Journal of Communication Disorders, Deaf Studies & Hearing Aids

Shylaja and Manjula, Commun Disord Deaf Stud Hearing Aids 2016, 4:3
DOI: 10.4172/2375-4427.1000161

Research Article Open Access

Assessment of Superordinate Categorization in 2-4 years Typically Developing Children

Shylaja K* **and Manjula R**

Department of Speech Language Pathology, All India Institute of Speech and Hearing (AIISH), Naimisham Campus, Manasagangothri, Mysuru-570006, India

***Corresponding author:** Shylaja K, Junior Research Fellow (JRF), Department of Speech Language Pathology, All India Institute of Speech and Hearing (AIISH), Naimisham Campus, Manasagangothri, Mysuru-570006, India, Tel: +918792973239; E-mail: shylajak19@gmail.com

Received date: May 23, 2016; **Accepted date:** June 30, 2016; **Published date:** July 7, 2016

Abstract

Objective: Taxonomic categorization plays an important role in the cognition development and language learning of children. This study aimed to analyze and compare the trend in the superordinate categorization in typical children across age, gender and type of superordinate categories.

Method: A total of 226 typically developing Kannada speaking children between the ages of 2 to 4 years served as participants of this study and were tested in individual set up. After providing 3 practice trials, a total of 122 items were presented and children were asked to assign or categorize each item under 11 categories which were indicated with referent pictures on a stimulus board. The responses of the children were rated on a 4 point rating scale.

Results: Results revealed a developmental trend in typical children between 2 to 4 years for superordinate categorization. The performance of children between >2.0 to <2.6 years was poorer compared to other age groups in general. There was no ceiling effect observed in any of the age groups, even in children between >3.6 to <4.0 years. Effect of gender was not observed in all the age groups and on all the superordinate categories. There was no significant difference in the performance of children between natural categories and artifacts across age and gender.

Conclusion: The task for superordinate categorization in typical Kannada speaking children between 2 to 4 years showed a developmental trend indicating that superordinate categorization evolves with age and may continue after four years of age. The performance of children was not significantly different on natural categories and artifacts and this suggests that the children were capable of identifying perceptual and functional/contextual similarities and this could have probably helped in the categorization task, although they are differently used as a function of context and circumstances.

Keywords: Taxonomic categorization; Superordinate categorization; Conceptual organization; Natural objects; Artifacts; Perceptual similarities; Functional/ contextual similarities

Introduction

Classification is a powerful cognitive process, allowing us to organize a great deal of information efficiently and flexibly. When we form classes, we highlight important similarities among objects and events, treating very different items as equivalent for certain purposes, since a particular item could be a member of many different classes. For example, an apple can be classified under 'fruit', 'food', 'physical object', etc. These classes are hierarchically organized and they honor inclusion relations.

Taxonomic categorization involves classification of items into groups based on similarities in the characteristics, structure, origin etc of the stimuli. In taxonomic categorization, it is often expected that items in a group have a strong association between them. For example, 'lion' is strongly associated with 'tiger' as both belong to the cat family. Taxonomic categories are classified into basic, superordinate and sub-ordinate levels [1]. The categories of 'animal', 'vehicle' and 'furniture' belong to the superordinate level. Subordinate levels share greater number of attributes when compared to superordinate level and lesser number of attributes when compared to basic level. For example, 'pug', 'gearless scooter' and 'armchair' belong to the subordinate level. Basic categories have more number of attributes associated with them. For example, 'dog', 'scooter' and 'chair' belong to the basic level. Lesser attributes are reported to be associated to superordinate level when compared to basic level [2]. Hierarchical categorization or taxonomic classification operates on basic categories and sets them into new order relationships with other categories at the same level and at higher and lower levels. Although children possess cognitive skills that enable them to form categories and hierarchies, acquisition of the taxonomies of a given cultural and linguistic community is a result of exposure and experience with the language used to formulate them. Taxonomic principles of inclusion and asymmetry emerge from these acquisitions and are not apriority or prerequisites to them.

The superordinate domains generally include broad biological kinds (such as animals, birds, and fruits/vegetables) or man-made artifacts (such as vehicles and tools) [3]. The basis of category specificity remains controversial; one influential view is that the natural kinds/ artifacts dichotomy captures a fundamental difference in the nature of the representations underlying different semantic categories, rather than simply reflecting the presence of two distinct knowledge systems.

Knowledge about one class of objects (dominated by natural kinds) is thought to be encoded principally in terms of perceptual features (size, shape, color, etc.), whereas functional attributes (such as how we interact with or use the object) are more salient for another class of objects (predominantly artifacts) [3].

Typical children are reported to use the superordinate relations naturally and spontaneously. In order to examine if 5 and 6 year-old children could understand taxonomic relations even though they prefer thematic ones, they were presented with a target picture and two choice pictures, where one was thematically related and the other was taxonomically related to the target. When the experimenter pointed to the target and asked for "the one that goes best with this one", children tended to pick thematic choice, thereby indicating a preference for thematic relation. Nevertheless, when they were asked about the taxonomic choice, all the children could explain the taxonomic relation. Hence it was concluded that, children have the ability to organize objects taxonomically, but it is often obscured by their attention to thematic relations [4].

The traditional view of organization abilities in children holds that preschoolers have little grasp of taxonomic relations, while children between 7 to 8 years of age understand these relations. This view is now challenged and to a large degree replaced by the "nonshift" view, which holds that both taxonomic and schematic knowledge are available to the young child [5]. This view is supported by studies which used different experimental designs in children aged 19 months to 5 years who were reported to rely on taxonomic category relations when tested on cued recall [6], match-to-sample [4,7,8], and forced-choice or sorting tasks [9,10].

Two developmental models explain the concept formation in children as follows:

1. The concepts mature based on contextual similarity (i.e., how objects are used) [11-15].
2. The concepts mature based on perceptual similarity (i.e., how objects look) [16-18].

The event schemas or scripts which are generalized representations of the roles that people play and the objects that they interact with are reported to develop at the end of the sensorimotor period [11,12]. With increased exposure and experience, the event schemas or scripts are enriched wherein children begin to understand that the objects which play the same role in a script can be substituted. This abstraction mechanism leads to the development of the first type of superordinate category which is slot-filler categories, in which the objects of the same kind share functional features and occur in a similar context. In the later stages, generalization mechanism allows the child to build decontextualized superordinate categories. The path of development to reach superordinate categories in children is reported to occur between 2 and 7 years of age in few studies [19]. According to some investigators, [13-14] concept formation is driven by the role that objects play in events and the global conceptual categories (e.g., animals or vehicles) which is similar to observation of decontextualized superordinate categories [11,12] that is acquired by 7-9 months, while more precise distinctions of the basic concepts develop later. In children as young as 14 months, specific functional properties, such as drinking from cup, are more often generalized from a similar concept of 'dog to animals' than 'dog to vehicles', but nonspecific functional properties, such as entering a building, are generalized often equally and are comparable to the concept of 'dog to animals' and 'dog to vehicles' [15]. This suggests that by the end of the first year of life, some properties are generalized independent of the visual appearance of objects and hence it is inferred that functional similarity originates from event schemas. That is, contextual or functional information extracted from event schemas form the basis for the development of superordinate taxonomic concepts in the early developmental period and continue to contribute for the development of concepts in the later years of life.

