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Semantic Feature Production in Tamil-Speaking Young Adults vs. Geriatrics - A Comparative Study

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Abstract

Semantics is the part of linguistics that is concerned with meaning. Semantic features are theoretical units of meaning-holding components which are used for representing word meaning. Children typically have productive vocabularies of 50 words or more by 18 months of age, and a significant increase in naming can be expected as new words are acquired at a rapid rate. During this time, children begin to seek out names for things and to draw attention to interesting objects and events by naming them. This period is known as the "naming explosion" or "vocabulary spurt" (Bates,1991). Many developmentalists believe it represents significant advancements in children's semantic and conceptual knowledge (Bloom,1973). Although the spurt is a period of rapid cognitive and linguistic development, it is also a period of increased error. This study aims to compare the Semantic Feature Production in Young and Older Tamil-Speaking Adults which in turn could reflect the Cognitive Linguistic Changes across age range.

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Keywords: semantics, naming explosions, vocabulary spurt, conceptual knowledge, linguistic development

Introduction

Several studies have documented instances of children making spontaneous naming errors during their rapid word acquisition period (Anglin,1986). These errors appear to be caused by an overextension of a known word to a novel exemplar that shares some salient attribute, especially when the child has never heard the object named before (Huttenlocher & Smiley,1987). Children's naming errors are caused by a particular vulnerability of newly acquired words as they compete with more items in a rapidly expanding lexicon. That is, because of the absolute low levels of activation strength of lexical items that must occur as children learn their first words, errors may occur during the period of accelerated vocabulary growth. However, as children use those words repeatedly in production, they may become stronger and more resistant to interference. These naming errors, like those reported by Elbers (1985), did not appear to be simple overextensions, but occurred with a high frequency (nearly 30% of all naming in one study; Gershkoff-Stowe & Smith, 1997) at a time when children were learning many new words and beginning to produce those words with greater frequency and in closer temporal proximity. As a result, naming difficulties in children can be attributed to deviations observed at any stage of word development.

In most mature speech production models, accessing a word in the lexicon involves the activation and competition of multiple candidates; the stronger the activation of a word, the greater the probability of its selection. Additionally, strong words are more likely to withstand interference than weak words. These findings support the theory that the rise and fall of children's errors reflect changes in the activation strength of individual words as they are retrieved for production. However, there are not many models or hypotheses available to explain adult naming abilities and vocabulary growth. As a result, they are studied using Semantic Feature Activation tasks.

Literature Review

The brain is a complex neuronal structure, and several intrinsic connections are activated during semantic feature production tasks. Increased accuracy has been associated with greater activation in the occipito-temporal and temporo-parietal regions during category judgments to visually presented words (Shaywitz,2002) and in the middle and inferior temporal gyri during association judgments to visual or auditory words (Blumenfeld et al., in press). Improvement in accuracy from semantic training has also resulted in increased activation in the left middle temporal gyrus, particularly in high skill participants (Sandak,2004), which is attributed to both a larger number of lexical entries and stronger connections between these entries (McGregor and Appel, 2002). Enhancing activation in the lateral temporal region. There has also been evidence of developmental increases in activation in the inferior frontal gyrus during silent verb generation to auditorily presented concrete nouns, verbal semantic fluency to auditorily presented categories, and category judgments to visually presented words (Holland et al., 2006).

Roberto A. Ferreria (2015) investigated the neural correlates of semantic richness and the results revealed the most consistent effects of semantic richness were found in the left angular gyrus (AG) and middle temporal gyrus (MTG), where activation was higher for semantically rich words than poor words. The pattern was also seen in the bilateral pre-cuneus and the posterior cingulate gyrus. Age was linked to higher activation in the left middle temporal gyrus (BA 21) and the inferior parietal lobule (BA 40), implying that older children have more elaborated semantic representations and more complete semantic integration processes. Age decline was correlated with right superior temporal gyrus activation (BA 22), and accuracy decline was correlated with right middle temporal gyrus activation (BA 21), suggesting that ancillary systems in the right hemisphere are engaged for younger and lower-skilled children.

