Original Article

Effect of Semantic Cueing for Verbs and its Thematic Role Approach on Priming of Verbs and its Thematic Roles in Persons with Aphasia

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Abstract

Introduction: SCVTr stands for: semantic cueing for verbs and its thematic role. (SCVTr) is a therapy approach that aims to improve word retrieval in persons with aphasia (PWAs). It uses verbs and thematic roles (agent and patient) to facilitate word retrieval in PWA. **Aim:** The present study was conducted to analyze the effect of priming of verbs and their thematic roles in PWA. **Methods:** A total of five PWAs were recruited for the study, and the participants in the study initially received SCVTr therapy (Phase 1). Further, the study comprised two experiments (phase 2). In experiment 1, verb (prime) and agent (target) were presented. In experiment 2, verb (prime) and patient (target) were presented using PsychoPy software. These experiments were presented to glean reaction time and accuracy scores, during pre- and posttherapy measures, across the trained related, untrained related, and untrained unrelated conditions. **Results:** Researchers discerned improved reaction time and increased accuracy scores at posttherapy compare pretherapy conditions in four PWAs. In addition, researchers noted no difference in reaction time and accuracy scores across all the participants between experiment 1 versus experiment 2. **Conclusions:** This study throws light on the importance of thematic role during sentence processing and its relationship with verbs. Thus, this, in turn, might aid PWAs to retrieve the words with ease.

Keywords: Semantic therapy, stroke, word retrieval

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Introduction

Semantic cueing for verbs and its thematic role (SCVTr) is deemed the novel therapy approach proposed in this study to remediate word retrieval deficits in PWAs. This therapy was developed based on the fundamental ideas of verb network strengthening treatment (VNeST).[1] SCVTr uses verb as the core element, and also its corresponding thematic roles. This, in turn, might activate semantic networks associated with it, and also, there would be a possible occurrence of bidirectional priming for verbs and its thematic role. For instance, for verb tholi (wash), the corresponding thematic roles are "kelsagara" (servant)-"pathre" (utensils). Here, either "kelsagara" (servant) or "pathre" (utensils) will aid in priming or both together will prime the verb tholi (wash). These examples mentioned above belong to the Kannada language (the language spoken in South India). Thus, researchers further exploit an intriguing aspect of verbs and their thematic roles using different paradigms.

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A thematic role is a spatial, temporal, causal, or functional relation between entities that perform complementary roles in a particular event. A thematic role refers to an agent and patient pair respective to the verb. In general, an agent is the one who performs the act, and a patient is the one who receives the action in the event.[2-4] For instance, "book-pen" is related to the writing or reading theme and "dad and car" are related to the "driving" theme. In the latter example, "dad" acts as the agent because it answers the question – "who is performing the action." "Car" is the patient because it answers the question "what is driven."

Further, the thematic role is an external feature because it occurs between people, concepts, and events. The internal

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feature revolves around a single entity. For example, "dog" is hairy and has a tail; both features are considered internal features because the concept is encompassed by itself; these are specific properties or attributes of "dog." In other instance, consider example "dogs chase cats" contains external property of 'dog'; these cannot stand alone. The "dog chase" concept is not complete unless "cat" is introduced.

Besides, thematic roles for the verbs can be evoked by either affordance or convention-based method. Wherein, the former method refers to things or objects with several features or attributes, which interact with the other object or things in a specific way.[5] To illustrate an affordance method, consider "hammer." It is heavy, large, graspable, and flathead usually used in hitting. Conversely, nails are small, flathead that usually get hit. Thus, "hammer" and "nail" relation can be considered as affordance based. On the other hand, the convention-based method can be elucidated using the example of "wineglass" and "dinner plate." That is, this thematic role frequently co-occurs during mealtime. In this way, the convention method contrast with the affordance method. Owing to these intriguing aspects of thematic roles, researchers carried out studies in this line.

Over the past few years, the researchers have increased their interest in studying thematic roles and their relationship to verbs. McRae *et al*.[6] argued that thematic roles corresponding to the verb emerges through everyday experiences, knowledge of objects/things, and knowledge of people. This knowledge is activated when they hear the verb or read it. Further, researchers had argued that knowledge of thematic roles is deconstructed based on the characteristic features. The characteristic features entail to the agent and patient of a corresponding verb. In connection to the previous study, a study by Ferretti and McRae[7] explored whether the common features of the event are activated immediately when he/she reads or hears the verb (using online priming task). In this study, researchers used an animacy decision task with short stimulus onset asynchrony (SOA) of 250 ms. The study investigated the following conditions: verb and agent `xample, arresting and policeman); verb–patient (for example, arresting and criminal); verb and instrument (for example, cutting and scissors); and verb and location (for example, skating and arena). Results evinced positive priming effects on agent, patient, and instruments. However, contradictory results were found for verb and location conditions. In sum, the study highlights the use of a situation-based thematic role, encompassed with the particular verb.

Further, to extend the knowledge on the thematic role and its verb in young adults, in another study, participants read the prime word (thematic role) silently, and read the target word (verb) loudly. The study opines that contention of verbs is encompassed of episode traces that he/she is exposed to, and these traces were linked through lexical representation.[8] Moreover, the above studies have significantly contributed to understanding the relationship between verbs and their thematic roles. Furthermore, the results of the study have limited generalization. First, these studies were carried out merely on younger adults; second, these studies assessed thematic role knowledge using only one variant of paradigm; third, these studies are least explored in disordered population.

On the other hand, in the succeeding years, after studying thematic roles and their verbs in younger adults, researchers shifted their focus toward understanding and analyzing the knowledge of thematic roles and their verbs in the older adult group. For instance, Edmonds and Mizrahi[9] investigated verb-thematic role processing in younger and older adults. In this study, researchers tested verb (prime condition) and thematic role (target word) and vice versa, using the lexical decision task (with short SOA, 250 ms). Results evinced that younger adults manifest a bidirectional priming effect. That is, the priming effect was observed in agent-verb and patient-verb conditions. While analyzing older adults, they showed a priming effect on the patient-verb condition. Researchers gleaned a negative correlation for the agent-verb condition. There were slower reaction times for older adults compared to younger adults across all the conditions aforementioned.

There are considerable studies carried out to understand the nature of thematic roles and their verbs using different paradigms.[2,3] However, there are merely a few studies conducted to understand the thematic integrations in PWAs. Few studies have addressed thematic integrations in PWAs using the electrophysiological test. These studies discerned that Broca's aphasia and Wernicke's aphasia exhibit impairment during thematic integration.[10,11]

Nakanoa and Blumstein[12] conducted a study to explore the thematic relationship concerning nouns and verbs in the sentences across healthy individuals and PWAs. In this study, 12 healthy individuals, 9 Broca's aphasia, and 6 Wernicke's aphasia were enrolled. The study deployed three experiments: high cloze syntactic sentences, high cloze asyntactic sentences, and low cloze syntactic sentences. Under each experiment, four priming conditions were assessed, that is, real word-real word-target (RRT), real word-nonword verb-target (RNT), nonword-real word-target (NRT), and nonword-nonword verb-target (NNT). The NNT condition served as the baseline measure across three prime conditions through which the magnitude of priming was calculated. In all these experiments, participants were instructed to listen to the entire sentences and make the lexical decision based on the last word of the sentences. These experiments evinced that normal individuals manifested evidence for combinatorial thematics. These individuals exhibited an inflated priming effect when two real words were presented in the prime conditions than in the condition where only one real word was presented.

On the contrary, individuals with Broca's aphasia manifested no significant priming effect on the conditions mentioned above. Furthermore, the magnitude of priming (calculated by subtracting the reaction time of NNT during baseline condition with RRT, RNT, and NRT conditions) was absent. Individuals with Wernicke's aphasia showed a significant priming

effect for all the conditions but did not exhibit significant differences in the magnitude of priming. This study gleaned the differences manifested in thematic deficits across different variants of aphasia. Furthermore, it explored different patterns of performance in mapping thematic information in healthy individuals compared to PWAs. This study merited future research on this line across different types of aphasia.

On considering previous findings and contentions proposed on verbs and their thematic roles proposed by various authors had the following shortcomings. First, there is inconsistency in the paradigm used (a combination of animacy and inanimate tasks in a single study); second, studies emphasized less on varying nature of thematic roles based on the situation, exposure, and frequency; and third, there are limited studies on disordered population,[13] despite the enormity of understanding the nature of verbs and its thematic roles.

In addition, studies on thematic roles shed light on understanding potential differences in semantic processing across verbs and their thematic roles in PWAs and also on spreading activation network. Further, it enables the researcher to analyze the effect of bidirectional priming.[1-4] Subsequently, semantic processing and activation of the semantic network may vary across different language structures (S + V + O vs. S + O + V) and cultures. Therefore, considering all these research gaps from previous studies and understanding the nature of the thematic role and its verbs in sentence processing and comprehending the sentences becomes imperative.

In specific to PWAs, this study may enlighten the researchers in understanding the underlying deficits in the functional architecture of language processing. The paradigm used in the study may contribute to understanding which component of the sentences (agent/patient) would yield better facilitation during word retrieval training. In addition, this study integrated verbs in their paradigm to gauge the priming effect of the agent and patient across various conditions. This integration serves as the crucial element because verbs play a vital role in sentence construction, and it activates its corresponding thematic role. Hence, the study gains the importance of verbs and their thematic roles to render speech-language intervention in PWAs. Thus, the present study was conducted to analyze the effect of the SCVTr approach on the priming of verbs and its thematic roles in PWAs. Furthermore, the present study was designed based on the assumption that the paradigm used in the study intends to facilitate spreading activation that may enhance performance beyond trained conditions. In addition, the use of agent and patient tends to manifest a bidirectional priming effect.[1,6,9]

Objectives of the study

1. To compare the reaction time and accuracy scores of verb (prime) and agent (target) across trained related conditions, untrained related conditions, and untrained unrelated conditions during pre- and posttherapy measures
2. To compare the reaction time and accuracy scores of verb (prime) and patient (target) across trained related conditions, untrained related conditions, and untrained unrelated conditions during pre- and posttherapy measures
3. To compare the reaction time and accuracy of verb (prime) and agent (target) versus verb (prime) and patient (target) across trained related conditions, untrained related conditions, and untrained unrelated conditions during pre- and posttherapy measures.

Operational definitions

Agent

One who performs the act in the event is called the agent.

Patient

One who receives the action of the event is called the patient.

Thematic role

In a sentence, both agent and patient together form a thematic role.

For instance, consider the sentence "dad drive boat." In this sentence, "dad" will be the agent, "drive" is the verb, and boat is the patient. Further, "dad" and "boat" form the thematic role in this sentence.

Methods

Participants

The present study recruited five PWAs who had a cerebrovascular accident. Their native language was Kannada (a language spoken in South India), and all were from Mysuru district, Karnataka state, India see Table 1 for demographic details]. Participants for the study were selected based on a convenient sampling method, and the recruitment was done only after obtaining consent from the participants. The study was approved by the AIISH ethical committee. Out of five participants, four participants (P1, P2, P4, and P5) had not received any speech-language intervention before the recruitment. However, only the participant P3 underwent intensive speech-language intervention for 1 year. The participant exhibited fairly good improvement, as reported by the caregivers. Furthermore, no participants recruited for the study received SCVTr or VNeST therapy before participation in the present study.

The current research employed a single-subject design. Further, the study assessed cognitive impairment using mini-mental state examination (MMSE), psychological, vision impairment, and handedness through detailed case histories. All the participants recruited for the study were right handed pre morbidly.

Materials and stimulus

All participants were assessed for language deficits, aphasia type, severity, and cognitive impairment using a set of standardized test batteries. The test batteries used for assessment were Western Aphasia Battery (WAB) in Kannada for diagnosing the type of aphasia,[14] WAB-Revised for estimating the severity of aphasia quotient,[15] and MMSE for screening cognitive impairment.[16]

Table 1: Demographic details of participants

Participants	Age (years)/ gender	Occupation	Education	SPO	Aphasia type	SOL	Severity	AQ	MMSE scores
P1	35/male	Private employee	Postgraduation	6 months	Broca's	Left MCA	Moderate	62.8	28
P2	33/female	House maker	Secondary education	4 months	Conduction	Left MCA	Moderate	68.2	29
P3	64/male	Panchayat secretary	Graduation	5 years	Broca's Aphasia	Left MCA	Moderate	52.9	26
P4	23/male	Chef	Graduation	3 months	Anomic	Left MCA	Mild	84.7	30
P5	38/male	Charted accountant	Postgraduation	4 months	Anomic	Left MCA	Mild	85.7	30

P1: Participant 1; P2: Participant 2; P3: Participant 3; P4: Participant 4; P5: Participant 5. SPO: Stroke post onset; SOL: Site of lesion AQ: Aphasia quotient; MMSE: Mini-mental state examination

Table 2: Details pertaining to number of sessions received by the participants

Participants	Number of sessions attended
P1	20
P2	15
P3	25
P4	10
P5	10

Further, two sets of word lists were prepared. Set 1 consisted of verb (prime) and agent (target) lists of trained related, untrained related, and untrained unrelated conditions; set 2 consisted of verb (prime) and patient (target) lists of trained related, untrained related, and untrained unrelated conditions See appendix Appendix A].

Word lists for sets mentioned above were prepared with Manual for Fluent Aphasia in Kannada,[17] mental lexicon of nouns and verbs in the adult speaker of Kannada,[18] and used authors' word repertoire. A total of 80 words were prepared. Five experienced speech-language pathologists validated these sets based on frequency, familiarity, and ambiguity using a 3-point rating scale (0 being least score and 2 being maximum score). The words that received the maximum score for frequency (score 2) and familiarity (score 2) and least for ambiguity (score 0) were considered for the final set of stimuli. Finally, 30 words for each set were finalized after validation and used for the experiment.

Procedure

The present study assessed reaction time and accuracy of trained related, untrained related, and untrained unrelated conditions in pre- and posttherapy measures.

The study had two phases. In phase 1, SCVTr therapy was provided to all participants. This therapy approach has six steps. In step 1, participants had to retrieve the verb without any cues. If they failed to retrieve, then semantic cues were given. If they failed, then visual cues (flashcard) and orthographic cues were given simultaneously. Again, if participants were unable to respond to the cues provided, the researcher introduced one target word with three foils. Here, participants had to identify the target word among the foils. After retrieval of the verb, the corresponding agent and patient were generated. Similar cueing strategies were followed as earlier to generate thematic pairs. Only after successfully retrieving the target word (agent-patient-verb) or identifying the target word, participants were moved to the next step. In step 2, the generated agent + patient + verb pair was read. If participants were unable to read, then choral reading was employed. Either the participant had to independently read or choral read the generated pair to move to the next step. In step 3, "who," "what," "where," and "why" questions related to the generated pair were evoked. If participants failed to answer the questions, then choices of answers were provided to each question. Here, participants had to identify one of the choices correctly. Here, participants were trained until they respond correctly for each question. They were followed by training for the semantic judgment task in step 4. In this step, semantic judgments of the pair were carried out by responding yes or no for the sentences. This step was retained until the participant judged the sentence correctly. In step 5, verbs were retrieved with/without prompting. In step 6, all these steps were devoid of cues [for detailed descriptions of the treatment protocol, see Appendix B]. Further, all the participants were trained until they achieved 80% criterion. Participants had to retrieve 8 verbs and 24 agent + patient pairs out of 10 verbs. While reaching this criterion, participants did not maintain uniformity. Thus, the number of sessions for each participant varied. Participants received a minimum of 10 to a maximum of 25 sessions [Table 2]. However, this study has not assessed the efficacy of the SCVTr therapy approach directly because the efficacy of SCVTr was investigated phase 1 study. Hence, the present study focused on analyzing the effect of the SCVTr approach on verbs and their thematic roles during priming tasks.

In phase 2 of the study, the participants performed in a well-lit and quiet room. They were instructed to read the first word (prime) and subsequently judge the second word (target) based on relatedness. Judgment was made by pressing the keys (0 or 1) using his/her comfortable hand, where "0" indicated nonrelatedness and, indicated relatedness. During the entire course of the experiment, participants were given breaks at regular intervals. The experiments were run on a Lenovo laptop (14" monitor screen). These experiments were developed using PsychoPy software, and also, it was

used to run the same.[19] The study had two experiments to elicit reaction time and accuracy. In experiment 1, the verb (prime)-agent (target) across trained related, untrained related, and untrained unrelated conditions was presented. In experiment 2, the verb (prime)-patient (target) across similar conditions was presented.

In these experiments, each prime was presented for 2 s. This was followed by a 0.05 s interstimulus interval during which the screen stayed blank. The target word then appeared and remained on the screen for 8 s or until the participant responded. The subsequent prime appeared after 2 s (intertrial interval) to the previous target word cleared from the screen. If the participant failed to respond to a target within 8 s, it was recorded as an error response.