Few other studies have suggested that object concepts develop through the continual enrichment of perceptual categories [16-18]. During the first 3 to 4 months of life, infants form categorical representations at both basic and superordinate levels for certain natural objects (e.g., dogs, mammals) and certain artifacts (e.g: tables, furniture) [16,20]. Further, the acquisition of global perceptual categories precedes basic level categories [21]. Categorization in early infancy is reported to be fundamentally perceptual because modifications of the visual appearance of exemplars change infants' categorical responses and connectionist networks which receive physical attributes as input to reproduce infants' behavior [21-23]. Further, with increasing age, additional knowledge is acquired in several ways such as action with objects, language, and social interaction, which are associated with early categorical representations [16,17]. Object concepts are seen as having a single origin in all children, namely a perceptual/visual origin that is thought to be effective for all types of object. The visual information continues to influence preschoolers' categorization behavior, as in novel noun generalization tasks (extending a novel name to a novel object and in inductive generalization tasks extending a novel property to a novel object) [24-28].

A pluralistic approach to cognitive development states that several processes can fulfill the same cognitive function [29]. Others have reported that the functional/contextual and perceptual/visual similarities appear to play a role in infants' and children's concept formation; they seem to rely either on functional similarity [30,31] or on physical similarity [32,33] depending on situations. Further, the pluralistic view predicts that each process that fits a given situation would be utilized by a given individual. However, it is influenced by their experience with objects and differential use of concepts such as natural objects and artifacts [34-36].

Several other studies have also expressed that the visual and contextual similarities might be helpful in the categorization of natural objects and artifacts. In children aged between 4 years 2 month to 6 years 6 month, the core concepts of objects are reported to contain both functional and perceptual properties [37]. Functional properties were defined broadly as 'the purpose of the item, the people or instruments that act on the item, the way it is acted on, or the outcome of the item's actions', and perceptual properties were defined as 'physical properties, including color, shape, smell, feel, composition, life cycle, and movement', and further it was observed that only when object concepts contained knowledge of both perceptual and functional properties, objects were accurately identified by name [37].

The development of flexibility of categorization in children aged 3 to 5 years, were assessed in two experiments using a picture-matching task [38]. Results revealed that the children were able to produce both thematic and taxonomic types of categorization choices. Overall, a developmental path varying from spontaneous variability in 3 year olds to flexibility in five year olds was observed with a predominance of one mode of response. However, a majority of 4-year-olds were consistent on the thematic mode of response and adapted their responses to the scenes only to a limited extent.

A longitudinal study was carried out in children between 3 and 4 years to review the claims of pluralistic approach to concept formation [39]. Findings in the first experiment revealed that both perceptual and contextual similarities facilitated taxonomic grouping. Further, visual similarity was found to be more helpful in categorizing natural objects at the superordinate level, while contextual similarity facilitated specifically the categorization of artifacts. The second experiment on 3 year old children revealed that their individual preference for either basic level taxonomic (perceptually-based) or thematic (contextually-based) relations were affected superordinate categorizations of objects differently in both domains. In the third experiment, 5-year old children were trained to look for either common visual properties or common functions and it was found to differently modify superordinate categorization of natural objects and artifacts. The results of this study supported the pluralistic approach wherein different cues were found to be involved in the formation of natural and artifact concepts.

Another study on two to six year old children tested the ability of the children in cross-classification. Two different categories were used to test cross-classification: script (e.g: school-time items, birthday party items) and taxonomic (e.g: animals, clothes). The results revealed that from an early age, children form and use both taxonomic and script categories for cross-classification [40].

In an fMRI study with match to sample task, taxonomic processing was found to activate the visual networks that are commonly recruited during perceptual tasks since it involves looking for similarities between features [41].

This study aimed to analyze superordinate categorization abilities in 2-4 year old typically developing Kannada speaking children. Very few studies have addressed the taxonomic categorization abilities in children younger than 3 years of age [40]. Taxonomic categorization, especially the superordinate relations are found to be difficult for young children, though it is an important relation used by children in word or language learning. Investigators have reported that children rely more on thematic and slot-filler type of relations when assessed using match-to-sample task or recall conditions [4,42-44]. Few studies have used verbal prompt such as labeling or novel word conditions to assess the superordinate relations and they found that children preferred taxonomic relations in novel word conditions [10]. Hence the type of training and instructions issued to carry out the task were also reported to influence the children's ability to sort according to taxonomic relations or appearance [45,46]. Few other studies have reported that from an early age, children have the conceptual flexibility to use different types of categorization skills such as thematic or scripts and taxonomic [40,46,47]. Since different views are expressed and also because very few studies have addressed the superordinate classification abilities in children below 3 years of age, this study was undertaken including children below 3 years of age, using selected tasks which included classification of target stimuli presented along with distracters under various superordinate categories.

Aim of the Study

Aim of the study was to analyze and compare the performance of typical children in the age range of 2 to 4 years on superordinate categorization.

The specific objectives of the study were to analyze and compare the performance:

Across age and gender

1. Across the types of superordinate categories
2. Across and within the superordinate categories belonging to 'natural objects' and 'artifacts'.

Method

Participants

A total of 226 typical children were selected from different play homes and schools in Mysore city of Karnataka. All children spoke Kannada as their first language. These children were incipient bilinguals, with Kannada as their first language and exposed to English as their second language as the medium of instruction in their preschools. The children were divided into four sub groups based on their chronological age (>2.0 to <2.6 years; >2.6 to <3.0 years; >3.0 to <3.6 years; >3.6 to <4.0 years). The gender distribution of the group is shown in Table 1.

Gender	Age Groups in years			
	>2.0 to <2.6	>2.6 to <3.0	>3.0 to <3.6	>3.6 to <4.0
Boys	29	32	34	23
Girls	27	25	29	27
Total	56	57	63	50

Table 1: Total number of boys and girls in the study.

All the children were screened for any speech-language delay and deviations, neurological, sensory-motor, cognitive, behavioral and learning deficits by administering WHO disability screening checklist [48]. They were tested for age appropriate receptive and expressive language skills using the Assessment Checklist for Speech and Language skills [49]. All the children belonged to middle socio-economic status as assessed on NIMH Scale [50]. Informal screening by the investigator was carried out to ensure that all the children had normal or corrected visual abilities. Ethical clearance was obtained from heads of the play homes and/or schools to enroll the children for the present study. The school principal and parents were explained about the purpose and procedures of the study and verbal and written consent were taken.