Semantic Feature Association (SFA) is an evidence-based practise that works with the goal of improving Semantic Feature Retrieval using the common lexical categories that one is exposed to. SFA uses a feature analysis chart, which includes multiple semantic categories, to help direct this process. “Persistent and systematic practice in producing semantic features in this way enables individuals to achieve more systematic word retrieval without extensive use of compensatory strategies.” (Boyle, 2010). This method has shown to improve word-finding abilities and coherence of the connected discourse produced in individuals diagnosed with mild to moderate expressive aphasia Mary Boyle (2004), Alzheimer’s disease Flangan (2016) and

children with Learning Disability (Candace S Bos), Autism Spectrum Disorder (Ulrika Lofkvist, 2016) by stimulating the identification of semantic features of the target concept.

Therefore, the Production and the development of Semantic feature association is influenced by several factors that include the, age, gender, language Adel Z AlShaikhi (2011) and culture Cameron (1992). and concreteness and abstractness Cynthia S Q. Siew (2020) of the word that is presented. Katherine (2012) documented the Semantic feature distinctiveness and frequency, which revealed that younger adults had faster response time and older adults had better concept retrieval. David P Winson (2008) studied the semantic feature production norms for a large set of objects and events and the results revealed that the subjects were able to produce features that were related to the motoric and visual aspects of the words that were presented.

Linguistic proficiency could be determined by the degree to which semantic networks are densely organised. However, several studies have been conducted to create a normative data base for the various nouns and verbs found in each of the languages under consideration. Jorge Vivas developed Semantic Feature Production Norms in Spanish (2016). Semantic feature production norms provide many quantitative measures of various feature and concept variables, which are required to resolve some debates about the nature of normal and pathological semantic memory organisation. Mc Rae proposed Semantic Feature Norms for a wide range of Living and Non-living Things (2005). This study was conducted in English, for basic-level concepts and all of the features were classified into one of nine knowledge types: three for visual information (visual-color, visual-parts and surface properties, and visual-motion), four for other primary sensory processing channels (smell, sound, tactile, and taste), one for functional/motor information about how people interact with objects (function), and one (encyclopaedic).

Semantic Feature Association has been shown to be an evidence-based practise that aids in naming in a variety of disorder. This technique has been shown to improve discourse skills as well. Therefore, improving the semantic feature association for various classes of words will improve both the cohesiveness and efficacy of the conversation in each language. Normative data base should be established in each language extensively to understand better about the Semantic Feature Activation and Production. However, there is a dearth of such studies in Indian

languages hence this study could be considered as a preliminary base for developing such Normative data in Indian Language.

Aim

To compare the Semantic Feature Production in Young and Older Tamil-Speaking Adults which in turn could reflect the Cognitive Linguistic Changes across age range.

Method and Participants

The study was approved by the Institutions Ethical committee. The study aimed to obtain the semantic feature production in Tamil. Initially, five semantic categories with 15 words each in Tamil were chosen and given for validation. The categories and the words under them were determined based on the review of literature. The validation was performed by 10 Speech Language Pathologist who had at least work experience of 4 years and above in the field of Neuro-communication disorders. Google forms were circulated among the Speech Language Pathologist and the responses were collected and consolidated. A list of 30 words was prepared based on the consolidated results which consisted of two concrete categories (Food & drinks, Small house hold items) and one abstract category of (action words and emotion).

The study included two group of participants. Group A included young adults (19-35 years) and Group B included Geriatrics (55-75 years) who are fluent in Tamil and had normal or corrected hearing and vision. Participants with neurodegenerative conditions were excluded. The study was carried out in 3 phases. In Phase I, informed consent was obtained from the participants included and MMSE was administered to rule out underlying cognitive impairment. The participants who obtain a score of 25-30 indicated normal day to day functioning however, mild defects might be present were included in the study. Individuals with a score less than 25 are excluded from the study.