Following is the illustration of experiment 1. The trained related condition would be/akalisu/(yawning)(verb)-/magu/(child)(agent), untrained related condition would be/akalisu/(yawning)-/kothi/(monkey)(agent), and untrained unrelated condition would be/akalisu/(yawning)-/mara/(tree)(agent). All presented using PsychoPy software. In the above-mentioned examples, for a related condition, the PWA had to press key "1"; for an unrelated condition, the PWA had to press key "0" to glean the correct response. Subsequently, in experiment 2, trained related condition would be/akalisu/(yawning)-totilu (cradle) (patient), the untrained related condition would be/akalisu/(yawning)-/mancha/(bed) (patient), and untrained unrelated conditions/akalisu/(yawning)-/niru/(water) (patient) were presented. Similar judgment strategies were followed as in experiment 1.

Data analysis

The reaction time for the experiments was automatically computed in PsychoPy software. After extracting the reaction time from the data, the researcher excluded the reaction time of incorrect word pairs, and the mean reaction time was calculated merely for the correct words across all participants individually. Concurrently, the accuracy of the word pair was computed by calculating the total number of positive responses out of overall responses for each participant.

Results

The present study aimed to investigate the effect of SCVTr therapy on priming for verb and its thematic role. It is difficult to recruit a homogenous group of aphasia due to a wide variety of symptoms reported among individuals with aphasia. Keeping these limitations in view, a descriptive single-case study design was implemented. Thus, each participant's results were discussed using mean scores individually with respect to the objectives of the study.

Objective 1 was to compare the reaction time and accuracy scores of verb (prime) and agent (target) across trained related conditions, untrained related conditions, and untrained unrelated conditions during pre- and posttherapy measures. The researchers computed mean reaction time and accuracy scores for all the participants, where the mean reaction time for participants P1, P2, P4, and P5 yielded faster mean reaction time in posttherapy measures compared to pretherapy measures across all the conditions [Table 3]. Further, the accuracy scores of P1, P2, P4, and P5 were analyzed. Results revealed proliferated accuracy scores in posttherapy measures compare to pretherapy measures across all three conditions [Table 4].

Objective 2 was to compare the reaction time and accuracy scores of verb (prime) and patient (target) across trained related conditions, untrained related conditions, and untrained unrelated conditions in pretherapy versus posttherapy measures. On analyzing mean reaction time and accuracy scores of verbs (prime) and patient (target), the results revealed faster mean reaction time and improved accuracy scores in posttherapy measures compared to pretherapy measures across all three conditions among P1, P2, P4, and P5 [Tables 3 and 4].

On the other hand, while analyzing the mean reaction time and accuracy scores of P3 in objective 1 and 2, the results evinced that there is merely a marginal difference in mean reaction time and accuracy scores in pretherapy versus posttherapy across all three conditions [Tables 3 and 4].

Objective 3 was to compare the reaction time and accuracy scores of verb (prime) and agent (target) (experiment 1) versus verb (prime) and patient (target) (experiment 2) across trained related conditions, untrained related conditions, and untrained unrelated conditions in pre- and posttherapy measures. The results evinced negligible differences in mean reaction time and accuracy scores across P1, P2, P3, P4, and P5 when compared between two experiments across different conditions in pretherapy versus posttherapy measures [Tables 3 and 4].

To recapitulate the results, participants P1, P2, P4, and P5 yielded faster mean reaction time and improved accuracy scores in posttherapy measures compared to pretherapy measures across all three conditions (trained related, untrained related, and untrained unrelated) in both objective 1 (verb-agent) and objective 2 (verb-patient). On the contrary, P3 performance for mean reaction time and accuracy scores did not differ in objective 1 and objective 2. On the other hand, when addressing objective 3 (verb-agent versus verb-patient), researchers discerned a marginal difference in the performance of P1, P2, P3, P4, and P5 in regard to mean reaction time and accuracy scores across all the conditions.

