WORD NAMING

THE INFLUENCE OF SYLLABLE STRUCTURE AND PRIME DURATION ON INTRA-WORD CONSTITUENT PROCESSING IN ADULT SPEAKERS OF ENGLISH AS SECOND LANGUAGE

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CHAPTER I

INTRODUCTION

The psycholinguistic study of word naming has provided information on the componential effects that parts of words have on the production of words. Research has shown that there are variations in the extent to which parts of words cause changes to the eventual output of the word. The segmental overlap hypothesis (Schiller, 1998, 2000, 2004) has rather comfortably made its presence through demonstration of these effects in priming experiments across languages, albeit with certain dissimilarities concerning the exact length of the segments per se (e.g.: Chen, Chen, & Dell, 2002; Roelofs, 2006). As an example, if a word comprises four letters ‘abcd’, reading the word is apparently faster when it is quickly preceded by a display of a part/segment/letter of the word as in ‘a’, ‘ab’, ‘bc’ or ‘abc’ etc. The factors influencing them have ranged from linguistic relevance of the components to methods of presentation of the same as in the duration of a segmental prime preceding a target word. More importantly, languages exhibit differential effects based on the inherent traits of a particular language system. This background provides ample opportunity to explore the ambit of segmental overlap influence. The present study is an outcome of one such inquiry into the influence of syllable structure along with prime duration (the time for which a ‘prime’ is shown on a display screen preceding the actual word that is required to be read) in intra-word component based promotion of a word naming parameter viz. speed in speakers of English as a second language (ESL).

Word Naming, a task very simple in its outlook is governed by several stages of information processing. The delineation of these stages has been possible with psycholinguistic measurements based on theoretical models of visual word recognition, reading and speech production. A word may be received as a whole or as a combination of its parts (intra-word constituents) and repetition of the same may involve the collation of these constituents or the word representation as a whole prior to production. Priming using intra-word constituents is one such psycholinguistic application which tests the 'segmental overlap' hypothesis that opines that the speed of word naming increases with an increase in the overlap between the prime and target. Here, a prime comprising a part of the word is presented before a word that is to be named as soon as it appears on a computer screen. The prime is lodged between irrelevant symbols on the time scale to provide a masked priming effect to ensure the operation of implicit processes alone, as far as possible. The segmental overlap hypothesis tested through such experiments has been found to be largely true across most languages. The only difference being the overlapping segment that causes faster naming which need not be a fixed linguistic unit as in a phoneme / syllable.

Need for the Study

A study on ESL speakers (Uthappa, Shailat & Shyamala, 2012) revealed that the influence of extent of segmental overlap was similar to that reported in native language speakers. In addition, the effects were also found to be dependent on the duration of the prime. The study however, tested the phenomenon at only two prime durations (50 and 100 milliseconds) on simple CVC words. The presence of phoneme (or letter) specific segmental overlap is very interesting considering the syllabic / near syllabic nature of Indian languages, particularly in the southern region comprising Dravidian languages. As the stimuli were limited to three letter units in monosyllabic production, the effects may not be generalized to larger units. Also, the time provided to process primes may alter the impinging influence on speeded naming latency considering the language-specific processing abilities of ESL participants; thereby calling for an extended study into the effect of duration of a prime on the segmental overlap. Hence, all syllable structures rendered possible by words comprising up to six letters following certain rules essential for accurate interpretation in the current context were to be chosen and tested across a series of prime durations from 25 to 400 milliseconds.

An investigation on these lines would add to the information on the basic unit of word naming in English, especially when it is acquired as a second language. The processes involved in explicit acquisition of the second language may differ from that of the first language, where learning was an implicit one (Kescskes & Albertazzi, 2007). Thus, this investigation would help in probing the forms of phonological encoding in a masked word naming paradigm involving complex syllable structures and a range of durations. It is crucial to understand the dynamics of intra-word constituent processing to arrive at decisions on employing cueing strategies in language intervention for individuals with reading deficits, developing models for word naming and applications in studies that utilize linguistic stimuli comprising words with varying syllable structures.

Aim and Hypothesis

The current project thus took shape with an aim to study the influence of syllable structure and prime duration on intra-word constituent processing in a segmental overlapping manner in word naming under a masked priming paradigm in adult speakers of English as second language. It was hypothesized that segmental overlap based enhancement of word naming speed would be no different for words with different syllable structures (CVC, CCVC, CVCC, CVCVC, CCVCC, CVCCVC), and that they would be independent of any effect of prime duration (25, 50, 100, 200 and 400 milliseconds).