In Phase II, black and white line drawing of 10 words from 3 distinct semantic categories (Food and drinks, common objects and actions words) were presented through Auditory- visual modality via Microsoft-power point for duration of 30 seconds. The participants were given a common instruction to verbally list down all the features in Tamil that were related to the word that was projected as single words. All the participants were given with 3 practice items to

familiarise with the procedure. The responses were recorded through phone recorder which was subjected to further analysis.

In Phase III, the responses that were recorded was segregated based on the visual, functional, proprioceptive and motoric features of the word that was presented. Code mixed (other language responses) and omitted responses (repetition of the same answers, phrasal responses) were documented. The data was subjected to appropriate statistical analysis.

Results and Discussion

The current study aimed at comparing the semantic feature production between neurotypical Young Adults and Geriatric population. Group A included Young Adults (N=30) of the age range 18-35 years with a mean of 25.2 years and Group B consisted of Geriatrics (N=30) of the age range 55-75 years with the mean of 66.4 years. All the participants were presented with 30 words from three distinct semantic categories of food and drinks, common objects, and action words. Each stimulus was presented for a duration of 30 seconds and the responses were recorded and subjected to analysis. The time to initiate the response was noted. The semantic features that were produced were categorized as visual, motoric, functional, and proprioceptive features. The number of omitted responses and number of code-mixed words were analysed and compared between the two groups. Descriptive Statistical analysis was performed using SPSS version 21. Independent T test was used to compare the mean differences between the Young Adults and Geriatrics on the Semantic Features that were produced, Average Response Onset Time, Code Mixing and Omitted Responses. Mann Whitney U test was performed to compare the differences that were present between the Male and the Female participants included within the groups that were considered for the study.

A. 1. Documentation and comparison of Semantic feature production between Young Adults and Geriatrics for the category of Food and drinks, Common objects, and Action words.

On comparing the semantic feature production between Young adults and Geriatrics, statistically significant difference ($p<0.05$) between the groups in the production of Function and Proprioceptive features for the category of food and drinks, statistically significant difference ($p<0.05$) between the groups in the production of visual and Proprioceptive features for the

category of common objects and statistically significant difference ($p<0.05$) between the groups in the production of motoric, functional and proprioceptive features for the category of action words (Table 1.1). Quantitatively the Young Adults could produce a greater number of features within the given time frame compared to Geriatrics. However, this subjective difference that is obtained while comparing the feature production under each category chosen might be attributed to the ability to associate a given word to multiple concepts, the exposure to different linguistic and cultural backgrounds, ability to recall, familiarization of the functionalities, concrete representation of the objects in our brains or the lack of formation concrete imagery at the level of brain.

A Study done by Kave et al., 2014 on comparing the vocabulary and the word retrieval abilities in Young Adults and older adults which revealed that young adults had better word retrieval abilities and older adults had a higher vocabulary index. However, the results obtained in this partially supports the results of this study in terms of better word retrieval abilities in young adults which correlates with the results obtained in this study.

Table 1.1- Comparison of Semantic feature production between Young Adults and Geriatrics across the categories of Food and drinks (1), Common objects (2) and Action words (3)

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
VISUAL-1	Equal variances assumed	-0.18	58.00	0.85	-0.10	0.54	-1.19	0.99
	Equal variances not assumed	-0.18	57.52	0.85	-0.10	0.54	-1.19	0.99