Task for superordinate categorization

A total of 136, 3D-computerized color picture symbols were developed with the help of a professional graphic designer. These included 11 referent pictures to represent 11 different superordinate categories (animals, fruits, vegetables, clothes, birds, furniture, flowers, vehicles, kitchen items, body parts and insects – see Appendix). Three pictures were used as practice items and 122 pictures used for the main task. The pictures were subjected to ambiguity test wherein 2 Speech-Language Pathologists viewed the pictures and rated them on a 3-point rating scale, where '0' indicated least ambiguity and '3' indicated high ambiguity. The pictures which were judged to be least ambiguous were included as test items. If they were judged to be ambiguous, they were modified by graphic designer and were again subjected to rating by SLP's to be included only after being rated as not ambiguous.

Procedure

The children were interviewed, one at a time, in a quiet environment in their kindergarten premises which was a familiar environment for them. The match-to-sample task was introduced to the children as if it were a game. Each child was presented with a stimulus board with 12 blocks, where each of the first 11 blocks was filled with pictures symbol depicting lexical categories of animals, fruits, vegetables, clothes, birds, furniture, flowers, vehicles, kitchen items, body parts and insects respectively (see list in Appendix). The referents used to depict each of the eleven superordinate categories were as follows: a picture symbol of 'dog' was placed as a referent symbol to depict the category 'animal', 'apple' was used to depict 'fruit', 'carrot' for 'vegetable', 'shirt' for 'clothes', 'crow' for 'birds', 'chair' for 'furniture', 'rose' for 'flower', 'car' for 'vehicle', 'glass' for 'kitchen items', 'eyes' for 'body pats', and 'mosquito' for 'insects'. Children were explained about each of the referent picture by taking one or two exemplars from each category as instances. Before carrying out the task, the child was given 3 practice items (which were not part of the study), to ensure that they understood the task and the instruction. Once the child understood the instruction for the task to be carried out, the child was presented with 122 stimulus items one after the other and instructed to place each stimulus picture that was handed over to him/her by the investigator in the respective block/square depicting a particular superordinate category to which the child thought the stimulus item belonged. The investigator used the instruction *"Look at this picture. Where should you place this picture? To which picture does this match?"* No feedback was given about the performance of the child. The 122 sets were presented in random order across children to overcome order effect. Time taken for testing each child was approximately 1 hour with two to three rest periods in between and the task was completed in 1-3 sessions depending on the attention span and motivation of the child. Younger children (2-3 years of age) usually required more number of sessions, whereas older children (3.6 to 4 years) completed the task in one session with 2-3 rest periods in between. The children were reinforced with tokens or verbal praise irrespective of their response being correct or incorrect to keep them motivated to complete the entire task.

Analysis

The response of each child was scored as shown in Table 2. The maximum possible score that a child could attain was 366 (if all the 122 stimulus items were performed correctly by the child without any prompts). The total scores per child across the 11 lexical categories were tabulated and the group scores were noted.

Score offered	Type of responses
3	Child placed the picture symbol under correct superordinate category without requiring any cue.
2	Child required a visual prompt wherein the investigator randomly pointed to few of the referent pictures including the correct referent that matched the target, thereby reducing the number of distracters from 10 to 5.
1	Child required verbal prompt wherein the investigator named the target picture and facilitated placement of target under the required superordinate category.
0	Child placed the target picture in an incorrect block despite the visual and verbal prompts.

Table 2: Scoring pattern for different responses on the task of superordinate categorization.

Results

The total scores and percent scores were subjected to statistical analysis using SPSS software version 17 to address the objectives of the study. The data was first checked for assumptions of normality, to see if the dependent variable is normally distributed for each group for the independent variables namely, age and gender. Shapiro-Wilk test of normality was used and it was found that, there was normality only for the age groups >2.0 to <2.6 years (both boys and girls) and in >3.6 to <4.0 years (girls). The Levene's test of homogeneity of variance was run and it was found that, homogeneity of variance was absent in girls. Since the assumptions of normality and homogeneity of variance were not met for all the age groups and gender, nonparametric tests were run on data set, to test the aims and objectives of the study. Statistical measures such as descriptive statistics to obtain mean, median and standard deviation, Kruskal Wallis-H test to compare across different age groups, Mann Whitney- U test to compare between two independent groups, Friedman test and Wilcoxon signed rank test to compare between tasks were used in the study to meet the objectives of the study.

Effect of age and gender in superordinate categorization

The mean, median and SD of the children on the Task for Superordinate Categorization (TSC) is presented in Table 3. The mean scores indicate a developmental trend for the TSC task, inferring that the accuracy of the performance increased with increase in age. The main effect of age was significant on Kruskal Wallis-H test [(3)=97.97, $p<0.001$]. Further, results of pair wise comparison of age groups using Mann-Whitney U test on the overall TSC shown in Table 4 revealed a significant difference in the performance of children across different age groups wherein children of younger age groups performed significantly poorer than the children of older age groups at $p<0.008$, with large effect size ($0.5>r<0.9$) for all the pairs which were significantly different.

Age group (years)	Gender	Mean	Median	SD
>2.0 to ≤ 2.6	Boys	16.14	10.38	17.22
	Girls	12.18	1.91	20.36
	Total	14.23	3.82	18.73
>2.6 to ≤ 3.0	Boys	46.08	49.59	25.83
	Girls	53.28	55.19	18.55
	Total	49.24	53.55	23.02
>3.0 to ≤ 3.6	Boys	49.96	56.01	25.59
	Girls	66.54	70.22	13.93

>3.6 to ≤ 4.0	Total	57.59	64.21	22.48
	Boys	63.67	65.03	18.26
	Girls	70.6	68.03	9.69
	Total	67.42	66.53	14.55
Total		46.91	55.6	28.2

Table 3: Mean, Median and SD in percentage for the TSC across age and gender. TSC: Task for Superordinate Categorization; SD: Standard Deviation.