Objectives

i. To study the effect of segmental overlapping primes on speeded CVC word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations

ii. To study the effect of segmental overlapping primes on speeded CCVC word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations

iii. To study the effect of segmental overlapping primes on speeded CVCC word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations

iv. To study the effect of segmental overlapping primes on speeded CVCVC word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations

v. To study the effect of segmental overlapping primes on speeded CCVCC word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations

vi. To study the effect of segmental overlapping primes on speeded CVCCVC word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations

Possible Implications

The study is conducted to primarily ascertain the role of intra-word segments (letters) in naming words with different syllable structures and to test whether the temporal parameters would have obvious effects on segmental overlap influence. If ascertained, it would provide preliminary data on a quantifiable basis with reference to the nature of single word reading in speakers of English as a second language. The designation of value to single letters in varied word structures could shape the nature of cueing employed during word reading instruction in typical and atypical populations. Timing, if found to be relevant, could open avenues for clinical and research applications on the dynamics of cueing. As a distant implication, the researchers opine that the data could be used to model the word naming process for the target population.

CHAPTER II

REVIEW OF LITERATURE

Overview

'Word Naming', as it is called, refers to the process of decoding a written script limited to the length of a word and encoding its corresponding phonemic partner in order to explicitly produce the same as articulatory gestures. The process has been elaborated in the dual route cascaded model of visual word recognition (Coltheart, Rastle, Perry, Langdon, & Ziegler, 2001) wherein reading a visually represented word aloud is a process that is navigated initially by a preliminary analysis of the nature of representation of script, which then triggers the patterns of accessing the word based on either the phonological conversion rules (relying on the components of the representation) or lexical/semantic rules (through recognition of the same or similar entities in the internal storage of the individual) available, as the case may be, and sometimes inter-changeably, to eventually transform the incoming visual input to a phonological stream either through direct conversion of the components of the script presented or a ready-made production template, to terminate in the actualization of the presented script through the action of the articulators, as word naming. It opines that reading a word is not a mere act of deciphering the component graphemes to convert them into productive phonemic strings, but involves processes that are lexically and post-lexically governed. A detailed study of such processes is conducive under constraint-induced word naming or reading conditions.

Speeded naming is a condition which taps the most preliminary process involved in naming with some degree of automaticity. Here in, the constraints that are embedded in a lexical decision task do not surface as extensively because it does not involve a conscious decision making process as such. Hence, speeded naming has been used extensively in research that focuses on the sub-lexical aspects of reading. However, in the context of speeded naming too, factors such as familiarity, non-word reading, etc. has been found to influence the rate of naming. This has been overcome largely by introducing the preparation paradigm (Meyer, 1990, 1991), also called the implicit priming task. By employing this procedure, a prime (generally with an overlapping onset) is presented prior to a target word that has to be read. The utility of this procedure has been exploited in word naming research.

Brief history

In fact, the study of word naming has its precursor in the studies of object naming (Cattell, 1886). The appreciation of the pictorial and visual orthographic routes, through psycholinguistic modelling, aided in the understanding of the similarities and differences between the two. Cattell's research in 1886, where he attempted to measure reaction times for object naming, served as the catalyst for chronometric research trends which later on diversified in measuring latencies for naming words, pictures, and objects. In Posner's (1978) opinion, 'mental chronometry' dealt with the time taken by the human nervous system in processing information.

The focus of earlier researches was mainly to differentiate between latencies obtained for object and picture naming. Cattell pursued similar chronometric research, including a first of its kind in bilingualism, in which the subjects were asked to translate words which were presented in the native language and vice versa, in English and French bilinguals. Word naming eventually moved beyond apparent description of errors to delineating the domains of phonology and higher linguistics.

The simple task of naming a word was used to generate theories and models, like the Dell's computational model of word production in 1984. Interpretations regarding the processing involved when presented with half a segment of a word versus the word itself were made through studies based on such models (Dell, 1986, 1990; Dell, Juliano & Govindjee, 1993; Dell & O'Seaghdha, 1994).

Other varieties of word naming research, such as evaluating the relationship between word frequency effects and naming latencies (Oldfield & Wingfield, 1964) rose formidably. Meanwhile, Fraisse (1967) added to existing research in chronometric studies, stating that there exists a different coding system for naming an object and naming a word.

The alteration of stimulus conditions was another step in word naming research, and it extended from altering a single unit/segments of a unit **(**Mehler, Dommergues, Frauenfelder, & Segui, 1981) to changing the context (Ferrand, Grainger, & Segui, 1994) or higher cognitive decisions (Stroop, 1935). Subsequently, more fine grained modification in stimulus presentation was undertaken. Glaser and Dungelhoff (1984) added a new dimension by varying the stimulus onset asynchronies (SOA) between target pictures and distracters. Stimulus onset asynchrony refers to a temporal measure of the distance between the onset of a distracter (or prime) and the onset of a target (word or picture) in a sequential display of a stimulus for experimental purposes. These studies paved the way for more temporal analytical research.

With constant evolution of language, language use, cultural and linguistic inter-mixing, word naming emerged as a simple tool to study the basis of language in its scientific depth. Questions such as those targeting the identification of the basic unit of a language (syllable or phoneme etc.) paved way for the use of word naming in priming paradigms.

Components of word naming

A person, when asked to read a word, counters mainly two steps, visual word identification and speech production. Visual word identification helps form a link between a target and its corresponding structure (perceptually guided) in the mental lexicon. This process can be divided into processing a word orthographically or phonologically. Access to both these links helps word recognition and, thereby, word naming. The models in word naming or visual word recognition have played a central role in the understanding of the process of retrieval of a word from the long term memory and its subsequent extraction of the phonological store to name a word. (Morton, 1969; Seidenberg &McClelland, 1989; Coltheart, Curtis, Atkins, & Haller, 1993; Plaut, McClelland, Seidenberg, & Patterson, 1996; Jacobs, Rey, Ziegler, & Grainger, 1998; Harm & Seidenberg, 1999; Rastle & Coltheart, 1999; Coltheart et al., 2001)

In laboratory controlled experimental paradigms, the process of word naming can be interrupted by stimulus alterations or by delay in the presentation of the target, thereby altering the processing of the word with respect to its latency and accuracy. The interruption may provide information that aids the formation of certain words. For instance, explicit cueing, where a word/part of the word precedes the target leads to facilitation of the target response in most cases (Meyer & Schvaneveldt, 1971). On the implicit front, several primed naming experiments such as Schiller (2000) have duly appreciated the possibilities of such manipulations to study the components of word naming.

Factors influencing word naming

Word naming is influenced by various characteristics like age of acquisition, semantic and phonological characteristics of a word, imageability, word frequency etc. The factors can be influencing word naming at a lexical or a sub lexical level. The relationship between word frequency and word naming has been much researched in the history of visual word recognition and a linear relationship has been established. The more frequent a word's occurrence, faster it is named (Spieler & Balota, 2000).

The number of letters stringed for a particular word, the word length, also seems to influence naming. Younger adults have found to produce longer words with increased latency (Spieler & Balota, 2000). Imageability plays a role in reading target words that have low frequency and which are inconsistent (Cortese, Simpson, & Woolsey, 1997). This goes on to suggest that semantic systems are employed due to the difficulty in relying on orthographic to phonological system.

The type of orthography also matters in this regard. Deep orthographies like English, force heavy reliance on lexical reading when compared to the shallow/transparent orthographies like Italian (Frost, Katz, & Bentin, 1987; Frost, 1994; Brysbaert, Lange, & van Wijnendaele, 2000; Arduino & Burani, 2004). Languages like Japanese and Chinese have found that imageability and concreteness play an important role in processing a word (Zhang & Zhang, 1997; Chen & Peng, 1998; Shibahara, Zorzi, Hill, Wydell, & Butterworth, 2003). Among other factors, phonetic regularity, the number of strokes and number of components affect the word naming skills in Chinese (Zhou, Shu, Bi, & Shi, 1999). Lexical neighbourhood though not the most popular factor that influences naming, happens to be an influential one. Andrews (1992) opines that naming latency decreases with a dense lexical neighbourhood and the reverse is true for a sparse lexical neighbourhood.

The interplay between age and word naming is also a concern among researches as to how these factors influence word naming. As an individual age, reading modifies, as the focus from sub-lexical components (word length and lexical neighbourhood density) to more unified lexical units (word frequency). This process is termed as unitisation (Samuels, LaBerge, & Bremer, 1978). If this hypothesis is true, then sub-lexical factors would influence less compared to lexical factors as the individual ages. Thus word frequency effects play a more powerful role in word naming for older adults than their younger counterparts whose word naming process is influenced by sub-lexical factors like word length and lexical neighbourhood density (Spieler & Balota, 2000).