MOTOR-1	Equal variances assumed	-1.70	58.00	0.09	-0.57	0.33	-1.23	0.10
	Equal variances not assumed	-1.70	57.99	0.09	-0.57	0.33	-1.23	0.10
FUNCTIONAL-1	Equal variances assumed	2.53	58.00	**0.01**	0.87	0.34	0.18	1.55
	Equal variances not assumed	2.53	57.61	**0.01**	0.87	0.34	0.18	1.55
PROPRIOCEPTIVE-1	Equal variances assumed	15.14	58.00	**0.00**	10.27	0.68	8.91	11.62
	Equal variances not assumed	15.14	37.96	**0.00**	10.27	0.68	8.89	11.64
	Equal variances not assumed	29.51	44.37	**0.00**	7.30	0.25	6.80	7.80

	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference

							Lower	Upper
VISUAL-2	Equal variances assumed	5.09	58.00	**0.00**	2.87	0.56	1.74	3.99
	Equal variances not assumed	5.09	47.91	**0.00**	2.87	0.56	1.73	4.00
MOTOR-2	Equal variances assumed	-0.41	58.00	0.69	-0.07	0.16	-0.40	0.26
	Equal variances not assumed	-0.41	57.93	0.69	-0.07	0.16	-0.40	0.26
FUNCTIONAL-2	Equal variances assumed	0.60	58.00	0.55	0.37	0.61	-0.86	1.60
	Equal variances not assumed	0.60	54.21	0.55	0.37	0.61	-0.87	1.60
PROPRIOCEPTIVE-2	Equal variances assumed	2.60	58.00	**0.01**	2.00	0.77	0.46	3.54
	Equal variances -not assumed	2.60	50.95	**0.01**	2.00	0.77	0.45	3.55

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
VISUAL-3	Equal variances assumed	-0.52	58.00	0.61	-0.07	0.13	-0.32	0.19
	Equal variances not assumed	-0.52	57.95	0.61	-0.07	0.13	-0.32	0.19
MOTOR-3	Equal variances assumed	1.98	58.00	**0.05**	0.50	0.25	0.00	1.00
	Equal variances not assumed	1.98	57.77	**0.05**	0.50	0.25	0.00	1.00
FUNCTIONAL-3	Equal variances assumed	2.45	58.00	**0.02**	1.07	0.44	0.20	1.94
	Equal variances	2.45	57.92	**0.02**	1.07	0.44	0.20	1.94

	not assumed							
PROPRIOCEPTIVE-3	Equal variances assumed	7.58	58.00	**0.00**	8.07	1.06	5.94	10.20
	Equal variances not assumed	7.58	51.98	**0.00**	8.07	1.06	5.93	10.20

A.2. Comparison of Average Response Onset time for the three categories included between Young Adults and Geriatrics.

Average Response Onset time is the time taken to initiate the response after the stimulus is presented. On comparing the Response onset time between the groups, the results revealed that there was a statistically significant difference ($p<0.05$) that was obtained for all the categories included in the study (Table 1.2). This quicker initiation of responses is an indication that the younger adults have better comprehension of the instructions and diverse production of semantic features is facilitated. Even though in Geriatrics the feature elicitation is seen they exhibit a difficulty to initiate a quicker response.

Similar results that were obtained in this study, Gehman et al., 2021 investigated the role of processing speed, cognitive control, and word retrieval in aging and aphasia and concluded that aging and aphasia lead to slower processing speed but did not affect cognitive control. The results obtained in this study supports the results obtained in our study to agree to the fact that older adults have a slower processing time when compared to younger adults with or without the role of cognition.

Table 1.2- Comparison of mean scores for Average Response Onset time between the Young Adults and Geriatrics for all the categories.