The main effect of gender was found to be significant on Mann Whitney-U test (/Z/=2.55, p<0.05). In addition, the effect of gender in each age group revealed a significant difference in the age range >2.0 to <2.6 years (/Z/=2.27; p<0.05), wherein boys performed significantly better in this age group. Further, Kruskal Wallis-H test revealed a significant difference in the performance of children across age groups within boys [(3)=39.10, p<0.001], and also within girls [(3)=57.17, p<0.001]. Results of Mann-Whitney U test as shown in Table 4 revealed a significant difference between boys of different age groups with medium to large effect size (0.4>r<0.8) for the pairs which were significantly different. Similarly, significant difference was found in the performance of girls across different age groups with medium to large effect size (>0.3 r<0.9) for the pairs which were significantly different.≤

Age groups (years)		TSC Overall		TSC in Boys		TSC in Girls	
		/Z/	r	/Z/	r	/Z/	r
>2.0 to ≤ 2.6	>2.6 to ≤ 3.0	6.57**	0.62	4.00**	0.51	5.12**	0.71
	>3.0 to ≤ 3.6	7.39**	0.68	4.32**	0.55	5.87**	0.78
	>3.6 to ≤ 4.0	8.30**	0.81	5.51**	0.76	5.98**	0.81
>2.6 to ≤ 3.0	>3.0 to ≤ 3.6	2.4	0.22	0.99	0.12	2.69**	0.37
	>3.6 to ≤ 4.0	4.83**	0.5	3.14**	0.42	3.54**	0.49
>3.0 to ≤ 3.6	>3.6 to ≤ 4.0	2.15	0.2	2.16	0.29	0.58	0.08

Table 4: Results of Mann- Whitney U test for pairwise comparison of age groups on TotTSC overall and in both gender groups. TSC: Task for Superordinate categorization; **: p<0.008; r: Effect size.

Performance across superordinate categories

Figure 1, shows the mean percent scores of the children for different superordinate categories. The observations from Figure 2 indicates that children in all the age groups obtained highest mean percent scores on the categories of birds, flowers, except for children of >2.0 to <2.6 years who obtained highest mean percent scores on 'vehicles'. Further, children in all the age groups obtained lowest scores on clothes, animals, furniture, followed by vegetables.

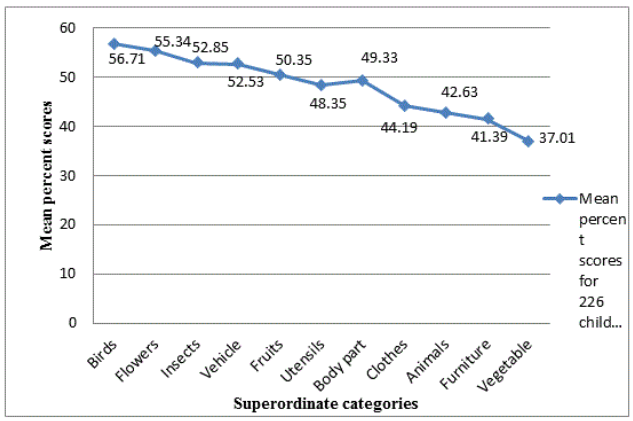

Figure 1: Mean percentage scores of all children for 11 superordinate categories.

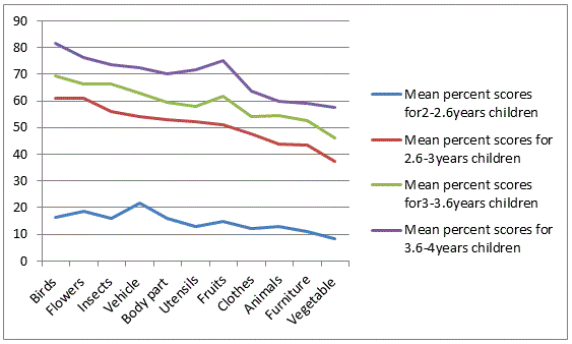

Figure 2: Developmental trend for superordinate categories across age groups.

Friedman test revealed significant difference in the performance of children across different superordinate categories [(10)=409.64, p<0.001]. Wilcoxon signed rank test was run and the results are shown in Table 5. Kruskal Wallis-H test revealed a significant main effect of age on each of the eleven superordinate categories at p<0.001 levels of significance. That is, a developmental trend was seen in all the superordinate categories with increase in age. Further, results of Mann-Whitney U test revealed that children of >2.0 to <2.6 years performed significantly poorer compared to children of all other age groups, on all of the superordinate categories at p<0.008 levels of significance with large effect size (0.5>r<0.7). No significant difference was found between the performance of children of >2.6 to <3.0 years and >3.0 to

<3.6 years on all the categories except for that of animals with small effect size (r=0.27. However, they performed significantly poorer when compared to children of >3.6 to <4.0 years on all the eleven superordinate categories at p<0.008 levels of significance with medium effect size (0.3>r<0.5). There was no significant difference found between children of >3.0 to <3.6 years and >3.6 to <4.0 years group on all the categories except on fruits. In summary, highest scores were achieved by the children in the age range of >3.0 to <3.6 years and >3.6 to <4.0 years on all the categories except for fruits which was performed better by children of >3.6 to ≤4.0 years.

Superordinate categories	/z/ & r values	Animals	Birds	Body parts	Flowers	Fruits	Insects	Vehicles	Clothes	Furniture	Utensils
Vegetables	/z/	5.21**	10.80**	7.84**	10.30**	9.05**	9.25**	9.9**	5.61**	3.41**	8.60**
	r	0.35	0.72	0.52	0.68	0.6	0.62	0.66	0.37	0.23	0.57
Animals	/z/		9.42**	5.34**	8.89**	6.79**	6.91**	7.91**	0.97	1.2	4.71**
	r		0.63	0.36	0.6		0.46	0.53	0.06	0.08	0.31
Birds	/z/			4.46**	1.81	5.13**	3.64**	3.44**	9.62**	9.50**	6.50**
	r			0.3	0.12	0.34	0.24	0.23	0.64	0.63	0.43
Body parts	/z/				3.73**	0.57	1.8	1.72	3.92**	5.41**	1.26
	r				0.25	0.04	0.12	0.11	0.26	0.34	0.08
Flowers	/z/					3.99**	1.88	2.27**	8.40**	8.54**	4.98**
	r					0.27	0.13	0.15	0.56	0.57	0.33
Fruits	/z/						1.34	1.82	5.75**	6.19**	1.93**
	r						0.09	0.12	0.38	0.,41	0.13
Insects	/z/							0.26	6.47**	7.75**	3.40**
	r							0.02	0.43	0.52	0.23
Vehicles	/z/								7.74**	8.31**	3.08**
	r								0.52	0.55	0.21
Clothes	/z/									2.59	4.07**
	r									0.17	0.27
Furniture	/z/										5.24**
	r										0.35

Table 5: Results of Wilcoxon signed ranks test for pairwise comparison of superordinate categories. **: p<0.05; r: Effect size.

Results of Mann Whitney-U test revealed a significant effect of gender on the superordinate categories of vegetables, clothes, animals, body parts and fruits at p<0.05 levels of significance, where the performance of boys were significantly better than girls on these categories. Further, the effect of gender in each age group revealed a significant difference between gender in children of >2.0 to <2.6 years (where in boys performed significantly better on birds and flowers at p<0.05), in >2.6 to <3.0 years (girls performed significantly better on furniture at p<0.05), and in >3.0 to <3.6 years (girls performed significantly better on animals, body parts, fruits, vehicles, clothes, and utensils at p<0.05).

