POSITION EFFECTS OF LETTER PRIMING ON CVC WORD NAMING IN ADULT SPEAKERS OF ENGLISH AS SECOND LANGUAGE

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Abstract

The segmental overlap effects of intra-word constituents in naming CVC type of monosyllabic words by second language speakers of English has been established. However, the relative effect of position of the constituents when presented independently is not known. The present study investigated the effects of the initial, medial and final letter overlap on word naming in 30 second language speakers of English through a masked priming paradigm. The results revealed the presence of facilitation only by overlapping letters in the initial position, thereby signifying the role of 'position' in primed naming with overlapping components.

Key words: *word naming, letter priming, segmental overlap, letter position*

Introduction

Word naming refers to the simple task of reading a written word. Although apparently simple, the task requires an individual to recognize the components of the written word and formulate its production through appropriate lexical selection and phoneme sequencing, as the case may be. These stages of processing render the task temporal so that the steps involved in the process of naming are in a timed sequence (Glushko, 1979; Seidenberg, 1985a). When these processes are theoretically or practically delineated, they offer a scope for intervention in to the processes through priming experiments. The general premise is that word naming may be facilitated when components of the word are presented prior to its actual introduction, as in the 'segmental overlap hypothesis' (Schiller, 1998; 2000).

Several studies have documented these facilitating effects of form-based priming in different languages (e.g.: Forster & Davis, 1991; Ferrand, Grainger & Segui, 1994; Chen, Chen & Dell, 2002; Roelofs, 2006; Verdonschot et al., 2011), where word naming is speeded with an increase in overlap of segments / components between the prime and target. The minimal unit considered a 'segment' for facilitation to occur however, has seen variations across languages. Chen, Chen and Dell (2002) and Ferrand, Segui and Grainger (1996) found the 'syllable' as a minimal unit providing facilitatory effects in Mandarin Chinese and French, respectively. Schiller (1998) and Roelofs (2006) on the other hand have found that the 'segmental overlap' holds true at the phonemic level itself in English for native speakers.

Primarily, although segmental overlap facilitation on serial presentation is confirmed with certain constraints, the influences of the individual components in terms of their position in the word are unclear. An early attempt by Grainger and Jacobs (1991) to study the effects of words with embedded target letters as primes on alphabetic decision timing revealed the presence of position specific facilitation where alphabetic decisions were faster when the embedded letters occupied the same position in the word string as that of the target. The processing requirements of the task however, are widely different from that of word naming. In this regard, Schiller (2004), on the basis of a series of experiments revised the 'segmental overlap hypothesis' and emphasized on the concept of 'onset form priming', implying that the overlapping onset of a certain word is primary for facilitation and that words with non-overlapping onsets do not yield the same extent of facilitation even if the subsequent segments share their components.

Most models of word recognition and the ensuing process of naming also complement the idea of component based activation either by spreading of activation (connectionist models such as Seidenberg & McClelland, 1989) or generation of and selection from cohorts (modular models such as Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001). The extraction of these components are serially based in modular models and distributed in connectionist models. If the primes are letters of the word in their corresponding positions, the activation should be limited to initial letter presentation if the serial processing accounts ought to stand. On the contrary, if distributed networks in parallel systems operate, the word may well be primed by subsequent letters of the word too.

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What remains to be discerned is whether and how these varied propositions interact on behavioural tasks such as a simple primed naming paradigm for monosyllabic words. Moreover, some implicit mechanisms involved in word naming have been found to be different in first and second language speakers of English (Uthappa, Shailat & Shyamala, 2012) in that phonological overlap does not elicit facilitation as in native speakers of English, which adds to the existing dilemma.

It is apposite to examine these relative mechanisms involved using a single type of monosyllabic words, which aid in discounting several factors influencing the reading of longer linguistic chunks such as word length, number of syllables, syllable structure etc. Thus, the present study aims to evaluate the position effect of letter priming in adult second language speakers of English using simple meaningful monosyllabic words with a $C_1V_1C_2$ structure (e.g.: mel). It is hypothesized that the presentation of any of the three letters among C_1, V_1 and C_2 as primes would facilitate the speed of reading the word. In other words, any isolated letter, considered segment, of a word presented as a prime to the word would decrease naming latency irrespective of its position (i.e. position-invariant isolated segmental overlap facilitation).

Method

Participants: Thirty healthy individuals (27 females and 3 males) aged between 21 and 27 years participated in the study. The participants fulfilled the following criteria:

1. English as the medium of instruction in school / college for a minimum of 10 years
2. Native speakers of a Dravidian language (Malayalam – 13, Kannada - 11, Telugu - 4, Tamil - 2)
3. May or may not have had exposure to a third / fourth / fifth language
4. Normal or corrected to normal vision

Stimulus: The stimulus comprised a list of 120 'prime-target pairs' programmed to run on the DMDX software. They were borrowed from Uthappa, Shailat and Shyamala (2012) and selected as follows:

1. The original list comprised a set of 240 $C_1V_1C_2$ words represented by words beginning from letter 'b' to't'. These words were chosen based on a search for words with the above syllable structure in series from the Webster's New World College Dictionary by Agnes in 2000. There was no restriction on the grammatical category of the words with the exception of proper nouns, historical names and those representing scientific units
2. The words were arranged in alphabetic order and every alternate word beginning with the first was chosen
3. Thus a set of 120 target words were obtained (Appendix 1)
4. These words were arranged in alphabetic order from right to left in four columns to derive four lists of 30 words each for each of the four types of primes (C_1%% - $C_1V_1C_2$, %V_1% - $C_1V_1C_2$, %%C_2 - $C_1V_1C_2$ & %%% - $C_1V_1C_2$; e.g.: m%% - mel, %e% - mel, %%l – me & %%% - mel). This method of selection was used to ensure an equivalent distribution of words beginning with each letter in each of the lists
5. The 120 'prime-target pairs' were programmed for use in DMDX for the masked priming experiment
6. The presentation of each item was programmed as follows: An initiation point '*' was set to be displayed for 500 milliseconds. This would be followed by the forward masker '###' for 500 milliseconds. The prime would follow for 100 milliseconds after which a backward masker '###' for 15 milliseconds would appear. This would be followed by the target which would remain displayed for 2000 milliseconds. This paradigm was considered to allow a relative comparison with the findings of Uthappa, Shailat and Shyamala (2012), where 50 milliseconds primes failed to produce significant facilitation on onset-letter priming (C_1%%), while 100 milliseconds primes of the same type exhibited speeded naming. Also, masked priming was employed in order to primarily elicit the action of implicit mechanisms alone (Evett and Humphreys, 1981). An example of stimulus presentation for an initial letter overlap prime (C_1%% - $C_1V_1C_2$, i.e. m%% - mel) is illustrated in Figure 1

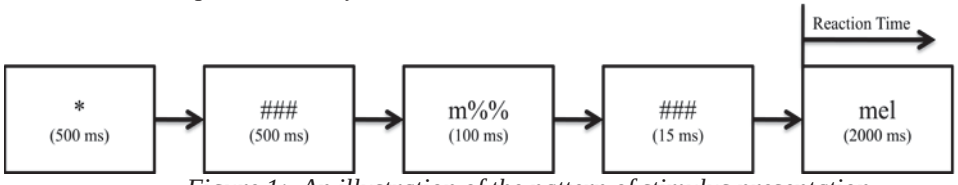

Figure 1: An illustration of the pattern of stimulus presentation

7. A set of twelve practice items were also programmed. The target items for practice were taken from the set of 120 words that were not considered for the study, randomly

Instrumentation/ Software: A Compaq Presario CQ 60 laptop with a 17" screen was used to present the stimulus through the DMDX software. A Mipro MM-107 microphone was used to record the responses of the participants. The Check Vocal software was used to view and analyze the waveform and spectrograms of the recorded samples for naming latency. The Statistical Package for Social Sciences (SPSS) – version 18 software was used for statistical analyses.

Procedure: The participants were comfortably seated before the laptop in a well lit and silent room. The inclination of the laptop screen was adjusted for visibility as per participant requirements. The participants were asked to maintain the distance of the microphone from the lip within a range of 4 to 6 inches. They were instructed to begin looking at the laptop screen on the appearance of '*'. They were asked to continue looking as entities (masker and prime) flashed, before a word stabilized on the screen. They were instructed to read this word that followed the fleeting elements on the laptop screen as soon as possible. The practice items were run prior to the experiment. They were then asked to read the list of target items aloud once, so as to provide an opportunity for the experimenter to correct any deviant pronunciation and to ensure that all the words were familiar to the participants. This was followed by the experiment in which the stimulus items were presented in random order as decided by DMDX. On completion of the experiment, the participants were provided an edible token of appreciation.

Analysis of the samples: The naming responses for each item of every participant were analyzed to calculate the reaction time at onset by inspecting the waveform, spectrogram and auditory playback. The responses that were erroneous or disfluent were omitted (35 in all, maximum of two errors per participant). The average values of reaction time (in milliseconds) of the correct responses for each participant for each type of 'prime-target' pair were considered for statistical analyses.

Results and Discussion

The outcome of the analysis using Check Vocal software was the average values of reaction time for each 'prime-target' condition for each participant. The mean and standard deviation values for the same were calculated in SPSS 18 (Table 1).

Table 1: Mean and S.D. values of reaction times across the four 'prime-target' conditions

'prime-target'	Mean	S. D.
C_1%% - $C_1V_1C_2$	541.87	98.37
%V_1% - $C_1V_1C_2$	565.03	96.11
%%C_2 - $C_1V_1C_2$	560.59	100.94
%%% - $C_1V_1C_2$	570.43	95.08

The data were subsequently subjected to Repeated Measures ANOVA [F (3, 87) = 18.792] which revealed a significant difference ($p < 0.001$) between the conditions as a whole. In order to identify pair-wise differences, Bonferroni's comparison was made. The outcome is represented in Table 2. The 'no prime' (%%% - $C_1V_1C_2$) condition was found to be significantly different ($p < 0.001$) from the initial letter overlap (C_1%% - $C_1V_1C_2$) condition. The C_1%% - $C_1V_1C_2$ condition also differed significantly ($p < 0.001$) from the medial (%V_1% - $C_1V_1C_2$) and final letter (%%C_2 - $C_1V_1C_2$) overlap conditions. There were no significant differences between the 'no prime' condition and medial / final letter overlap conditions. The medial and final letter overlap conditions were also not different from each other.

Table 2: Bonferroni's pair-wise comparison across the four 'prime-target' conditions

'prime-target'	C_1%% - $C_1V_1C_2$	%V_1% - $C_1V_1C_2$	%%C_2 - $C_1V_1C_2$	%%% - $C_1V_1C_2$
C_1%% - $C_1V_1C_2$		S	S	S
%V_1% - $C_1V_1C_2$			NS	NS
%%C_2 - $C_1V_1C_2$				NS
%%% - $C_1V_1C_2$				

Note. S - Significant difference ($p < 0.001$), NS – No significant difference

The findings clearly reveal the presence of facilitation of word naming when the prime is an overlapping letter in the initial position (e.g: b%% - bad). The finding is in consonance with the studies of Schiller (1998), Roelofs (2006) and Uthappa, Shailat and Shyamala (2012) in speakers of English, both as first and second language. It is also in accordance with the modular models of word recognition (Coltheart et. al., 2001) where the choice of words for naming that form a cohort is guided based on an initial activation by the first serial element of the word. When an initial letter (say 'b') is presented as a prime, the possible

subsequent target is reduced to one among the words starting with the letter 'b', thereby increasing the speed of lexical selection for naming.

On the contrary, the overlapping segments in the medial (e.g.: %a% - bag) and final (e.g.: %%g - bag) segments are not statistically significant in their facilitation. It implies that only a serially activated cohort promotes naming swiftness. For instance, a prime that overlaps with a target as in '%e% - men' or '%%t – met' does not facilitate naming speed as a prime such as 'm%% - mel' when compared to the naming latency for a non-primed naming condition such as '%%% - mob'. Moreover, the dissimilarity in the extent of facilitation caused by the initial letter versus that of the medial / final letters emphasizes the importance of position in letter priming and affirms the idea of onset based priming under the revised segmental overlap hypothesis (Schiller, 2004) even for second language speakers of English.