Discussion

The current study analyzed the effect of priming on the verb and its thematic roles in PWA. While addressing objectives 1 and 2, researchers predicted a robust priming effect that would extend the priming effect beyond the trained stimuli. We also predicted that the priming effect might not vary when the target conditions were counterbalanced, in support of the contention of bidirectional priming. Subsequently, researchers

Table 3: Mean reaction time of pre- and posttherapy measures across agent and patient conditions

Participants	TRC-PRERT (s)	SD	TRC-POSTRT (s)	SD	URC-PRERT (s)	SD	URC-POSTRT (s)	SD	UUC-PRERT (s)	SD	UUC-POSTRT (s)	SD
P1												
Agent condition	3.22	0.71	1.77	0.34	2.76	0.84	0.79	0.06	2.48	0.68	1.70	0.32
Patient condition	3.09	0.68	1.72	0.32	2.67	0.79	0.65	0.04	2.44	0.66	1.52	0.25
P2												
Agent condition	4.66	2.41	2.07	0.47	4.11	1.87	1.58	0.27	3.85	1.64	1.18	0.15
Patient condition	4.75	2.50	2.13	0.50	4.13	1.89	1.55	0.26	3.88	1.67	1.16	0.14
P3												
Agent condition	1.11	0.13	1.08	0.12	0.74	0.06	0.76	0.06	1.03	0.11	1.04	0.12
Patient condition	1.09	0.13	1.06	0.12	0.70	0.05	0.70	0.05	1.03	0.11	1.04	0.12
P4												
Agent condition	7.90	1.75	5.98	1.32	8.47	7.97	4.97	2.74	8.75	1.94	5.36	1.19
Patient condition	7.95	1.76	5.90	1.31	8.42	1.87	4.93	1.09	8.78	1.95	5.45	1.21
P5												
Agent condition	6.57	1.46	3.19	0.70	6.23	1.38	3.57	1.41	8.23	1.82	4.59	1.02
Patient condition	6.51	1.44	3.10	0.68	6.34	1.40	3.50	0.77	8.28	1.84	4.54	1.00

TRC-PRERT: Trained related condition-pretherapy reaction time; TRC-POSTRT: Trained related condition-posttherapy reaction time; URC-PRERT: Untrained related condition-pretherapy reaction time; URC-POSTRT: Untrained related condition-posttherapy reaction time; UUC-PRERT: Untrained unrelated condition-pretherapy reaction time; and UUC-POSTRT: Untrained unrelated condition-posttherapy reaction time; SD: Standard deviation

Table 4: Accuracy scores of pre- and posttherapy measures across agent and patient conditions

Participants	TRC-PREACC	TRC-POSTACC	URC-PREACC	URC-POSTACC	UUC-PREACC	UUC-POSTACC
P1						
Agent condition	4	7	4	7	5	9
Patient condition	3	7	4	7	4	9
P2						
Agent condition	5	8	4	7	5	8
Patient condition	4	7	4	7	5	8
P3						
Agent condition	4	5	4	4	3	3
Patient condition	3	3	4	4	3	3
P4						
Agent condition	6	9	6	8	6	9
Patient condition	6	9	5	8	6	9
P5						
Agent condition	6	9	6	8	5	8
Patient condition	6	9	6	8	5	8

TRC-PREACC: Trained related condition-pretherapy accuracy; TRC-POSTACC: Trained related condition-posttherapy reaction time; URC-PREACC: Untrained related condition-pretherapy accuracy; URC-POSTACC: Untrained related condition-posttherapy accuracy; UUC-PREACC: Untrained unrelated condition-pretherapy accuracy; UUC-POSTACC: Untrained unrelated condition-posttherapy accuracy

made generalized predictions based on the studies which use thematic roles and verbs in their paradigm.[7-9] However, these studies were conducted on typically developing individuals. While analyzing verb (prime) and agent (target condition), researchers discerned the mean reaction time, and accuracy scores improved substantially from pretherapy to posttherapy measures, across trained related conditions, untrained related conditions, and untrained unrelated conditions.

While analyzing verb (prime) and patient (target condition), researchers gleaned a similar trend of results in the previous

experiment for both mean reaction time and accuracy scores. Presumably, the findings of both the above conditions may be attributed to the systematic training of thematic roles, and its verbs in the paradigm, which simultaneously facilitated activating semantic network associated with these words. This may, in turn, facilitate PWAs to generalize the training effect beyond the trained stimuli.[20] In addition, the faster reaction time and increased accuracy scores across all three conditions could be attributed to the use of the highly frequent words in the therapy and during the experiments because a frequent word consists of a high number of features and more extensive semantic representation.[21] Further, the present study used the verb as the core element in therapy and experiments. This might activate a wide array of lexical representations of verbs and their thematic roles. Thus, it yielded better performance in reaction time and accuracy scores in posttherapy measures.

Interestingly, improved performance for unrelated untrained conditions was noted. This can be attributed to the activation of a wide array of semantic networks or lexical representations. Furthermore, the PWA might inhibit the unintended word and activate the intended word according to the context.

In this study, even with counterbalancing of the target conditions, the patient as target word, mean reaction time, and accuracy scores improved drastically from pretherapy to posttherapy measures. One explanation posits that the usage of verbs as prime activates corresponding thematic roles (agent or patient), resulting in a robust effect in priming the verb. In addition, the patient (receiver of the action) of the corresponding verb might have cued the verb to comprehend it faster. Hence, this strategy can be further used in the assessment and intervention of PWAs.

On the other hand, results of P3 for objectives 1 and 2 indicated subtle differences in mean reaction time and accuracy scores in posttherapy measures across all the conditions mentioned above. Presumably, this finding can be attributed to the presence of associated conditions (cognitive impairment) in the participant (P3), which might have gone unnoticed because of the usage of screening tools instead of the comprehensive assessment tool to rule out cognitive impairment. Another possibility could be a higher degree of severity of aphasia that might have interfered with the individual's performance. The age and stroke post onset (SPO) of the participant may hinder the performance. When compared to the age, and SPO of other participants, P3 had higher SPO and was older than other participants. This might have resulted in alleviated performance in P3. Furthermore, the PWA would have had difficulty in semantic processing that was not ruled out during the initial assessment.

Objective 3, was intended to measure two experiments, that is, verb (prime) agent (target) versus verb (prime) patient (target). In these experiments, researchers predicted the bidirectional priming effect based on anecdotal evidence.[9] Even with the changes in target conditions, reaction time and accuracy scores should remain the same in all the conditions. Meanwhile, the present study results manifested a positive priming effect in all PWAs, even when the target conditions were counterbalanced. The result is in consensus with previous studies.[7-9] Thus, the result of the present study extends our knowledge on agents and patients priming with verbs, regardless of the change in target word conditions. Furthermore, it aids in exploiting the prominence of agent and patient role in comprehending the sentences. However, there is a study that contradicts the present study. In the study, the researcher argued that during verb-patient condition, reaction time is faster than verb-agent conditions. It could be due to the order effect. In other words, the verb thematic role is in canonical order with patient conditions than agent conditions.[22]

Conclusions

In a nutshell, to our knowledge, this is the first study on PWAs exploring the effect of SCVTr therapy on verb and its thematic roles. This study supports the contention that semantic-based treatment shows positive effects on strengthening and expanding the semantic networks. However, the study results cannot be generalized to the population of aphasia due to the paucity of sample size and varied symptomology. In addition, the study throws light on thematic role processing in apprehending the sentences. The study illuminates knowledge on understanding the relationship between thematic roles and semantic systems. Thus, this study might provide new insight for understanding theories of semantic processing in PWAs.

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Conflicts of interest

There are no conflicts of interest.

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Appendix –A

Related trained agent and patient stimuli

Agent	verb
/Magu/ಮಗು	/a: kalisu/(ಆಕಳಿಸು)
/Batta/ಬಟ್ಟೆ	/toil/(ತೊಳೆ)
/Pujari/ಪೂಜರಿ	/Pujisu/(ಪುಜಿಸು)
/Bekku/(ಬೆಕ್ಕು)	/idi/(ಇಡೆ)
Kalla/ಕಳ್ಳ	/Muri/(ಮುರಿ)
/Janaru/ಜನರು	/ele/(ಎಳೆ)
vyapari(ವಯಪಾರಿ)	/tege/(ತಗೆ)
/Navika/ನಾವಿಕ	/Odisiu/(ಓಡಿಸು)
/Mesthari/(ಮೇಸಪರಿ)	/Kattu/(ಕಟ್ಟಿಟು)
Minugara (ಮೀನುಗಾರ)	/Mulugu/(ಮುಳುಗು)

verb	Patient
/a: kalisu/(ಆಕಳಿಸು)	/Hasige/ಹಾಸಿಗೆ
/toil/(ತೊಳೆ)	Pathre ಪಾತರೆ
/Pujisu/(ಪುಜಿಸು)	/devaru/ದೇವರು
/idi/(ಇಡೆ)	Illi (ಇಲಿ)
/Muri/(ಮುರಿ)	/bagilu/ಬಾಗಿಲು
/ele/(ಎಳೆ)	/Ratha/ರಥ
/tege/(ತಗೆ)	/Aagadi/(ಅಂಗಡಿ)
/Odisiu/(ಓಡಿಸು)	/Hadagu/ಹಡಗು
/Kattu/(ಕಟ್ಟಿಟು)	/kattada/(ಕಟ್ಟಿಡ)
/Mulugu/(ಮುಳುಗು)	/nadi/(ನದಿ)