Further Kruskal Wallis-H test revealed that there was a significant difference in the performance of children across age groups in all the 11 superordinate categories within boys and also within girls at p<0.01 levels of significance. Results of Mann-Whitney U test reveals that boys of >2.0 to <2.6 years performed significantly poorer compared to boys of all other age groups, on all of the superordinate categories at p<0.008 levels of significance with large effect size (0.5>r<0.9). A significant difference was found between the performance of boys of >2.6 to <3.0 years and >3.0 to <3.6 years only on the categories of animals and insects with medium effect size (0.3>r<0.5). Further, significant difference was found between the performance of boys of >2.6 to <3.0 years and >3.6 to <4.0 years only on the categories of birds, body parts, fruits, insects and utensils at p<0.008 levels of significance with medium to large effect size (0.3>r<0.6). There was no significant difference found between children of >3.0 to <3.6 years and >3.6 to <4.0 years group on all the categories at p>0.008 levels of significance.

The response of girls of younger age groups i.e., girls of >2.0 to <2.6 years on Mann-Whitney U test were similar to the boys of the corresponding age group at p<0.008 levels of significance with medium to large effect size (0.4>r<0.8). Further, significant difference was found between the performance of girls of >2.6 to <3.0 years and >3.6 to <4.0 years only on the categories of flowers, fruits, vehicles and

furniture at p<0.008 levels of significance with medium effect size (0.3>r <0.5).

Comparison of performance between superordinate categories representing natural objects and artifacts

The superordinate categories were grouped into two domains namely 'natural objects' and 'artifacts'. In this study, the classification of natural objects and artifacts was adapted from a previous study [3], which defined natural objects as those with biological underpinnings (such as animals, birds, and fruits/vegetables) and artifacts as man-made objects (such as vehicles and tools)]. In this study 'natural objects' included 7 superordinate categories namely vegetables, animals, birds, body parts, flowers, fruits and insects and 'artifacts' included 4 categories namely vehicles, clothes, furniture and utensils.

Although the mean percentage values for the categories of natural objects and artifacts were different across the two categories as shown in Table 6, when Wilcoxon signed ranks test was run, the differences were not found to be significant across categories (/Z/=0.316, p>0.05) and the four age groups, and within gender [boys: (/Z/=1.16, p>0.05) and girls (/Z/=0.78, p>0.05)] at p>0.05 levels of significance.

Age group (in years)	Gender	NO			ARTF		
		Mean	Median	Standard Deviation	Mean	Median	Standard Deviation
>2.0 to ≤ 2.6	Boys	15.75	9.01	16.21	17.09	12.77	19.47
	Girls	11.98	1.8	20.51	12.77	2.13	20.94
	Total	13.93	4.5	18.33	15.01	3.55	20.13
>2.6 to ≤ 3.0	Boys	46.59	52.7	26.58	46.25	48.94	26.04
	Girls	53.05	52.7	18.98	54.78	56.74	19.33
	Total	49.42	52.7	23.58	49.99	53.9	23.53
>3.0 to ≤ 3.6	Boys	50.32	59.01	25.49	50.46	58.16	27.05
	Girls	67.92	72.07	13.89	65.79	68.79	15.78
	Total	58.42	65.77	22.61	57.51	65.25	23.69
>3.6 to ≤ 4.0	Boys	63.45	63.51	18.8	65.37	68.09	19.09
	Girls	72.09	71.17	11.21	69.77	70.21	10.36
	Total	68.12	67.12	15.63	67.74	70.21	15.02
Total		47.27	48.32	28.7	47.35	48.94	28.71

Table 6: Percentage Mean, Median and SD for *NO and *ARTF across age and gender. NO: Natural Objects and ARTF: Artifacts.

Comparison of performance within superordinate categories representing natural objects and artifacts

The percentage Mean, Median and SD for the natural objects and artifacts in the superordinate categories are shown in Table 7.

Domains	Superordinate categories	Descriptive	>2.0 to <2.6 years		>2.6 to <3.0 years		>3.0 to <3.6 years		>3.6 to <4.0 years		Total
			Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls	
Natural Objects	Vegetables	Mean	8.58	7.69	35.58	39.79	39.52	53.49	51.17	63.06	37.01
		Median	5.13	0	30.77	33.33	46.15	51.28	53.85	58.97	38.46
		SD	14.56	17.33	26.25	28.8	25.63	17.47	25.68	20.37	28.94
	Animals	Mean	13.19	12.61	43.04	44.42	45.05	65.82	56.37	62.51	42.63
		Median	8.77	1.75	50.88	45.61	53.51	73.68	56.14	63.16	48.25
		SD	12.51	21.1	25.72	19.5	24.67	18.95	21	14.85	27.61
	Birds	Mean	20	12.35	56.77	66.13	63.43	75.98	76.23	85.93	56.71

		Median	13.33	0	68.33	76.67	73.33	80	80	86.67	70
		SD	22.84	23.6	33.45	23.92	34.11	18.05	22.97	12.86	35.24
	Body part	Mean	19.23	12.68	48.96	57.82	49.38	70.95	64.82	74.41	49.33
		Median	6.06	3.03	54.55	66.67	50	75.76	69.7	81.82	51.52
		SD	26.3	21.15	30.07	24.15	30.98	23.03	28.76	23.76	33.52
	Flowers	Mean	23.22	13.83	54.58	68.8	61.96	71.26	72.75	79.51	55.34
		Median	20	0	60	66.67	73.33	73.33	80	80	66.67
		SD	21.35	21.32	28.26	19.51	30.64	18.44	18.08	13.83	31.53
	Fruits	Mean	15.98	13.95	46.46	57.07	50.98	73.91	70.58	78.77	50.35
		Median	10	0	51.67	60	53.33	73.33	73.33	83.33	56.67
		SD	16.98	25.47	29.68	23.91	28.14	17.86	22.71	15.64	32.5
	Insects	Mean	19.35	12.55	53.99	58.67	59.48	74.14	69.08	77.37	52.85
		Median	5.56	0	66.67	55.56	72.22	77.78	72.22	83.33	61.11
		SD	23.92	23.35	31.99	21.22	31.24	18.68	24.78	11.42	33.07
Artifacts	Vehicles	Mean	26.19	17.02	50.3	58.57	55.25	71.43	72.26	72.84	52.53
		Median	28.57	4.76	52.38	61.9	57.14	73.81	73.81	71.43	58.33
		SD	25.32	25.57	28.16	21.85	28.46	18.8	21.15	13.41	30.41
	Clothes	Mean	13.12	11.32	41.75	54.67	46.73	62.84	60.75	66.26	44.19
		Median	5.56	0	38.89	55.56	52.78	66.67	58.33	69.44	52.78
		SD	20.55	20.67	28.9	19.49	28.87	14.87	18.94	12.3	29.31
	Furniture	Mean	11.93	9.72	37.76	51	47.79	58.33	59.42	58.49	41.39
		Median	4.17	0	37.5	54.17	52.08	58.33	58.33	58.33	41.67
		SD	16.01	19.23	24.06	19.74	29.23	19.19	22.45	17.28	28.4
	Utensils	Mean	14.15	11.4	51.28	53.13	50.38	67.02	65.89	76.64	48.35
		Median	5.13	0	61.54	51.28	56.41	69.23	76.92	82.05	56.41
		SD	22.84	22.64	29.6	26.1	29.63	21.23	23.72	15.29	32.79

Table 7: Percentage Mean, Median and SD for each category in the domains of natural objects and artifacts. SD: Standard Deviation.

From Table 7, it can be observed that the children scored the highest for the category of birds and the least for the category of vegetables within natural objects. Similarly, children scored highest for the category of vehicles, and lowest for the category of furniture within artifacts. Friedman test revealed significant difference in the performance of children between all seven categories of natural objects [(6)=251.18, p<0.01]. Further, Wilcoxon signed rank test revealed a significant difference between all of category pairs of natural objects at p<0.001 level of significance, except for flowers-birds (/Z/=1.81, p=0.07), fruits – body parts (/Z/=0.57, p=0.57), insects- body parts (/Z/=1.80, p=0.07), insects- flowers (/Z/=1.88, p=0.06), and insects-fruits (/Z/=1.34, p=0.18).

Within the pairs of Artifacts, Friedman test revealed a significant difference in the performance of children between the 4 categories of artifacts [(3)=100.40, p<0.01]. Further, Wilcoxon signed rank test revealed a significant difference between all the artifact pairs at p<0.001 level of significance. That is, they performed significantly better on the category of vehicles, followed by utensils, clothes, and furniture.

Discussion

The task for superordinate categorization in children between 2 to 4 years showed a developmental trend. The performance of children between >2.0 to <2.6 years was poorer on the task of superordinate categorization despite being facilitated with cues. In comparison, children above the age of 2.6 years showed a better performance. There was no ceiling effect observed in any of the age groups, even in children between >3.6 to <4.0 years, who obtained a maximum score

of 67%, which shows that superordinate categorization evolves with age and may continue after four years of age. The performance of the children in the higher age groups (>3.6 to <4.0 years) was better than the lower age groups suggesting that with increase in age, the ability to identify functional relationships within the superordinate categories improves and this could probably be due to improvement in cognitive abilities. This could also be attributed to increase in vocabulary and familiarity with age for category labels such as birds, flowers, dress, body parts, fruits etc as a reflection of exposure at home and preschool environments. Further, categorization of superordinate items such as vehicles, flowers and birds were better when compared to other categories such as animal. For example, children in the higher age group could label 'mango' as a 'fruit' when asked whether 'mango' is a 'fruit or vegetable', where as they failed to label 'dog' as an 'animal' when asked whether dog was an animal or bird. Hence it can be said that the ability of superordinate categorization was yet to mature even in children of >3.6 to < 4.0 years. Similar results were reported in earlier studies [4,42-44]. These studies found that young preschoolers' conceptual knowledge was confined to the level of slot-filler form of taxonomic categorization which are event or context bound relations (e.g., food eaten at lunch), with mastery of superordinate categories with age and maturation of cognitive processes such as the ability to identify the abstract functional relationships and commonalities between different slot-filler categories and language growth to recognize that the same superordinate term applies across slot-filler sets. Further, it is observed that the performance of children in each of the age groups is highly variable (very high standard deviation), which suggests that the ability of superordinate taxonomic categorization is not homogenous within the group; individual differences are possible. Similar trend was found in earlier studies conducted by [38,40]. Other studies also reported that children do not acquire the concept of superordinate categorization until 7 to 8 years of age [51-54]. Contrary to the observations made in these studies, the results of this study suggests that the concept of superordinate categorization starts emerging in children as young as 2.6 years and gets better with age. There was no scope to compare these results with mature adults and hence it is not sure whether the evolution of these categorization abilities continues up to adulthood.

Further, the response pattern of children in the different age groups varied. Many children in the >2.0 to <2.6 years group did not seem to understand the concept of categorization. Few of these children were observed to respond randomly despite controlling the instructions and the cues. For example, some children matched beans to crow, owl to glass, rabbit to glass. Few others seemed to partially understand the concept of grouping, basing it on matching for perceptual similarities that were largely influenced by colors. For example, matching a blue colored vessel to a referent representing the category of vehicles, which were also blue in color.

Few of the children were confused when categories which were semantically similar such as fruits and vegetables and vice-versa were presented. For example, matching banana with carrot, cabbage with apple etc. Few of these children also showed thematic and functionally guided responses like matching knife to apple, shirt to cup-board. The younger children required more cues such as visual prompting and naming to perform better on the categorization task than the children of higher age groups who could perform better with visual prompting wherein the number of distracters was reduced and they also required lesser prompts in the form of naming when compared to children in younger age groups. The response pattern of children in the >2.6 to <3.0 years age group in the categorization tasks were similar to that of >2.0 to <2.6 years, but showed differences while categorizing the members of 'birds and insects' and 'animals and insects'. This can also be viewed as the ability to categorize the stimuli based on semantic cues as both the categories were related semantically. Further, the error patterns of the children in the age group of >3.0 to <4.0 years were similar to that of >2.6 to <3.0 years.

Also, no significant difference emerged in the performance of children when compared across natural objects and artifacts; age groups and gender. This suggests that the 2 to 4 year old typical children have acquired the concepts of perceptual similarities and functional/contextual similarities which help them categorize natural objects and artifacts though they are differently used as a function of context and circumstances. These results are in consonance with the view expressed in the "Pluralistic approach" [29], according to which both functional/contextual similarities and perceptual/visual similarities appear to play a role in infants' and children's concept formation. This was further supported by other studies [55,56].

The responses of the children for items belonging to natural objects were better for the categories of birds and flowers, followed by insects, fruits, body parts, vehicles, and utensils. On the other hand, poor responses were observed for the categories of clothes, animals, furniture and the least on vegetables. This suggests that the children probably scored better for categories with high perceptual similarity to the referent (such as birds and flowers) compared to the categories with poor perpetual similarity to the referents (such as animals and vegetables). It was also observed that although all the items of the categories of birds and flowers were not within the expressive vocabulary of the children, they probably depended on their conceptual representations of overall features of birds such as presence of beak, wings, and their familiarity with the category term for bird ['Pakshi' (bird) in Kannada], functional concept such as 'fly' etc and hence showed better performance for this category compared to the category of animals which had more diverse perceptual features compared to birds. The category items of animals were better known to the children by their names such as dog, cat, cow, etc. than their familiarity with the superordinate term of animals ['Praani (Animal) in Kannada]'. Similarly the better performance for the category of flowers could be due to the overall similarity in the form of different flowers, and familiarity with the category label ['hoova' (flower) in Kannada]'. It could also be speculated that in most instances, the exposure to the categories of animals and vegetables can be more frequent in children compared to the categories of birds and flowers and hence along with the factor of perceptual similarity, exposure and familiarity with the term indicating the category holistically along with the knowledge of functional attributes could have aided the performance. Similar view was expressed by other investigators [37] who reported that the core concepts of objects in children aged between 4 year 2 month to 6 year 6 month contained both functional and perceptual properties. The findings of this study can also be compared with the view expressed by investigators [57] who observed that the taxonomically related items share one or more attributes and that in early phases of development, the shared features that define a class for the child are likely to be perceptual (e.g., dogs and cats look alike in many respects) and/or functional (e.g., dogs and cats are both treated as pets), but with increasing age, children seem to acquire the potential to appreciate the abstract features which define superordinate levels of taxonomic relations (e.g., birds and buffalo are both living beings). They [57] also reported that 2-year-olds were capable of recognizing a variety of taxonomic relations, but their ability to do so was largely depended on the presence of shared perceptual features. This view was also

supported by a study [41] wherein it was hypothesized that taxonomic relations would selectively activate visual networks because they entail similarity of features.

The performance of children on matching the artifacts revealed better performance for the category of vehicles, followed by utensils, clothes and furniture. The combined effects of high functional use/ similarity between the members of the vehicles (such as the concept that all the vehicles move), frequency of exposure and attraction level of the stimuli to the children of this age group, and also the perceptual similarities between the members of this group (for example, most of the vehicles have wheels), could be the reason for the better performance for the category of vehicles compared to other categories. It was noted that perceptual similarity, familiarity with the superordinate label, and contextual similarity probably facilitated the responses of the children and helped in categorization of natural objects. On similar lines, it is observed that the functional or contextual similarity, actions performed, and to some extent perceptual similarities helped children to respond better for the artifacts. Further, the amount of exposure and experiences with the stimuli, attraction level of the stimuli served as additional factors to aid in the performance of children on both the categories. These observations are in line with a study [39] which reported that the developmental mechanisms of concept formation differ according to the objects involved and in this way support the 'pluralistic approach' [29,58] rather than views based on either 'contextual similarity [12,14] or 'perceptual similarity' [17] of development of superordinate concepts. Another study [39] revealed that by 4 years of age, contextual similarity serves as an efficient cue to group artifacts than the natural objects, while visual similarity helps in the categorization of natural objects, suggesting that different mechanisms might be at work as a function of the objects involved and the children's own preferences, during concept formation.

Conclusion

The superordinate categorization abilities showed a clear developmental trend with age and emerged in children as young as 2.6 years and continued to progress up to the age of >3.6 to <4.0 years. Effect of gender was not consistent, as gender effect was not seen in all the age groups and on all the superordinate categories. A developmental trend was also seen in each of the eleven superordinate categories where the performance of children got better on each category with age. Overall the performance of children was better for categories of 'birds', 'flowers', 'insects', and was poor for the categories of 'clothes', 'animals', 'furniture', vegetables'. The performance of children was not significantly different for natural categories and artifacts across age and gender, suggesting that the children could have acquired the concepts of perceptual similarities and functional/ contextual similarities which helped in categorizing natural objects and artifacts although they are differently used as a function of context and circumstances. Further, the results highlighted the role of perceptual similarities, functional/ contextual similarities and familiarity with the superordinate label, as key factors in superordinate categorization. Other factors that seemed to influence the responses in the superordinate categorization task included the amount of exposure, experience with the stimuli and the level of attraction towards the stimuli.

Acknowledgements

We would like to extend our sincere gratitude to the Director, AIISH, Mysore for the opportunity to conduct the study. We would like to thank all the cute tiny kids who actively and patiently participated in the study. We also thank all the school authorities and parents for their consent and timely cooperation for the sake of science.

References

1. Rosch EH, Mervis CB (1975) Family resemblances: Studies in the internal structure of categories. Cogn Psychol 7: 573-605.
2. Schlosser R (1997) Nomenclature of category levels in graphic symbols, Part I: is a flower a flower a flower? Augment Altern Commun 13: 4-13.
3. Garrard P, Lambon Ralph MA, Hodges JR, Patterson K (2001) Prototypicality, distinctiveness and intercorrelation: Analyses of the semantic attributes of living and nonliving concepts. Cogn Neuropsychol 18: 125-174.
4. Smiley SS, Brown AL (1979) Conceptual preference for thematic or taxonomic relations: A nonmonotonic age trend from preschool to old age. J Exp Child Psychol 28: 249-257.
5. Mandler JM (1983) Representation. In JH Flavell & EM Markman (Eds.), PH Mussen (Series Edn). Handbook of child psychology: Cognitive development 3: 420-494.
6. Blewitt P, Toppino T (1991) The development of taxonomic structure in lexical memory. J Exp Child Psychol 51: 296-319.
7. Bauer P, Mandler J (1989) Taxonomies and triads: Conceptual organization in one- to two-year-olds. Cogn Psychol 21: 156-184.
8. Fenson L, Cameron MS, Kennedy M (1988) Role of perceptual and conceptual similarity in category matching at age two years. Child Dev 59: 897-907.
9. Markman EM, Cox B, Machida S (1981) The standard object-sorting task as a measure of conceptual organization. Dev Psychol 17: 115-117.
10. Markman EM, Hutchinson JE (1984) Children's sensitivity to constraints on word meaning: Taxonomic versus thematic relations. Cogn Psychol 16: 1-27.
11. Nelson K (1983) The derivation of concepts and categories from event representations. In EK Scholnick (Ed.), New trends in conceptual representation: Challenges to Piaget's theory? Hillsdale, NJ: Erlbaum: 129-149.
12. Nelson K (1985) Making sense. Development of meaning in early childhood. New York: Academic Press.
13. Mandler JM (1992) How to build a baby: II. Conceptual primitives. Psychol Rev 99: 587-604.
14. Mandler JM (2000) Perceptual and conceptual processes in infancy. J Cogn Dev 1: 3-36.
15. Mandler JM, McDonough L (1998) Studies in inductive inference in infancy. Cogn Psychol 37: 60-96.
16. Quinn PC, Eimas PD (1996) Perceptual organization and categorization. In C. Rovee- Collier and L. Lipsitt (Eds.), Advances in infancy research, Norwood, NJ: Ablex Publishing Corporation 10: 1-36.
17. Quinn PC, Eimas PD (2000) The emergence of category representations during infancy: Are separate perceptual and conceptual processes required? J Cogn Dev 1: 55-61.
18. Rakison DH, Poulin-Dubois D (2001) Developmental origin of the animate-inanimate distinction. Psychol Bull 127: 209-228.
19. Lucariello J, Kyratzis A, Nelson K (1992) Taxonomic knowledge: What kind and when? Child Dev 63: 978-998.
20. Arterberry ME, Bornstein MH (2001) Three-month-old infants' categorization of animals and vehicles based on static and dynamic attributes. J Exp Child Psychol 80: 333-346.
21. Quinn PC, Johnson MH (2000) Global before basic category representations in connectionist networks and 2-month old infants. Infancy 1: 31-46.

22. Quinn PC, Eimas PD, Rosenkrantz SL (1993) Evidence for representations of perceptually similar natural categories by 3-month-old and 4-month-old infants. Perception 22: 463-475.
23. French RM, Mareschal D, Mermillod M, Quinn PC (2004) The role of bottom-up processing in perceptual categorization by 3- to 4-month-old infants: simulations and data. J Exp Psychol Gen 133: 382-397.
24. Baldwin DA (1992) Clarifying the role of shape in children's taxonomic assumption. J Exp Child Psychol 54: 392-416.
25. Jones SS, Smith LB (2002) How children know the relevant properties for generalizing object names. Dev Sci 5: 219-232.
26. Sloutsky VM, Fisher AV (2004) Induction and categorization in young children: A similarity-based model. J Exp Psychol 133: 166-188.
27. Fisher AV, Sloutsky VM (2005) When induction meets memory: evidence for gradual transition from similarity-based to category-based induction. Child Dev 76: 583-597.
28. Yoshida H, Smith LB (2005) Linguistic cues enhance the learning of perceptual cues. Psychol Sci 16: 90-95.
29. Lautrey J (2003) A pluralistic approach to cognitive differentiation and development. In R. J. Sternberg, J. Lautrey, & T. Lubart (Eds.), Models of Intelligence: International Perspectives, Washington, DC: APA Press: 117-131.
30. Kemler NDG, Russell R, Duke N, Jones K (2000) Two-year-olds will name artifacts by their functions. Child Dev 71: 1271-1288.
31. Diesendruck G, Markson L, Bloom P (2003) Children's reliance on creator's intent in extending names for artifacts. Psychol Sci 14: 164-168.
32. Landau B, Smith L, Jones S (1998) Object shape, object function, and object name. J Mem Lang 38: 1-27.
33. Graham SA, Williams LD, Huber JF (1999) Preschoolers and adults reliance on object shape and object function for lexical extension. J Exp Child Psychol 74: 128-151.
34. Bonthoux F, Scheuner N, Roll N (2003) Construction methods of categories differentiated by field. Elements of response in children and older adults. Cogn Brain Behav 7: 91-109.
35. Bonthoux F, Berger C, Blaye A (2004) Birth and development of concepts in children categorize to understand, Paris, Dunod.
36. Bonthoux F, Blaye A (2007) The child and the world of objects: conceptual development aspects. In A. Blaye, & P. Lemaire. (Eds.), Cognitive development of the child, Bruxelles, De Boeck: 95-123.
37. McGregor KK, Friedman RM, Reilly RM, Newman RM (2002) Semantic representation and naming in young children. Journal of Speech, Language and Hearing Research 45: 332-346.
38. Blaye A, Bonthoux F (2001) Thematic and taxonomic relations in preschoolers: The development of flexibility in categorization choices. Br J Dev Psychol 19: 395-412.
39. Bonthoux F, Kalenine S (2007) Preschoolers superordinate taxonomic categorization as a function of individual processing of visual vs. contextual/functional information and object domain. Cogn Brain Behav 11: 713-731.
40. Nguyen SP (2007) Cross-classification and category representation in children's concepts. Dev Psychol 43: 719-731.
41. Kalenine S, Peyrin C, Pichat C, Segebarth C, Bonthoux F, et al. (2009) The sensory-motor specificity of taxonomic and thematic conceptual relations: A behavioral and fMRI study. NeuroImage 44: 1152-1162.
42. Lucariello J, Nelson K (1985) Slot-filler categories as memory organizers for young children. Dev Psychol 21: 272-282.
43. Nelson K, Nelson AJ (1990) Category production in response to script and category cues by kindergarten and second grade children. J Appl Dev Psychol 11: 431-446.
44. Yu Y, Nelson K (1993) Slot-filler and conventional category organization in young Korean children. Int J Behav Dev 16: 1-14.
45. Deák G, Bauer PJ (1995) The effects of task comprehension on preschoolers' and adults' categorization choices. J Exp Child Psychol 60: 393-427.
46. Waxman SR, Namy LL (1997) Challenging the notion of a thematic preference in young children. Dev Psychol 33: 555-567.
47. Nguyen SP, Murphy GL (2003) An apple is more than just a fruit: cross-classification in children's concepts. Child Dev 74: 1783-1806.
48. Singhi P, Kumar M, Malhi P, Kumar R (2007) Utility of the WHO Ten Questions screen for disability detection in a rural community the north Indian experience. J Trop Pediatr 53: 383-387.
49. Swapna N, Jayaram M, Prema K, Geetha Y (2010) Intervention module for pre-school children with communication disorders to facilitate speech-language domain.
50. Venkatesan S (2011) Socio-economic status scale. Revised version of NIMH Socio Economic Status Scale-1993. Mysore: AIISH.
51. Inhelder B, Piaget J (1964) The early growth of logic in the child. New York: Harper & Row.
52. Olver RR, Hornsby JR (1966) On equivalence. In J. S. Bruner, R. R. Olver, & P. M. Greenfield (Eds.), Studies in cognitive growth, New York: Wiley: 68-85.
53. Nelson K (1977) The syntagmatic-paradigmatic shift revisited: a review of research and theory. Psychol Bull 84: 93-116.
54. Ornstein PA, Corsale K (1979) Organizational factors in children's memory. In C. R. Puff (Ed.), Memory organization and structure: 219-257, New York: Academic Press.
55. Kemler Nelson DG (1995) Principle-based inferences in young children's categorization: Revisiting the impact of function on the naming of artifacts. Cogn Dev 10: 347- 380.
56. Diesendruck G, Hammer R, Catz O (2003) Mapping the similarity space of children and adults artifact categories. Cogn Dev 18: 217-231.
57. Fenson L, Vella D, Kennedy M (1989) Children's knowledge of thematic and taxonomic relations at two years of age. Child Dev 60: 911-919.
58. Bonthoux F (2001) The development of categorization. In O. Benga and M. Miclea (Eds.), Development and cognition, Cluj-Napoca, Cluj University Press: 59-88.