Although second language speakers of a language are known to employ more explicit learning strategies (Kescskes & Albertazzi, 2007), which may be assumed to reflect in the recognition of each letter in a word irrespective of positional preponderance, the present findings do not earmark any difference with first language speakers of English in terms of the position effect of primes. It may thus be identified that ESL speakers also adhere to the basic principles of modular activation through cohorts, in the current context.

In addition to the salient findings, observation of descriptive data provides information regarding the subtleties of position-based component priming. The latencies of naming are faster than the no prime condition in each of the prime conditions as indicated by the mean values, although the difference between them is negligible in absolute terms. It implies that the direction of influence of the primes is facilitative (with all the primed conditions, e.g.: t%% - tin, %i% - tip, %%d - tod, exhibiting faster naming than the no prime condition, e.g.: %%% - top), although not statistically significant, with the exception of initial overlap primes.

On closer inspection, it can be noted that the effect of priming is not governed based on serial positioning (i.e. the initial, medial and final letter overlapping primes yielding decreasing facilitation in the same order), as the final letter overlap yielded faster naming than the medial. The greater relevance of consonant segments to word representation and activation, compared to vowels may be a possible explanation for the faster response to primes with a final consonant overlap (e.g.: %%g – jog) than a medial vowel overlap (e.g.: %o% - job). Also, contrary to the outcome of the study by Grainger and Jacobs (1991) on an alphabetic decision task, each letter / component presents a specific position variant alteration to the word naming latency.

Although, the initial segment (letter) led to a strong facilitation statistically, the following letter did not trace the pattern, implying that cohort based selection is purely based on the activation of an initial component owing to 'bottom-up priority' (Marslen-Wilson, 1989). If this holds true, the observations made on the medial and final letter positions would require an alternate explanation. It may only be speculated that contextually relevant segments of a word are activated better, whose relevance are determined by their contribution to the word in terms of content (i.e. consonants).

Summarily, the experiment has revealed that the position effects of letter priming on $C_1V_1C_2$ word naming is pertinent and that only letters in the initial position yield facilitation of significant quantity. Thus, the hypothesis that supports position-invariant isolated segmental overlap facilitation is rejected.

Conclusions

The study confirmed the supremacy of segments in the initial position over those in the medial and final positions in accelerating the process of word naming temporally, as far as CVC type of monosyllables are concerned in second language speakers of English. It largely supports the initial selection process described in cohort models of word selection and provides further evidence to 'onset form priming'. The direction of movement of the mean reaction times for the medial and final position segmental primes from the no prime conditions leaves scope for alterations in the experimental paradigm for finer investigation in to the processes involved. It also provides a platform for further study in discerning the positional influence of consonant segments versus vowel segments in word naming facilitation.

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Appendix 1

Target words for the four prime types

C_1%%	%V_1%	%%C_2	%%%
bad	bag	Ban	bat
bet	bid	Big	bit
bug	bum	Bun	but
can	cap	Car	cob
cot	cub	Cud	cup
dam	dap	Den	dig
dog	don	Dot	dug
fan	far	Fat	fen
fin	fit	Fob	fop
gad	gam	Gap	get
gob	god	Got	gun
ham	hap	Hat	hen
hip	hit	Hob	hog
hug	hum	Hut	jet
jig	job	Jog	jug
kid	kin	Kip	kop
led	leg	Let	lip
lop	lot	Lug	man
mel	men	Met	mob
mor	mot	Mud	nab
nib	nip	Nit	nog
nut	pad	Pan	per
pet	pig	Pin	pod
pus	rag	Ram	rap
rib	rid	Rig	rip
rub	rug	Rum	rut
sat	set	Sib	sin
sod	son	Sop	sum
tad	tag	Tan	tar
tin	tip	Tod	top