



Facilitation Versus Inhibition in Sentence Production

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Abstract:

Lexical access is defined as the retrieval of the most appropriate word from the lexicon. It is hypothesized that the participant must search his or her semantic memory to generate the word, also called as lexical access hypothesis. This is achieved through mainly two stages, first stage is semantic and syntax specific retrieval and second stage is phonologically specific representation. Words which belong to the same category are arranged together and thus facilitate spreading activation theory. Priming is the process in which experience of an item leads to increase in retrieval of that and related items. Based on this, two hypotheses are formulated, facilitation hypothesis and suppression hypothesis. The present study aimed to study the effects of lexical retrieval through priming on sentences in neuro-typical individuals. A total of 40 participants were taken for the test. Action Naming Test was administered to test for lexical retrieval. Out of 57 pictures, 19 pictures were preceded by semantically noun related noun phrase, 19 pictures were preceded by semantically related verb phrase and the remaining 19 pictures were preceded by unrelated precursors. Accuracy scores were measured as a response, statistically significant difference was found for related targets than unrelated targets and for semantically related verbs than semantically related nouns.

Keywords: facilitation; inhibition; sentence production; word picture interference

Introduction:

A stimulus given in the visual or auditory form can generate a response in following three sub-processes. (i) lexical access, the retrieval of appropriate words; (ii) grammatical encoding, the specification of the order and grammatical forms of those words; and (iii) phonological encoding, determining the pronunciation of the sequence of words. Lexical access hypothesis suggests that the participant must search his or her semantic memory during the process of generation of the word.

The search activates semantic features in memory that are related to the target item. During the retrieval of the target item at testing, the semantic features serve as retrieval cues and aid in the recall of the target item. Lexical access is defined as the retrieval of the most appropriate word from the lexicon. Naming task assesses the top down route of lexical access, while priming task assesses the bottom up route (Holich, 2011). Naming tasks is the most commonly used task used to assess lexical access. The words in the lexicon is assumed to be arranged in a typical pattern. Words which belong

the same lexical category is assumed to be arranged together. According to (Garrett, 1976), the words are accounted by grammatical features and not by phonological properties, and the sounds by phonological and not semantic or syntactic properties, which indicates that separate stages of lexical access are involved in the production of speech. There are two stages that he speaks about, the first stage involves retrieval of a semantic and syntax specific representation and the second stage involves retrieval of phonologically specific representation.

Priming (to prime=to prepare, to instruct in advance) constitutes a cognitive phenomenon that can be predicated on the establishment of context-based associations between a stimulus and a response. The priming effect describes the circumstance that the “prior exposure to a stimulus (prime) can facilitate its subsequent identification and classification (target)” 5 , as the various processing stages that were required to select that response during its first presentation are bypassed. (Horner & Henson, 2008). It is the process which increases the accessibility of related materials/ or words and behaviours by perception (or experience) of an item (or person or event).

Priming is based on the idea that information is stored in units (schemas) in long-term memory, whose activation levels can be increased or decreased. It refers to increased sensitivity to certain stimuli due to prior exposure &/or experience. According to the spreading activation theory, information is encoded in cognitive units and forms a interconnected network after a stimulus has been presented. Lexical retrieval happens after spreading activation happens throughout the network. Priming is believed to work on the spreading activation principle and facilitating lexical selection. When a person is asked to name a picture, several semantic representations receive activation.

There are three types of priming: Repetition priming, associative priming and Negative priming. Repetition priming and associative priming are all concern facilitation effects: increased activation of concepts related to a prime. However, in Negative priming, it can actually decrease the activation of particular schema, spreading inhibition rather than activation. This effect may arise from the way the brain deals with schema that are competing for attention.