Role of the intra-word components

Words are composed of letters or segments or syllables. ‘Syllable’, over the years of psycholinguistic, phonetic, phonological and linguistic research has come to be defined in different perspectives and has also assumed various roles. So it ranges from supposedly a unit of speech production involved in planning to have an onset, nucleus, and coda (Hooper, 1972; Fujimura & Lovins, 1978; Selkirk, 1982; Kenstowicz, 1994).

The role of the syllable in psycholinguistic research has been evidenced using priming experiments in different languages. Researchers delved into whether a syllable as a whole aids a prime for word naming or parts of a syllable aid in the same. The parts of a syllable have been referred to as sub-syllabic units or intra-words. Monitoring tasks such as syllable and phoneme monitoring (Savin & Bever, 1970) had been used to detect the relative importance associated with intra-word components. These tasks revealed the outcome of timed decision making where participants were required to identify the first phoneme or syllable of a word or non-word presented aurally, as fast as possible. The preponderance of syllables over phonemes was recognized.

One of the most significant psycholinguistic researches was contributed by Mehler and others (1981) who explored the significance of the syllable through priming experiments whose stimuli were designed based on the rationale of the monitoring tasks. This was done to establish the syllable’s role in French. The subjects found it easier to name the target when the prime was the complete syllable as opposed to the prime being a non-syllable (faster naming of ‘palace’ over ‘palmier’ with ‘pa’ as the prime, due to the overlap being a complete syllable only in case of the former). The role of the syllable was again tested in a masked priming experiment by Ferrand, Segui, and Grainger (1996). Faster responses were observed when the prime word corresponded to the first syllable. Thus BA%%% when primed for *BA*LADE produced facilitatory responses when compared to BAL%%% as BA was the CV syllable for *BA*LADE. The result resonated in a similar manner when BAL%%% was primed for *BAL*CON, BAL being the CVC syllable for BALCON. Thus the word BALADE was named faster when preceded by the prime BA than by BAL, whereas the word BAL.CON was named faster when preceded by the prime BAL than by BA. Thus, it was verified that the *syllable priming effect* occurred at the level of the output phonology for French.

In English there are ambisyllabic consonants, where either of the segments can be treated as syllables. Thus for the word BALANCE, both BA and BAL could be considered as syllables, as it does not have a clear syllable boundary. Ferrand, Segui, and Humphreys (1997) replicated the same experiment mentioned above in English to find that, both these syllables produced equivalent responses and were named faster when compared to the no prime situation (%%%%%%%). While for a non-ambisyllabic word like BALCONY, where *BAL* was the syllable, faster naming latency was obtained than when BA, which was not the syllable for BALCONY, was presented. Syllabic priming effect was yet again observed in this experimental paradigm too.

Languages with different types of orthographies also play a role in word naming. The orthographies of Chinese, Japanese differ significantly when compared to the orthographies of English, Dutch and French. Hence the experiments in word naming done in these languages reflect variations in the findings. Dutch failed to produce equivocal effects in syllabic priming (Roelofs, 2006) as Mandarin Chinese. In one of the experiments Chen, Chen and Dell (2002) used syllables (*ma, mi, mu*) as first syllable primes for the target words closely paralleling another version of the study done by Ferrand et al. (1996) in French. In

Chinese the syllables had a facilitatory effect on the target response while in Dutch, the sub-syllabic segments (smaller than a syllable) played a role, which posits that the syllable might not be a functional unit for speech production; while in Mandarin Chinese the syllable played a significant role in sub-lexical planning of speech production. Ferrand et al. (1996) who was one of the first to use the above mentioned experiment opined that syllables played a key role in speech production, like in Mandarin Chinese. Verdonschot, Kiyama, Tamaoka, Kinoshita, Heij and Schiller (2011) claimed that in Japanese, a whole mora (metrical units) when overlapped with the target facilitates faster word/sentence reading and the onset of the target failed to produce the same effect in Kana script. Similar results were obtained when this masked experiment was carried out in Romanised Japanese and Hiragana. Hence mora in Japanese helps in word form encoding.

The syllable priming effects were challenged subsequently by the segmental overlap hypothesis. Schiller (1998) questioned the role of syllable in word-form encoding during speech production. The hypothesis stated that the extent of the overlap of segments between the prime type and target causes a linear increase in priming effect. Thus, naming speed of a word corresponded with the number of segments overlapping between a prime and target, with greater overlap yielding faster responses, irrespective of the position of the overlapping segment. Each segment, i.e. the consonant and vowel, in English has a role to play in speeded naming. For instance, a word ‘balloon’ may be primed by ‘baXXXXX’, ‘balXXXX’, ‘XXlloon’ etc., and the number of common letters would most likely determine the speed of naming the word. Schiller (2000) replicated Ferrand et al. (1997) study using a similar methodology and test materials. The syllabic priming effect noticed by Ferrand failed to follow a similar trend. Segmental overlap was found to be the cause of facilitation. Schiller found that Dutch and English were in consonance with segmental overlap hypothesis and that they differ from French which exhibits syllabic priming. A study in English on adults speaking English as a second language (Uthappa, Shailat, & Shyamala, 2012) revealed that the influence of extent of segmental overlap is also dependent on the duration of the prime. The study however tested the phenomenon at only two prime durations (50 and 100 milliseconds) on simple CVC words.

The segmental overlap effect was modified subsequently to accommodate the masked onset priming effect through response competition hypothesis (Forster and Davis, 1991) (Kinoshita, 2000). Accordingly, a segmental overlap facilitates word naming only if the initial segment is shared in the corresponding position. Schiller (2004) included the onset effect in word naming with reference to the segmental overlap hypothesis whereby a superior role for onset intra-word components was acknowledged (e.g.: ‘balXXXX’ yielding greater facilitation than ‘XallXXX’).

CHAPTER III

METHOD

Participants

A total of forty six healthy individuals participated in the study. Ten of those individuals (3 males, 7 females) participated in Phase I (pilot) of the study. Thirty six participants (8 males, 28 females) went through the main experiment. They aged between 18 and 26 years with a mean age of 21.44 years. The criteria for selection of participants for the pilot and the main study, as ascertained through an interview of each participant to obtain past and present information, were as follows:

i. English as the medium of instruction during schooling
ii. Native speaker of a Dravidian language – Kannada (35) or Malayalam (11)
iii. Physical and mental health in good condition
iv. Vision (or corrected to normal vision) and hearing in good condition

Stimuli preparation

The words considered for the study was taken from an English dictionary - Webster's New World College Dictionary (Agnes, 2000). Word lists were created for six syllable structures - CVC, CCVC, CCCVC, CVCC, CCVCC, CVCVC and CVCCVC. Following were the steps taken to come to a finalized word list. The pre-selection criteria for selecting the words were as follows:

i. Maximum length of the word – not more than six letters
ii. Common orthographic and phonological structure
iii. No proper nouns and scientific units
iv. Only words beginning and ending with consonants

v. Initial consonant between letters ‘b’ and ‘t’

Step 1: A serial search was performed for all words meeting the pre-selection criteria.

Step 2: The words were grouped according to their syllable structure. They were: CCCVC – 143 words, CCVC – 174 words, CVCC – 365 words, CCVCC – 162 words, CVCVC – 480 words, CVCCVC – 605 words. CVC words were chosen from the list of 240 items used by Uthappa, Shailat and Shyamala (2012). As there had to be a minimum of ‘30 * number of letters’ words in each list, the CCCVC structure was rejected. Thus, CVC, CCVC, CVCC, CVCVC, CCVCC and CVCCVC structures were chosen.

Step 3: These words were put through an appropriateness rating. Three Speech-Language Pathologists ensured that the lists did not comprise of words with unusual pronunciations. These SLPs were asked to read the words aloud and confirm the appropriateness. The words that were difficult to pronounce or which were unfamiliar to any of the raters were deleted from the list. After this stage, the word list count depleted to 1850 words and each structure had the following number of words- CVC - 240 words, CCVC - 173 words, CVCC - 343 words, CCVCC - 161 words, CVCVC - 393 words and CVCCVC - 540 words.

