premises Facilitates the Transition Between Familiar and Abstract Reasoning. *Child Development*. https://doi.org/10.1111/j.1467-8624.2010.01526.x

Masterson, J. J., & Perrey, C. D. (1999). A Program for Training Analogical Reasoning Skills in Children With Language Disorders. *American Journal of Speech-Language Pathology, 8*, 53.

Mau, W. C. (1995). Educational planning and academic achievement of middle school students: A racial and cultural comparison. *Journal of Counselling & Development, 73*(5), 518–526.

McCarty, M. E., Clifton, R. K., & Collard, R. R. (1999). Problem solving in infancy: The emergence of an action plan. *Developmental Psychology, 35*(4), 1091–1101.

Nieto, M., Ros, L., Medina, G., Ricarte, J.J., & Latorre, J.M. (2016). Assessing executive functions in preschoolers using shape school task. *Frontiers in Psychology,* Sep 7, 1489. https://doi.org/10.3389/fpsyg.2016.01489

Nippold, M. A., Allen, M. M., & Kirsch, D. I. (2000). How adolescents comprehend unfamiliar proverbs: the role of top-down and bottom-up processes.

Journal of Speech Language and Hearing Research, 43(3), 621–630.

Nippold, M. A., Frantz-Kaspar, M. W., Cramond, P. M., Kirk, C., Hayward-Mayhew, C., & MacKinnon, M. (2015). Critical Thinking About Fables: Examining Language Production and Comprehension in Adolescents. *Journal of Speech Language and Hearing Research, 58*(2), 325. https://doi.org/10.1044/2015_JSLHR-L-14-0129

Nippold, M. A., Schwarz, I. E., & Undlin, R. A. (1992). Use and understanding of adverbial conjuncts: A developmental study of adolescents and young adults. *Journal of Speech and Hearing Research, 35*, 108–118.

Nippold, M. A., & Sullivan, M. P. (1987). Verbal and Perceptual Analogical Reasoning and Proportional Metaphor Comprehension in Young Children. *Journal of Speech Language and Hearing Research, 30*(3), 367–376.

Nippold, M.A., & Taylor, C.L. (1995). Idiom understanding in youth: Further examination of familiarity and transparency. *Journal of Speech Language and Hearing Research, 38*(2), 426–433. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7596108

Otten, M., & Van Berkum, J. J. (2009). Does working memory capacity affect the ability to predict upcoming words in discourse? *Brain Research,* Sep 29(1291), 92–101.

Piaget, J. (1970). Piaget's Theory.

Prevost, R. A., Bronson, M. B., & Casey, M. B. (1995). Planning processes in preschool children. *Journal of Applied Developmental Psychology, 16*(4), 505–527. https://doi.org/10.1016/0193-3973(95)90002-0

Radziszewska, B., & Rogoff, B. (1988). Influence of adult and peer collaborators on children's planning skills. *Developmental Psychology, 24*(6), 840–848. https://doi.org/10.1037/0012-1649.24.6.840

Richland, L.E., & Burchinal, M.R. (2013). Early executive function predicts reasoning development. *Psychological Science, 24*(1), 87–92. https://doi.org/10.1177/0956797612450883

Richland, L. E., Morrison, R. G., & Holyoak, K. J. (2006). Children's development of analogical reasoning: Insights from scene analogy problems. *Journal of Experimental Child Psychology, 94*(3), 249–273. https://doi.org/10.1016/j.jecp.2006.02.002

Stein, N. L., & Glenn, C. G. (1975). An Analysis of Story Comprehension in Elementary School Children: A Test of a Schema. *New Directions in Discourse Processing, 53*–120.

Tidwell, P. S., Sadowski, C. J., & Pate, L. M. (2000). Relationships Between Need for Cognition, Knowledge, and Verbal Ability. *The Journal of Psychology, 134*(6), 634–644. https://doi.org/10.1080/00223980009598242

Uekermann, J., Thoma, P., & Daum, I. (2008). Proverb interpretation changes in aging. *Brain and Cognition, 67*(1), 51–7. https://doi.org/10.1016/j.bandc.2007.11.003

Vetter, N. C., Leipold, K., Kliegel, M., Phillips, L. H., & Altgassen, M. (2013). Ongoing development of social cognition in adolescence. *Child Neuropsychology, 19*(6), 615–629. https://doi.org/10.1080/09297049.2012.718324

Willbrand, M. L., & Rieke, R. (1991). Strategies of Reasoning in Spontaneous Discourse. *Annals of the International Communication Association, 14*, 414–440. https://doi.org/10.1127/1864-1318/2007/0123-0057

Zelazo, P. D., Helwig, C. C., & Lau, A. (1996). Intention, Act, and Outcome in Behavioral Prediction and Moral Judgment. *Child Development, 67*(5), 2478–2492.

Zorza, J. P., Marino, J., & Acosta Mesas, A. (2016). Executive Functions as Predictors of School Performance and Social Relationships: Primary and Secondary School Students. *The Spanish Journal of Psychology, 19*, E23. https://doi.org/10.1017/sjp.2016.23

Sudhin Karuppali, Ph.D., Associate Professor, Dept of Audiology & Speech Language Pathology, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal. Email id: sudhin.karuppali@manipal.edu

Rini Elsa Jacob, Post graduate student, Department of Audiology & Speech Language Pathology, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal.