Original Article

Culturally Appropriate Stimuli for Cognitive Neuropsychology-Based Treatment "Intensive Language Action Therapy (ILAT)"

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Abstract

Context: A standardized set of picture stimuli for neuro-language disorder has been long overdue. **Aims:** To develop a standardized set of 303 pictures for use in experiments of Intensive Language Action Therapy (ILAT). **Methods and Material:** Several sources with standardized picture stimuli having culturally unbiased features were studied. Among those studies two prime sources (1) Snodgrass & Vanderwart (1980), 127 (89+37) items and (2) Neininger & Pulvermuller (2002), 147 (89+56) items were used extensively. Out of 303 stimuli, 89 items were common to both principle sources. An Indian study by George & Mathuranath (2007) has also been taken as an additional source. Line drawing stimuli were standardized on four variables of central relevance to memory and cognitive processing: name agreement, image agreement, familiarity, and visual complexity. **Statistical analysis used:** All measures related to 303 concepts i.e. % correct, H statistics, familiarity, image agreement and visual complexity were analysed descriptively. **Results:** Low mean and positive skew on H statistics and visual complexity show that many concepts had a high name agreement (13 concepts have H values of .0, and 55 have H values of 0.68 or below, where 0.68 represents consensus among all but few of the subjects on a picture's name) and were visually simple line drawings. The intercorrelations among the four measures were low, suggesting that they are indices of different attributes of the pictures. **Conclusions:** Usage of appropriate items/stimuli has immense potential to influence aphasia therapy outcome. This set of pictures and its normative variable has enhanced the ILAT outcome. It could be generalised for other aphasia therapy too to understand its efficacy.

Keywords: Familiarity, ILAT, Imageability and visual-complexity, snodgrass and vanderwart

Guest editor's notes: It's a tough paper to read for general neurologists. However, it is desirable that clinicians with some interest in aphasiology do get acquainted with a bit of linguistics and psychometric principles and methods for development of standardised and validated 'stimuli' for assessment and therapy. The 'stimulus' means any picture, photograph, drawing, printed word and sentence and more, for testing. The authors report development of a set of 303 pictures, which were subsequently used in a 'card matching game' by a few groups of PWA, as a part of Intensive Language Action Therapy.

Background

Aphasia is an acquired disorder of language caused by damage to the regions of the brain in the left cerebral hemisphere which are responsible for language production and comprehension. In India, a prospective study by Panicker *et al*., 2003 found that 25% of people with ischemic stroke exhibited aphasia.[1]

There have been major advances in Speech Language Therapy (SLT) in the last 1–2 decades. Many well designed and ingenious randomized clinical trials of SLT have provided robust evidence for efficacy of therapy.[2] Intensive Language Action Therapy (ILAT) is a type of approach based on Cognitive Neuro-Psychological (CNP) model of language organization in brain.[3,4] ILAT aims to re-strengthen links between phonological, lexical, semantic, and conceptual circuits, related to actions and perceptions, by co-activating these neuronal ensembles. ILAT comprises of: (i) massed practice, (ii) behaviorally relevant multimodal inputs that mimic communication in everyday life, and (iii) means to prevent "learned non-use" of communicative functions.[5]

One variety of ILAT engages a small group of PWA (3–5) in an interesting "Card Matching Game."[5] The cards for this

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therapeutic game have to be chosen and created in a scientific manner. Probing and analysis of language processing in healthy and diseased brain requires experimental stimuli such as a real object or line drawing or photographs of objects, actions and scenes, printed letters, words, phrases, and sentences. Images and words have a wide variability in term of perceptual saliency, frequency in daily usage, familiarity, shape, and meaningfulness. Several investigators have developed and normalized many sets of stimuli permitting better control over features which influence performance over different type of tasks.

Clinicians' and researchers in aphasiology and cognitive behavioral neurology got benefitted from a standardized and validated database,[6] as they now can systematically balance these stimulus variables across experimental conditions. In the current era, it is not possible to use non-standardized stimuli for assessment, therapeutic intervention, and research experimentation. A normative database is essential to build upon a standardized set of stimuli.

Oxford Psycholinguistic Database by Medical Research Council (UK) and Boston Naming Test (1983) were the early examples of normative database.[7,8] These databases have been followed by many other, for example, a set of 400 pictures by Brodeur *et al*. and inclusion of set of action verbs by Masterson and Druks.[9,10]

It is also crucial to study how culture and language influence the behavior and performance across normative variables. The set of line drawings by Mathuranath and George from Kerala in South India is one such seminal work, which was one of the sources for us.[11]

Developing a standardized and validated set of black and white line drawings also requires attention to the purpose of use. Stimuli set for "diagnostic purpose" may be somewhat different from that for "therapeutic purpose." Our focus was to use this set of stimuli for a therapeutic purpose primarily.[12] Its usage has been studied during Intensive Language Action Therapy (ILAT) for chronic heterogeneous group of aphasia and its analysis is under preparation for another publication.[12] Familiarity with stimuli influences accuracy of word picture matching, word retrieval and helpful to strengthen communication in everyday life activities.[13] This aspect of stimuli was taken in consideration during ILAT.[12]

Methodology

Developing experimental card, its source and features

Set of picture cards developed by Snodgrass–Vanderwart (1980),[14] Pulvermüller–Neininger (2001),[15] and Mathuranath and George (2007)[11] were further revised and adapted in Indian linguistic and cultural context. Along with these standard sources, approximately 600 words were also generated over a period of 4 months. The significant others (SOs) of PWA with different socioeconomic backgrounds were involved to make a list of at least 50–70 everyday common items which they commonly use in their daily communication.

All items were selected and modified by a research team of speech–language pathologist, neurologist, psychologist, and linguist. Black-and-white line drawing of objects (n = 303), activities/actions cards (n = 57), and prepositions (n = 45) were drawn by a professional artist but action cards and prepositions cards were not standardized in present study. All black-and-white line drawings were presented on glossy cards sized 6 by 4 inches with white background. Each object/activity/preposition concept depicted on the card has a best-matching singular noun or verb, or more complex noun phrase or sentence. As per the protocol of our Card Matching Game in ILAT all picture cards were duplicated to obtain matching pairs of cards for therapeutic practices.[12]

Stimulus materials

Selections of stimuli from the sources were initially subjective, and then 303 words/stimuli chosen by us were sent to Prof. Dr Dipti Mishra Sharma, Department of Computational Linguistics, Indian Institute of Information Technology, Hyderabad, so as to group them into high, mid, and low frequency usage based upon a huge corpus of Hindi words from print matter database.[16]

In initial stage, 303 raw pictures with different frequencies were obtained from the internet with the help of 36 healthy volunteers (6 volunteers and 51 stimuli in serial order for each group). They were instructed to select images for each nominal/concept under recommended five different varieties,[17] that is, (1) Line drawing, (2) Grey scales, (3) Cartoonist art, (4) plural/group representation, (5) Colorful. Then five pictures for one concept were chosen and numbered as 1, 2, 3, 4, and 5 in a slide. Each slide for single concept was rated for appropriateness of a picture by **group A**. After appropriateness rating, line drawing for each concept was developed by artist which was approximating the most appropriate picture in visual appearance.

Method of developing norms

Subjects

One-hundred twelve healthy volunteers were chosen among significant others (SO) of persons with aphasia (PWA), medical college students and senior citizens in the neighborhood to

Table 1: Definition of Parameters

Name agreement (NA)	Percentage of name agreement was defined, for each item, as the proportion of all valid trials (a codable response) on which the participants produced the target name. The number of alternative names for each picture (*number of types*) was derived by simply counting number of different names provided on valid trials, including the target name.
Familiarity (F)	Defined as the degree to which you come in contact with or think about the concept.
Appropriateness (A)	Defined as the perception of the subject about schematic representation of concepts in terms of its appropriateness and clarity, for example, carrying important visual elements (e.g., texture, shade, size, etc.), conveying concept, unambiguous, easy to understand.
Image agreement (IA)	Defined as the judgement by the subject that how each picture closely resembles their mental image of the object.
Visual complexity (VC)	Defined as the amount of detail or intricacy of line in the picture.

participate in the study. Healthy native Hindi speakers with 10–12 years of education, normal vision, hearing and cognitive functions were set as inclusion criteria for subjects. 112 subjects were randomly divided into "group A" and "group B" with 56 subjects in each group. *Group A* (56 subjects) was asked to rate "name agreement" (NA), "familiarity," (F) and "appropriateness," (A) whereas *Group B* (56 subjects) rated "image agreement" (IA) and "visual complexity" (VC).

All tasks were performed by subjects in small groups of 10–15 in a classroom setup. Each line drawn picture was projected sequentially using an overhead LCD projector.

Ethical committee approval was taken from MGM medical college, Indore. Informed consent requirement was waived off due to use of de-identified data of healthy volunteers.

Instruction

Instructions, similar to those used by Snodgrass and Vanderwart,[14] were given to the participants of both groups, verbally and by a written form along with the answer sheet. All the participants completed the study at their pace and filled the response sheet. An "OK" sign appeared after participants provided each response so that they could move to the following pictures. It was made explicit that there were no correct or incorrect answers. Two examples, in which filler stimuli and responses were used, were presented to further clarify the task.

The order of appearance of the 303 pictures for Group A and Group B in the study was randomized to avoid semantic category sequence effects.

General procedure

I. Tasks performed by Group A

The pictures were projected sequentially on a large white screen by using a projector. 303 slides were used to determine the appropriateness (A), name agreement (NA), and familiarity (F) of a given concept. At the start of each task, subjects were explained and described the importance of normative data for pictures and were encouraged to respond carefully and consistently. Each slide was presented for a time period of 10–15 s. Subjects recorded their responses on individual data sheets. They were instructed to respond to every slide, leaving no blanks. Halfway through the slides, the subjects were given a 2-min rest period.

A 3-point rating scale was used in which 1- indicated very unfamiliar and 3- indicated very familiar. In this and all rating tasks, subjects were told to assign only one whole-number value to each picture and were encouraged to employ the full range of scale values throughout the set of pictures. All subjects were provided an idea of the range of familiarity in the set, and practice items were presented to them before familiarity ratings.

Name Agreement (NA)

Subjects were instructed to identify each picture briefly and write down its name which came to their mind. They were told that a name could consist of more than one word. Subjects were also instructed to respond as DK (don't know) if the picture was of an unknown object or they did not know the name [Table 1].

Familiarity (F)

Subjects were asked to judge the familiarity of each picture "according to how usual or unusual the object is in your realm of experience." They were told to rate the concept itself, rather than the way it was drawn. If they did not know what the object was, they were to respond with the letters DK.

Appropriateness (A)

To assess appropriateness, five pictures in the same slide representing the stimulus were labelled as 1, 2, 3, 4, and 5. The volunteers were asked to select and write labelling number (1…5) of pictures under "most appropriate," "somewhat appropriate," and "least appropriate image" column. Three pictures among five were categorized on the basis of subjective visual perception and picture appropriateness representing the name of stimuli. The Appropriateness Rating helped us in selecting one picture out of five, presented to the artist to develop an original line drawing.

Then on the basis of response analysis of Group A for 303 stimuli, original line drawings were drawn by an artist. Then after a set of 303 stimuli were administered on Group B to rate visual complexity and image agreement of the concept.

II. Tasks performed by Group B

Visual Complexity (VC)

Subjects were instructed to rate the complexity of each picture on a 3-point scale in which 1 indicated "very simple" and 3 indicated "very complex." They were told to rate the complexity of the drawing itself rather than the complexity of the real-life object it represented.

Image Agreement (IA)

At the start of the session, the experimenter called out the picture's most common name (as determined from data of the name agreement task), waited approximately 3 s, and then projected the picture on the screen. The subjects were now asked to judge how closely each picture resembled their mental image of the object. The degree of agreement between the mental image and the picture as projected was rated on a 3-point scale: 1 indicated "low agreement" that the line drawing provided a poor match to their image, and a rating of 3 indicated "high agreement." Subjects were instructed to write the letters NI (no image) if they could not form an image of an object for any reason. If subjects imaged a different object from the one pictured (e.g., imaging a lump of metal to the name "iron," instead of a household appliance), they were to respond DO (different object).

Results and Discussion

Many test materials are being used in India for PWA but the lack of validation and norms has been an enduring problem. Each clinician has been forced to develop his or her own set of pictures with a different pattern of drawing for the same concepts and it result in lack of authentic database. At global level, two prime sources with standardized picture stimuli having culturally unbiased features: (1) Snodgrass and Vanderwart (1980),[14] 127 (89 + 37) items and (2) Neininger and Pulvermuller (2002),[18] 147 (89 + 56) items were used extensively. In present study, out of 303 stimuli, 89 items were common to both principle sources. An Indian study of 103 (67 from Snodgrass and Vanderwart,[14] 36 new) line drawing by George and Mathuranath (2007)[11] has also been taken as an additional source.

Description of responses

Each participant of **group A** was asked to give 936 responses (312 pictures × 3 questions): Familiarity, the name of the depicted entity in set and appropriateness. Each participant of **group B** was asked to give 606 responses (303 pictures × 2 questions): visual complexity and image agreement.

Don’t know (DK) responses occurred in 22.8% items, more often low-frequency items, for example,ʂəʈəkoːɳə/(hexagon),/broːkoːliː/(broccoli), /pʰɑːvəɽɑː/(spade),/t̪urəɦiː//ʈrəmpeːʈə/(trumpet) with the exception of high-frequency stimuli, that is,/tʃuːɦɑː/(mouse). For other stimuli, maximum DK response obtained is 4. Words with unambiguous spelling errors were recorded in their orthographically correct form. Linguistic stimuli were used in their singular form. Picture names in plural were grouped with their singular form.

Description of Appendix I, II, and III measures (Supplementary Online Material)

Appendix I: The 303 pictures are presented with serial number (supplementary online material).

Appendix II depicts mean ratings for each concept with respect to name agreement, familiarity, visual complexity, image agreement. The items are listed serial wise, as administered to Group A and B. Starting from the leftmost column, Appendix II presents the following information for each item: (1) The identifying number and frequent/dominant name/target name of the picture in Hindi or English; (2) Two measures of name agreement, the information statistics H and the percentage of subjects giving the most common name, that is, % correct; and (3) The means and standard deviations of image agreement, familiarity, and visual complexity.

Appendix III presents detailed information on the nature of the difficulties that subjects encountered while naming, imagining, or rating the familiarity of the concepts and many examples of non-dominant naming, that is, synonyms, English translated, coordinates, super-ordinates, subordinates and naming failures instead of target name.

H Statistics

The information statistic H was computed for each picture by the formula:

$$H = \sum_{i=1}^{k} p_i \log_2(1/p_i)$$

i = 1 where **k** refers to the number of different names given to each picture and ***pi*** is the proportion of subjects giving each name. A picture that elicited the same name from every subject in the sample who was able to name it has an H value of 0.0 and indicates perfect name agreement. An item that elicited exactly two different names with equal frequency would have an H value of 1.00. Increasing H values indicate decreasing name agreement and, generally, decreasing percentages of subjects who all gave the same name.

The DK (don’t know) category of naming failures was eliminated when computing H values, but not when computing the percentage agreement scores. Thus, a picture with H value of 0**.0** can have a percentage agreement score that is less than 100% because the picture produced naming failures in some subjects. Many concepts showed perfect name agreement (i.e., an H value of 0.0), so we used a strict criterion for counting different instances of names. In many cases, the name given by a subject was similar to but not identical to an established name category. These cases included misspellings, abbreviations, elaborations, and multiple names.

The H value captures more information about the distribution of names across subjects than the percentage agreement measure. We have used the ***pi*** value as the primary measure of name agreement in subsequent analyses.

Name agreement

The variable of name agreement is likely to affect naming latencies for pictures. The results would lead us to expect that concepts with high H values will have longer naming latencies than concepts with low H values.[19] Accordingly, concepts with high name agreement will be better recognized than concepts with low name agreement in a concept recognition memory paradigm. Pictures that have high H values either are named with difficulty or have many synonymous names. In a recall task, it is obvious that pictures that are named with difficulty will probably be recalled less well than others with many synonymous names or unique names.

In our study the mean H value at 0.90 is higher than studies of Snodgrass and Vanderwart and Bates *et al*. with reported H values of 0.56 and 0.67(in English language) to 1.16 (in Chinese language), respectively.[14,20] It indicates that the subjects in our study used more alternative names to identify the objects. It might be due to the different synonyms, influence of regional or mother tongue, generalization of English words for nominal. We had a surprisingly larger percentage of responses (22.8%) in the DK category than George *et al*.[11] who had found education levels as a responsive factor for DK. In the present study mean education level is approximately 10 years, hence additional reasons could be inclusion of very low-frequency stimuli or inclusion of “did not know the object” (DKO), “did not know the name of the object” (DKN), and “a tip-of-the-tongue” (TOT) state or poor and ambiguous depiction of some concepts by our artist or the nature of the concept being not representable clearly.

Familiarity

The familiarity rating of a picture is analogous to the frequency count of the word form of the concept, and the two are highly correlated. It is a “purer” measure of the picturable sense of a word than frequency. Thus, familiarity should be a better predictor of memory performance for pictures and for words in which the experimental context biases a particular word meaning.

Visual complexity

The complexity of a picture primarily reflects the superficial visual characteristics of the object and its conventions of pictorial representation. The picture-naming task presumably requires at least two steps: picture recognition and name retrieval. The first phase of picture recognition may take longer for more complex pictures.

Brodeur *et al.*, evaluated familiarity (F) and visual complexity (VC) of 480 stimuli on 5 point rating scale (5 considered as "very familiar" for F and "very complex" for VC). Score obtained for F and VC were 4.0 and 2.4, respectively.[9] These values are numerically higher than the familiarity score of 3.3 but lower than the visual complexity score of 3.0 reported by Snodgrass and Vanderwart.[14] The mean (F) and (VC) ratings in present study were 2.61 and 0.51, respectively. The difference in the rating scale between present study and Snodgrass and Vanderwart[14] needs a correction factor to compare their respective score. After using correction factor **[Appendix V],** these values are numerically equal to the familiarity score of 3.3 but lower than the visual complexity score of 3.0 reported by Snodgrass and Vanderwart on 5 point rating scale.[14] Higher familiarity is not surprising and is due to the inclusion of objects of daily use. On the other hand, one would have expected a higher visual complexity score for the photos stimuli due to more details and similarity to daily used items than drawings.[20]

Image agreement

Image agreement is likely to influence semantic tasks in some interesting ways. As we just noted, the picture naming process presumably entails two sub-processes: First, the *image code* corresponding to the picture must be accessed (i.e., the object must be recognized for what it is), and then the *verbal label* must be accessed. That is image agreement measures the typicality of the form of the stimuli—it answers the question, how good a stimulus is to the picture of the concept it represents. Accordingly, pictures with high image agreement should be categorized faster than pictures with low image agreement.

The average image agreement of 1.32 has been observed for present set of 303 line drawing with maximum 1.86 agreement score on the 3-point scale. These results are consistent with the image agreement of 3.4–3.8 generally reported for pictures which were rated on 5-point rating scale.[14,21,22] A low image agreement could have been expected considering that objects had particular designs. The high rate of agreement thus suggests that in general, the items in this study are typical and presented from a standard viewpoint.

Overall descriptive statistics of the 303 concepts

All measures related to 303 concepts, that is, % correct, H statistics, familiarity, image agreement and visual complexity were analyzed descriptively [Table 2].

Table 2 presents a descriptive statistics for all four of the measures shown in Appendix II. Low mean and positive skew on H statistics and visual complexity show that many concepts had a high name agreement (13 concepts have H values of 0.0, and 55 have H values of 0.68 or below, where 0.68 represents consensus among all but few of the subjects on a picture's name) and were visually simple line drawings. Dimitropoulou *et al.*, Snodgrass and Vanderwart also obtained high name agreement with the exception of the Rossion and Poutois (2004) study.[14,23,24] In contrast, the high means and negative skew on familiarity and image agreement suggest that many concepts were familiar and generally matched the mental imagery for that concept. These results are similar to Himmanen *et al*. concepts in Boston naming test (BNT) which has demonstrated repeatedly that figures with higher values of image agreement are named faster and more accurately by both normal and brain damaged subjects.[8,25]

Familiarity and visual complexity ratings have shown a greater range of values than image agreement, reflecting greater consensus among subjects on the extremes of the scale.

Visual complexity ratings are symmetric around the "0" and "1" point of scale, that is, 0.51; which suggest visual representation of all stimuli in between very simple to simple. Familiarity and image agreement ratings tend to be negatively skewed, reflecting the fact that a few concepts were judged to be very low in either familiarity or image agreement. For image agreement, it is rare for subjects to agree that their visual image does not match the picture,[14] since the lowest IA rating was 0.56.

Correlations among the measures

We computed the inter-correlations among all measured parameters presented in Appendix II [Table 3].

Table 2: Overall descriptive statistical data on the 303 concepts for each parameter measured

	% correct	H Statistics	Familiarity	Image agreement	Visual complexity
Mean	81.08	0.90	2.61	1.32	0.51
Standard Error	1.22	0.03	0.02	0.01	0.01
Median	91.07	0.92	2.79	1.33	0.48
Standard Deviation	21.22	0.57	0.42	0.24	0.23
Skewness	-1.17	0.70	-1.63	-0.67	0.34
Range	89.29	3.67	1.93	1.30	1.33
Minimum	10.71	0.00	1.07	0.56	0.00
Maximum	100.00	3.67	3.00	1.86	1.33
Confidence Level (95.0%)	2.40	0.06	0.05	0.03	0.03

Snodgrass *et al.*, found quite low inter correlations among name agreement, familiarity, visual complexity, and image agreement, suggesting that the four measures represent largely independent attributes of the pictures.[14]

We also observed low correlation among all four measures. Positive correlation between name agreement and familiarity and negative correlation between name agreement and visual complexity have sometimes been found but they were rarely very significant[26,27] [Table 3]

Categorization of naming responses obtained for semantic categories

Out of 303 items, 100 items were categorized on the basis of familiarity under nine semantic categories out of 15.[28] Furniture and household category has been clubbed together and other categories, for example, musical instruments, toys has not been considered for separate categories rather few related nominal was taken separately. [Table 4].

Name responses given by participants for these stimuli were categorized in terms of dominant responses and non-dominant names, that is, synonyms, English translated, coordinates, superordinates, subordinates, and naming failures [Table 5].

Synonyms included a modifier added to the basic name that was redundant with the pictured concept (e.g., green pepper for pepper and bunch of grapes for grapes). Coordinates were defined as different exemplars of the same category (e.g., spider for ant, mouse for rabbit). Superordinates included insect or bug for ant, fruit for custard apple. Subordinates were defined as a subclass of the concept pictured, and included "rose for flower" instead of specific naming.

Table 5 presents the aggregate responses (in percentage) on semantic categories. All exemplars listed in Table 5 are included to get a percentage of correct name responses in 9 selected semantic categories (two different categories, i.e., furniture and household are merged).

In Table 5, column (d) labeled (a + b + c), representing the total percentage of dominant, synonymous and English translated names in each category and thus can be considered to be the percentage of correct names for the concept. Percentage of correct names varies from a low of 70% for the body parts category to a high of 98% for the furniture and households' category. In another study, Snodgrass *et al.* has got a low of 76% of correct names for insects' category and a high of 99% for the furniture category as obtained in the present study.[14] Minimum percentage of correct response for the body parts semantic category is unexpected, but it is a bit surprising to find that maximum superordinates responses was observed for body parts category. It might be due to the inclusion of palm, sole, knee, ankle, elbow separately as an individual stimulus and it was grossly named as hand and leg altogether by most of the participants. The incorrect naming responses under semantic categories were differed in pattern, that is, high percentage of coordinates and naming failures in the animal category, tools and body parts categories respectively.

Apart from stimuli under semantic categories, column (D) represents the combination of correct name concept. It helps in estimating the correct % of name agreement especially for those concepts which did not have an explicit Hindi name.

Concept versus name agreement

Synonyms such as TV for television and drum for barrel were treated as separate name categories while computing both H and percentage agreement. Names were classified as synonyms on the basis of the experimenter's judgment and the picture's appearance. Thus, the name "baby" was considered reasonably synonymous with the "pictured doll." These concepts are listed in Appendix IV. This definition of name agreement is useful for predicting cognitive tasks like naming latencies whereas it is less useful for picture recall, in which synonyms for the dominant name would probably be scored as correct responses. The primary aim of our study was to generate standardized and validated concepts and corresponding pictures for therapeutic purpose, rather than diagnostic.

We have identified concepts whose high values of H reflect linguistic ambiguity, as opposed to conceptual or pictorial ambiguity. Out of 112 concepts having H values of 1.00 or greater, 41 had high concept agreement. The difference between percentage name agreement and recomputed percentage agreement score (where all synonyms are considered equivalent to the dominant name) was more than 40% on these concepts.

Snodgrass and Vanderwart found 93% average percentage concept agreement score for 35 concepts compared to the average of 64% name agreement.[14] Out of 41 concepts, six items, that is,/pəɲ.d͡ʒɑː//ɦət̪ʰeːliː/(palm) (83.92%),/əŋ.giːʈʰiː/ (stove) (71.57%),/prəmə/(pram)(71%),/gʰɑːsə/(grass) (60.71%),/pʰuːləmɑːlɑː/(flower garland) (60.71%),/t͡ʃɑːj t͡ʃʰən.niː/(tea strainer) (69.64%) had wide difference between % name agreement and % concept agreement.

Concluding Remarks

We are aware of the limitations of the study. We need to have similar normative data for validation of picture stimulus cards depicting preposition, action verbs, singular–plural, qualitative and quantitative adverbs and conceptual cards. In this study only nominals with different frequency are being considered for standardization. Stimuli's parameters (NA, F, VC, IA) were only assessed on educated people of minimum 8 year of education. Due to the involvement of written response task, illiterates were not studied for same stimuli. Three-dimensional colored picture could have been taken and comparative responses be obtained and assessed for same stimuli on NA, VC, F, IA.[29] Introducing

Table 3: Correlation amongst the measured parameters amongst all the 303 concepts

Parameters	1	2	3	4
Name agreement	1.000			
Familiarity	0.101	1.000		
Image agreement	0.046	0.044	1.000	
Visual complexity	0.096	0.019	0.54	1.000

Table 4: Description of Semantic Category based concept

Sl. No	Animals	Id. no.	Clothing & footwear	Id. no.	Fruit	Id. no.	Vegetables	Id. no.
1	Dog	72	Shirt	120	Apple	267	Tomato	64
2	Cat	66	Pant	83	Mango	4	Potato	208
3	Donkey	229	Saree	106	Grapes	220	Onion	209
4	Goat	215	Skirt	246	Papaya	256	Carrot	103
5	Horse	137	Towel	162	Jackfruit	139	Chilli	288
6	Monkey	297	Frock	169	Pomegranate	102	Broccoli	280
7	Tiger	251	Coat	285	Custard apple	216	Spinach	248
8	Sheep	244	Tie	84	Banana	110	Karela/Bitter gourd	274
9	Bear	271	Shoes	70	Orange	213	Ladyfinger	174
10	Camel	284	Socks	161	Pineapple	212	Cauliflower	286
11	Hippopotamus	219	Sandal	187			Lauki/Bottle gourd	283
12	Cow	45	Earring	63			Brinjal	105
13			Chappal	277			Matar/Pea	257
14							Raddish	210
No. of stimuli	12		13		10		14	

Sl. No	Furniture & household	Id.no.	Tools	Id. no.	Vehicles	Id. no.	Body parts	Id. no.
1	Table	47	Axe	269	Bus	5	Eye	228
2	Chair	41	Fawda/Spade	172	Car	8	Nose	263
3	Door	40	Bhaala/Spear	135	Scooter	57	Ear	38
4	Bed	121	Saw	300	Jeep	43	Chin	156
5	Almirah	104	Screw	155	Boat	275	Palm	6
6	Refrigerator	92	Sickle	154	Train	15	Tongue	181
7	Cooler	232	Plyer	205	Cycle	168	Ankle	170
8	Table fan	190	Tyre	295	Motorcycle	177	Elbow	115
9	Mixer	142	Kripaan/Dagger	151	Bullock cart	123	Hair	12
10	Swing machine	191	Screw driver	243	Horse cart	157	Cheek	99
11	Pressure cooker	298	Hammer	176	Auto rickshaw	196	Lips	114
12			Shield	76	Thela	132	Shoulder	175
13					Truck	14	Nail	185
14							Leg	233
15							Sole	250
No. of stimuli	11		13		12		15	
	Total no. of stimuli 100							

Table 5: Percentage of Name Responses in 8 Selected Semantic Categories for (a) Dominant Response; (b) Synonyms; (c) English Translated (d) Coordinates ; (e) Super ordinates; (f) Subordinate; and (g) Naming Failures

Responses Category	(a) Dominant Responses (%)	(b) Synonyms (%)	(c) English translatedm (%)	(d) (a+b+c) (%)	(e) Co ordinates (%)	(f) Super ordinates (%)	(g) Sub Ordinates (%)	(h) Naming Failures (%)
Animals (12)	60	1	30	90	10	0	0	0
Clothes (12)	100	5	31	96	3	1	1	1
Fruits (10)	60	0	39	99	0	0	0	0
Vegetables (14)	74	8	21	100	4	0	0	2
Furnitures & household (12)	64	5	29	98	0	2	0	0
Tools (12)	73	3	14	89	9	1	0	3
Vehicles/transport (12)	70	9	11	91	5	3	1	1
Body parts (15)	42	0	27	70	5	16	5	4

color information may be useful in improving the performance of illiterates in naming drawing.[30] It would increase the amount of information contributed to better access to the name.

The stimuli developed by us are likely to serve as a useful tool for researcher due to its tested and already proved effectiveness on ILAT study. It has facilitated improvement in naming latency and accuracy of 12 participants during ILAT.[12] We hope that these standardized materials could be used for other therapy approach too and its efficacy could be studied.

Cognitive neuropsychology-based treatment approaches requires a large number of stimuli with qualitative and quantitative variations to shape the task requirements. It provides wide options to clinician to practice and maintain trained skills of PWA at different difficulty level of tasks. ILAT is one such approach. While planning to study its efficacy in a heterogenous group of PWA, we felt a need for a standardized set of picture stimuli (cards) as it would have a bearing upon the results in terms of naming, sentence formulation, understanding of complex sentence, social interaction, and other functional abilities.

A set of 303 concept names and their corresponding pictures has been developed by us, paying attention to psychometric principles which underpin such processes.

Our picture stimuli had low inter-correlations among name agreement, familiarity, visual complexity, and image agreement, that is,. Independent attributes of the pictures. Naming responses analysis in dominant, non-dominant and naming failure helped in understanding the pattern of correct/incorrect responses, correct % of name agreement and the proportion of name given to particular stimuli.

We hope that the cognitive neuropsychology-based concept materials developed by us will be useful for the PWA and other subject groups, across the Hindi dominant language region of India. The use of these materials is not only going to be limited to ILAT but may be used with other approaches of massed practice, reading-writing tasks, daily use or culturally appropriate facilitating approaches.

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Conflicts of interest

There are no conflicts of interest.

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APPENDIX V

Manual procedure to convert of 5 point rating scale score to 3 point rating scale score

Let **X**=Score from 5 point rating scale (e.g. I'll use the example of 4.1 below); **Y**= transformed score to 3 point scale.

Step 1: Recode to 0-1 scale Y_1=(X-min_old scale)/(max_old scale-min_old scale) y_1= (4.1-1)/(5-1)= 0.775

Step 2: transformed to 3 point scale Y=Y_1 (max_new scale- min_new scale)+min_new scale Y= 0.775(3-1)+1=2.55