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
AVGROT-1	Equal variances assumed	-30.43	58.00	**0.00**	-5.12	0.17	-5.46	-4.79
	Equal variances not assumed	-30.43	33.85	**0.00**	-5.12	0.17	-5.47	-4.78
AVGROT-2	Equal variances assumed	-30.26	58.00	**0.00**	-5.13	0.17	-5.47	-4.79
	Equal variances not assumed	-30.26	35.26	**0.00**	-5.13	0.17	-5.48	-4.79
AVGROT-3	Equal variances assumed	-29.83	58.00	**0.00**	-5.13	0.17	-5.47	-4.79
	Equal variances	-29.83	36.47	**0.00**	-5.13	0.17	-5.48	-4.78

	not assumed					

A.3 Comparison of Code-mixed responses for the three categories included between Young Adults and Geriatrics

All the participants were given a uniform instruction to recall and produce features in Tamil. Responses that were obtained other than the specified language were documented and analyzed as code mixed responses. On comparing code mixed responses between the groups, the results revealed that there was a statistically significant difference ($p<0.05$) that was obtained for all the categories included in the study (Table 1.3). On observation the code mixing was predominantly observed in English Language and was perceived to be more in Young Adult group when compared to the Geriatric group. This was attributed due to the life style habitation and societal interactions that makes Young Adults retrieve more appropriate features in English when compared to Tamil.

According to Ivy Hypothesis proposed by Schlyter et al., 2004 it stated that, the code mixing occurs as the interaction meant to be in the weaker language. This might be attributed to the exposure in the society where there is a predominant use of one language thereby increasing the competence in that language which is facilitating the survival resulting in significant code-mixing.

Table 1.3 Comparison of mean scores that are obtained for Code Mixed Responses amongst the Young Adults and Geriatrics for the all the categories.

		t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference

							Lower	Upper
CODEMIX-1	Equal variances assumed	7.31	58.00	**0.00**	8.63	1.18	6.27	11.00
	Equal variances not assumed	7.31	55.16	**0.00**	8.63	1.18	6.27	11.00
CODEMIX-2	Equal variances assumed	6.00	58.00	**0.00**	6.97	1.16	4.64	9.29
	Equal variances not assumed	6.00	56.74	**0.00**	6.97	1.16	4.64	9.29
CODEMIX-3	Equal variances assumed	10.73	58.00	**0.00**	16.63	1.55	13.53	19.74
	Equal variances not assumed	10.73	53.38	**0.00**	16.63	1.55	13.52	19.74

A.4 Comparison of Omitted responses for the three categories included between Young Adults and Geriatrics.

The participants were instructed to produce the semantic features that were related to the pictures that were presented. However, not all the responses that were produced by the participants were taken into consideration. Multiple repetition of the same responses either using the same words or synonyms of the words and phrasal responses were omitted and documented separately and subjected to analysis.

On comparing the omitted responses between the groups, the results revealed that there is statistically significant difference ($p<0.05$) that was obtained for all the categories included in the study (Table 1.4). On observation there was increase in the omitted responses seen at the Geriatric group when compared to the young adults According to Haas A 1979, it was found that male and female way of expression differs with respect to its form, subject, content and usage. This is the possible reason why there were increased number of omitted responses that was observed in the female participants included in the group when compared to males.

Table 1.4 Comparison of mean scores that are obtained for depicting the Omitted responses in the Young Adults and Geriatrics for the all the categories.

		t-test for Equality of Means						
		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower	Upper
OR-1	Equal variances assumed	-16.62	58.00	**0.00**	-14.37	0.86	-16.10	-12.64
	Equal variances not assumed	-16.62	33.51	**0.00**	-14.37	0.86	-16.12	-12.61
OR-2	Equal variances assumed	-26.25	58.00	**0.00**	-18.87	0.72	-20.31	-17.43
	Equal variances not assumed	-26.25	29.00	**0.00**	-18.87	0.72	-20.34	-17.40

OR-3	Equal variances assumed	-14.61	58.00	**0.00**	-17.30	1.18	-19.67	-14.93
	Equal variances not assumed	-14.61	29.00	**0.00**	-17.30	1.18	-19.72	-14.88

B. Comparison of the Semantic Feature Production, Average Response Onset time, Code mixed responses and Omitted Responses for all the three categories between Male and Female participants of Young adults (Group A).