Related untrained agent and patient stimuli

Agent	Verb
/kothi/ಕೋತಿ	/a: kalisu/(ಆಕಳಿಸು)
/kelasagara/ಕೆಲಸಗಾರ	/toil/(ತೊಳಿ)
/mantravadi/ಮಂತರವಾದಿ	/Pujisu/(ಪುಜಿಸು)
/police/ಪೋಲಿಸ	/idi/(ಇಡಿ)
/a; tagara/ಆಟಿಟಗಾರ	/Muri/(ಮುರಿ)
/raitha/ರೈತ	/ele/(ಎಳೆ)
/postman/ಪೋಸಟಿ ಮಯಾನ	/tege/(ತಗೆ)
/driver/ಡರವರ	/Odisiu/(ಓಡಿಸು)
/koligara/ಕೂಲಿಗಾರ	/Kattu/(ಕಟಿಟು)
/I; jugara/ಈಜುಗಾರ	/Mulugu/(ಮುಳುಗು)

verb	Patient
/a: kalisu/(ಆಕಳಿಸು)	/mancha/ಮಂಚದಲಲಿ
/toil/(ತೊಳಿ)	/mane/ಮನೆ
/Pujisu/(ಪುಜಿಸು)	/kadinalli/ಕಾಡಿನಲಲಿ
/idi/(ಇಡಿ)	/busstand/ಬಸ ಸಟಾಂಡ
/Muri/(ಮುರಿ)	/kolu/ಕೋಲು
/ele/(ಎಳೆ)	/ho; la/ಹೊಲ
/tege/(ತಗೆ)	/kaagada/ಕಾಗದ
/Odisiu/(ಓಡಿಸು)	/ro; dinali/ರೋಡನಲಲಿ
/Kattu/(ಕಟಿಟು)	/u; ru/ಊರಿನಲಲಿ
/Mulugu/(ಮುಳುಗು)	/nadi/ನದಿ

Untrained unrelated agent and patient stimuli

Agent	verb
/minu/ಮೀನು	/a: kalisu/(ಆಕಳಿಸು)
/sainika/ಸೈನಿಕ	/toil/(ತೊಳೆ)
/deva/ದೈವ	/Pujisu/(ಪೂಜಿಸು)
/kallaru/ಕಳ್ಳರು	/idi/(ಇಡಿ)
/iruve/ಇರುವೆ	/Muri/(ಮುರಿ)
/chitragara/ಚಿತ್ರಗಾರ	/ele/(ಎಳೆ)
/teacher/ಟೀಚರ	/tege/(ತಗೆ)
/vaidya/ವೈದ್ಯ	/Odisiu/(ಓಡಿಸು)
/a; chari/ಆಚಾರಿ	/Kattu/(ಕಟ್ಟಿಟು)
/Moda/ಮೋಡ	/Mulugu/(ಮುಳುಗು)

verb	Patient
/a: kalisu/(ಆಕಳಿಸು)	/niru/ನೀರಿನಲ್ಲಿ
/toil/(ತೊಳೆ)	/phone/ಫೋನ್
/Pujisu/(ಪೂಜಿಸು)	zoo
/idi/(ಇಡಿ)	/gali/ಗಾಳಿ
/Muri/(ಮುರಿ)	/paper/ಪೇಪರ್
/ele/(ಎಳೆ)	/vimana/ವಿಮಾನ
/tege/(ತಗೆ)	/gadiyara/ಗಾಡಿಯಾರ
/Odisiu/(ಓಡಿಸು)	/devastana/ದೇವಸ್ಥಾನ
/Kattu/(ಕಟ್ಟಿಟು)	/a; gasa/ಆಗಸ
/Mulugu/(ಮುಳುಗು)	/ro; dinalli/ರೋಡಿನಲ್ಲಿ