Further Caramazza(2010), proposed the Independent Network(IN) model of the lexicon, which assumes that lexical knowledge is organised in sets of independent networks connected to each other by a modality-specific lexical node. The assets of semantic properties, features, or predicates are represented as word meanings in the lexical-semantic network, whereas the features such as grammatical category, gender, auxiliary type, tense are represented in the lexical-syntactic network. The nodes in this network correspond to the different syntactic functions, which are formulated in different subnetworks. Thus, there is a subnetwork consisting of different nodes such as category nodes (Noun, Verb etc.); gender nodes (Male, Female); auxiliary types (be, have); and so on. Based on this notion on lexical arrangement, two hypotheses on lexical access/retrieval namely facilitation and suppression/inhibition hypotheses are formulated.

The facilitation hypothesis (Krill, 2002) derives its roots from the

shared lexical representation, which states that if a sentence with identical or related noun phrase or verb phrase in relationship to a target sentence is used as a prime, naming would become easier. A sentence with semantically related noun phrase or verb phrase condition facilitates lexical semantic activation of the noun phrase or verb phrase in the target sentences. The other hypothesis in consensus with distinct lexical representation is the suppression hypothesis (Gould, 2004). Response inhibition is a process where a subject suppresses one modality to selectively pay attention to the more relevant stimulus. The proponents of the suppression hypothesis believe that presentation of a neutral sentence (with distinct noun phrase and verb phrase) would enable easier retrieval of target sentence, as the distinct noun phrase and verb phrase would not interfere with lexical-semantic activation of the target sentence.

There is also evidence that object noun and action verb retrieval are differentially influenced by factors like word frequency and imageability (Barry et al.2001; Colombo and Burani2002;Cuetos and Alija2003;Kauschke and von Frankenberg2008;Székely et al.2005).

The two hypotheses can be tested by employing picture-word interference paradigm. This paradigm involves tasks where in a particular visual stimulus is given, and simultaneously some other word is displayed (which is not the stimulus picture word). The displayed word may act as a facilitator or inhibitor for the picture stimulus. Using tasks involving picture–word interference effect where pictures are displayed with semantically related or unrelated precursors, experimental evidence on facilitation or suppression hypothesis can be derived.

The facilitation hypothesis may be assumed to function when the reaction time or accuracy scores obtained for stimulus pairs under a semantically related noun phrase and semantically related verb phrase condition is better than unrelated condition. The interference hypothesis may be presumed to function when the reaction time or accuracy scores obtained for the stimulus pair preceded by an unrelated noun and verb phrase condition in the picture-word paradigm is better than the related condition.

Need for the study:

Most of the evidence pertaining to facilitation hypothesis and suppression hypothesis has been derived through priming experiments. The priming experiments operate at the word level; hence the findings cannot be generalized to the sentence level retrieval. The effect of word class on lexical retrieval in regard to facilitation and suppression hypothesis has not been explored much. These factors paved way for the current study.

Aim: To test the two hypotheses regarding the lexical retrieval in context to sentence naming.

Objectives: To compare the accuracy scores for sentences preceded by unrelated and related noun and verb phrases

Method:

Total number of participants taken for the study were 40, of which 11 males and 29 females were taken between the age range of 18-25 years. LEAP-Q (Ramya & Goswami, 2009) was administered before beginning the test to confirm language proficiency of the participant in English. Action Naming Test (Girish & Shyamala, 2015) was used to test the lexical retrieval. The test material contained 57 stimuli. Each stimulus contained a noun phrase and verb phrase. The sentences were preceded by precursors. The precursors were presented in auditory modality. The precursors were recorded in the female voice at an appropriate rate of speech. Out of 57 pictures, 19 pictures were preceded by semantically related noun phrase (where the noun of the precursor was semantically related to the noun in the target), 19 pictures were preceded by semantically related verb phrase (where the verb of the precursor was semantically related to the verb of the target) and the remaining 19 pictures were preceded by unrelated precursors (where both noun and verb were distinct). The auditory stimulus acting as the precursor was presented simultaneously with the visual picture stimulus. The duration for each stimulus was 3 seconds. The participants were instructed to name the pictures in a full sentence as the pictures are presented, in the presence of auditory stimulus. The participants were asked to not pay weightage to the precursor and concentrate on the target only.



Figure 1: Semantically related noun phrase

Precursor: The child is writing.

Target Sentence: The man is writing. (Noun phrase)



Figure 2: Semantically related verb phrase

Precursor: The boy is walking.

Target Sentence: The boy is running. (Verb phrase)

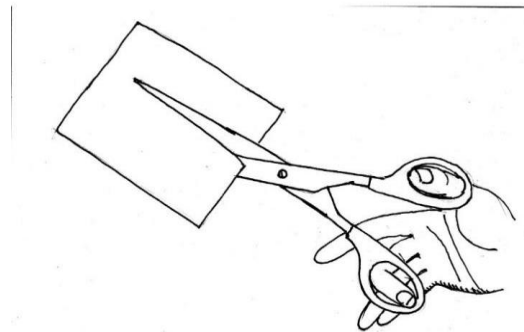


Figure 3: Unrelated phrase

Precursor: Wash the dishes.

Target Sentence: Cut the paper. (Unrelated phrase)

Criteria for analysis: The response was considered correct only when it was complete and had the right noun and verb. Each correct response was given a score of 1, while a no response, incorrect response and partially correct response was given a score of 0. The scores for the target preceded by unrelated, semantically related nouns and semantically related verb phrases were tabulated separately. The maximum score for each of these 3 categories was 19.

The testing was carried out in English.

Results:

All the participants were highly proficient as they had speaking proficiency of 4 (on 5-point rating where 4 is the highest level recorded). The mean scores for the stimulus preceded by unrelated precursor was 8 and the mean scores for the stimulus preceded by related noun precursor was 10, while the mean scores for target preceded by semantically related verb precursors was 12. The range of scores for the three sets in the same order was 6 to 13, 8 to 15, and 7 to 17. The standard deviation was high for the targets preceded by verbs compared to the other two conditions. The data was subjected to statistical analysis; the data did not abide by the properties of normal distribution. Friedman's test was used to compare the accuracy scores for targets preceded by unrelated, related noun phrases and related verb phrases. The X^2 obtained was 3.93 and the corresponding p value showed significant differences as shown in Fig 4. Hence Wilcoxon's signed rank test was used for pair wise comparison.

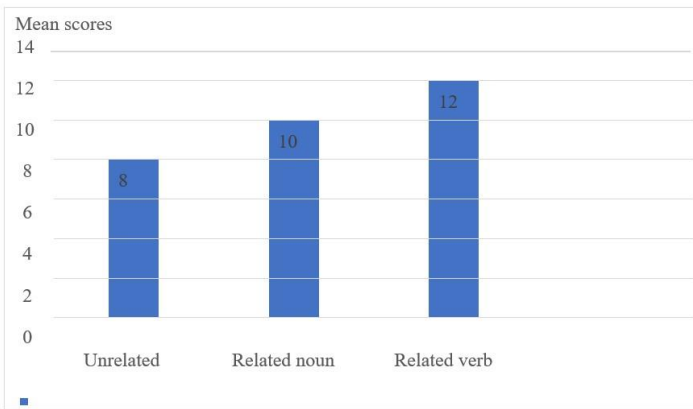


Figure 4: Comparison across different stimuli

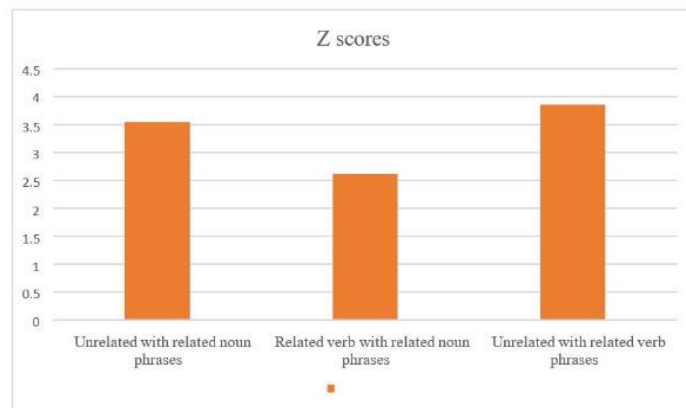


Figure 5: Pair-wise comparison between different stimuli

Discussion:

On comparing the accuracy scores of targets preceded by unrelated phrases, with related noun phrases; related verb phrases with related noun phrases and unrelated phrases with related verb phrases, Z scores of 3.54, 2.62 and 3.85 was obtained, the corresponding p values showed significant difference when unrelated condition was compared with related verb phrases, and when related noun phrases was compared with related verb phrases as shown in Fig 5. Statistically significant difference was not seen for the condition where the accuracy scores of unrelated conditions was compared with the accuracy scores of related noun phrases.

The stimulus used for the test was from the action naming test, where the emphasis was on the retrieval of verbs, and the noun phrases were relatively unimportant. The noun phrase was same across many target items and the participant did not rely on the noun phrases for the sentence production. Hence the noun phrase did not evoke facilitation or inhibition. The related verbs facilitated the retrieval. The participants felt it easy to retrieve sentences when it was preceded by verb phrase as the related verb phrase facilitated the retrieval. Thus, the facilitation hypothesis was more applicable in this context. The accuracy scores were poorest for unrelated condition as it did not have any role in retrieval of the target.

Conclusion:

The study was carried out with the aim of testing facilitation and inhibition phase in regard to sentence production. 40 participants were recruited for the study. They were asked to name the 57 picture stimuli borrowed from ANT. 19 of these sentences were preceded by unrelated, 19 were preceded by semantically related noun phrases and 19 stimuli were preceded by semantically related verb phrases. The accuracy scores were better for related targets compared to unrelated targets favouring facilitation. The semantically related verb phrases facilitated the target more than the semantically related noun phrases. This finding could be attributed to the fact that verbs describe the relationships between nouns or states of being of nouns; thus, verbs are more abstract and flexible in use because the same verb can describe relationships across a range of nouns. Nouns, on the other hand, stay relatively consistent in their meaning, regardless of the verbs in the surrounding context (Mandy Maguire et al, 2014). Since the number of nouns to be named were limited as compared to verbs, it may have led to some amount of confusion and facilitated better retrievals of verbs in the sentence.

References:

1. Abel, A. D., Maguire, M. J., & Naqvi, F. M. (2014). Lexical Retrieval of Nouns and Verbs in a Sentence. *Journal of Psycholinguistic Research*, 545-553.
2. Allan Horner and Richard J. Henson (2008): "Priming, response learning and repetition suppression." In. *Neuropsychologia* 46.7, 1.
3. Caramazza, A. (1997). How Many Levels of Processing Are There in Lexical Access? *COGNITIVE NEUROPSYCHOLOGY*, 177-208.
4. Dell, G.S., Jacobs, & C.L. (2016). Successful Speaking: Cognitive Mechanisms Of Adaptation in Language Production. *Neurobiology of Language*, 209-219.
5. John R. Anderson, 1983, A spreading activation theory of memory, *Journal of Verbal Language and verbal behaviour* 22
6. Ramya, M., & Goswami., S. (2009). Language Proficiency questionnaire: An adaptation of LEAP Q to Indian context. Unpublished master's dissertation: University of Mysore, Mysore.
7. SCHFUEFERS, H., MEYER, A. S., & LEVELT, W. J. (1990). Exploring the Time Course of Lexical Access in Language Production: Picture-Word Interference Studies. *JOURNAL OF MEMORY AND LANGUAGE*, 86-102.
8. WikiDiff. (n.d.). Retrieved from [www.wikidiff.com: https://wikidiff.com/lemma/lexeme](https://wikidiff.com/lemma/lexeme)