On comparing the responses obtained from the male and female participants in the Young Adult group, no statistically significant difference ($p>0.05$) was obtained for response onset time, code mixed responses and the omitted responses for the categories Food and Drinks and Action words included in the study. However, statistically significant difference ($p<0.05$) was obtained in the feature production of the common objects. (Table 2.1) Supportive evidence could be obtained from the study done by Erminio Capitani(1999) to account that Gender affects word retrieval abilities in certain semantic fluency task. The semantic categories considered were: animals, fruits, tools and vehicles. The influence of age and education was common to all the categories considered and seems a general characteristic of the semantic fluency task. Gender had a significant effect only with fruits and tools, but a diverging role: females fared better with fruits and males with tools. On the contrary, the results obtained in our study did not show any differences with respect to the semantic feature production in any of the categories that were chosen. However, this might be due to the familiarity and the categories of the words that were chosen that is least resistant to express the effect of gender in the production.

Table 2.1 Test statistics for Male and Female Young Adults for the category of Common objects.

Category	**VISUAL**	**MOTOR**	**FUNCTIONAL**	**PROPRIO CEPTIVE**

Young adults	Mann-Whitney U	74.50	80.00	106.00	69.50
	Wilcoxon W	210.50	185.00	211.00	205.50
	Z	-1.57	-1.51	-0.25	-1.78
	Asymp. Sig. (2-tailed)	0.12	0.13	0.80	**0.08**
	Exact Sig. [2*(1-tailed Sig.)]	.120[b]	.193[b]	.822[b]	.077[b]

C. Comparison of the Semantic Feature Production, Average Response Onset time, Code mixed responses, and Omitted Responses for all the three categories between Male and Female participants of Geriatric Group (Group B).

On comparing the responses obtained from the male and female participants in Geriatric group, no statistically significant difference ($p>0.05$) was obtained for feature production, code mixed responses and omitted responses for all categories included in the study. However, statistically significant difference ($p<0.05$) was obtained in response onset time (Table 3.1)

Christau et al., 2018 stated that delay in audiovisual response time was observed in the elderly group. This suggest that the older people should pay more attention to the general movements. Raquel 2002, studies the gender and aging moderate brain behaviour relationships Neuroanatomical studies with Magnetic Resonance Imaging (MRI) indicate the progressive decrease in brain volume affects fronto- temporal brain regions in brain in males when compared to females. These results correlate with the results obtained in the present study providing an attributable cause for slow processing and increased response onset time in Geriatrics. Subjective Observation of the Average Response Onset Time also revealed that female participants had a quicker Response onset time when compared to the male participants adhering to the neurobiological evidence observed.

Table 3.1 . Test statistics for Average Response Onset Time in Geriatrics for all the categories chosen

Category		AVG ROT-1	AVG-ROT 2	AVG-ROT 3
Geriatrics	Mann-Whitney U	42.00	42.00	42.00
	Wilcoxon W	147.00	147.00	147.00
	Z	-2.91	-2.91	-2.91
	Asymp. Sig. (2-tailed)	**0.00**	**0.001**	**0.001**
	Exact Sig. [2*(1-tailed Sig.)]	.003[b]	.003[b]	.003[b]

On observing the trend that governs the production of Semantic features it is very important to appreciate the differences that is redundant in the production of features as well as various factors that can possibly attribute to the results across age, gender and linguistic familiarity.

Conclusion

Semantic Feature production could be considered as a measure of understanding how well the concepts are organized and interlinked at the level of cortex. Semantic Feature Association is an evidence-based practice that could be used to work on naming in aphasics. However, there are subjective differences of opinions regarding the cues that must be provided to facilitate naming for any category of the words that is considered for therapy. This study can act as a baseline for overcoming this subjective bias. In the futuristic perspective expanding this study including different class of words from all the semantic categories in Tamil, correlating the results with the help of neuroimaging techniques, and administering it on the various disordered population will further increase the value of this study.

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