Step 4: To meet the requirement of the current study, ’30 * number of letters’ words had to be extracted from the above set. For example, a CVC word would require C%% (single-letter prime), CV% (two-letter prime) and CVC (repetition/identity) primes in addition to a no prime (%%%) whose words were to be chosen from among the words chosen for the prime types. Hence, ninety words had to be drawn for this structure to allocate them for their respective prime type. The procedure of distributing the words to their corresponding lists was done as follows:

i. CVC – The total had to be brought down to 90 target words from a set of 240 words. The 240 words were arranged in three columns in alphabetical order, row-wise. From a total of 80 rows from the three columns, every second, third and fourth row was deleted to arrive at 40 rows with 120 words. The items from the rows 1, 5, ... 29, were then deleted to arrive at 30 rows comprising 90 items (Appendix 1).

ii. CVCC – It consisted of 343 words after SLP rating, which had to be reduced to 120 words. Three words were deleted using the lottery method to arrive at a total of 340 words. The 340 words were arranged in four columns in alphabetical order, row-wise. Every alternate row was deleted, leaving 43 rows of 172 items. Then, every third row was eliminated, leaving 28 rows and 112 items. The remaining 8 items were chosen from the deleted list, randomly, to arrive at the 120 target words. The same procedure was followed for CCVC. These structures were finally left with 120 words (Appendix 2 and 3).

iii. CVCVC – It consisted of 393 words after SLP rating, which had be reduced to 150 target words. Three words were deleted using the lottery method to arrive at a total of 390 words which were arranged in 78 rows (alphabetically) of five columns. Every alternate row of items was deleted, leaving a total of 39 rows. Every fifth row was deleted, leaving a total of 29 rows, which comprised 145 items. The additional 5 words had to be brought back to the existing list to account for a total of 150 words. The five items were selected from the eliminated rows by selecting one item randomly from every alternate row (Appendix 4).

iv. CCVCC – It consisted of 161 words after SLP rating. One word was deleted using the lottery method, to arrive at 160 words. Thirty two rows were created by grouping them into five columns (the words arranged alphabetically, row-wise) and 10 items were deleted by eliminating every third item in every third row to arrive at the requisite 150 target words (Appendix 5).

v. CVCCVC – It consisted of 540 words, with a requirement for 180 target words. The words were arranged as 90 rows of items (alphabetical order) into six columns. Every second and third row was then deleted to arrive at 45 rows which were further subjected to the deletion of every third row that left a total of 30 rows and 180 target items (Appendix 6).

Step 5: Thirty words were again randomly chosen from the chosen sets of words for each syllable structure. These were assigned as targets for the 'no prime' condition.

Step 6: The prime target pairs were programmed in five modules with changes in prime duration from 25 milliseconds to 400 milliseconds (25 ms, 50 ms, 100 ms, 200 ms and 400 ms) in the DMDX software. The above prime durations were chosen based on the prime durations considered in research studies in the area, reflecting a range of processing strategies starting from a shorter duration that corresponds with complete automatic priming to a longer duration that entails the involvement of conscious priming. Each stimulus item had a forward masker ### (for CVC), #### (for CVCC, CCVC), ##### (for CCVCC, CVCVC), ###### (for CVCCVC) for 500 ms and a backward masker, likewise, for 15 ms. The primes were embedded between the maskers for 25, 50, 100, 200 and 400 milliseconds, respectively. The stimulus items were programmed to start with an initiation point '*'. The target was programmed to be visible for 2000 milliseconds. For example, a typical stimulus item is represented as follows - 1 <ms% 500> "*" / <ms% 500> "####" / <ms% 25> "b%%%" / <ms% 15> "####" / * "blab" <ms% 2000>/;. The stimulus items were stored in the rich text format. Corresponding to each stimulus item, an answer file was also stored in a folder. The answer file consisted of a list of the target items for that duration and syllable structure. The stimulus for each syllable structure and prime duration were stored separately, amounting to

30 programmes in all. In addition to the test stimuli, a set of 10 stimuli, which were not included in the main stimulus, were programmed for practice trials. The combination of prime and target of the 10 practice items ensured that they comprised a minimum of atleast one target word of each syllable type, atleast one item representing each prime type (i.e. single letter overlap, partial word overlap, complete overlap and no overlap) and atleast one item representing each prime duration, chosen through lottery method. The practice trials were to be repeated till the participants were comfortable with the task.

Instrumentation

The testing apparatus consisted of a laptop (Wipro Little Genius with a screen size of 15.4") and a hand held microphone (Frontech**).** The stimulus items were presented using the laptop and the participants were asked to respond through the hand held microphone provided, maintaining a distance of four to six inches from the lips.

Procedure

The testing took place in a quiet well lit, comfortable room. The participants of the study were asked to read the target stimuli list aloud for familiarization and doubts, if any, were cleared by the tester. Prior to the start of the experiment, the participants were given a practice trial which was presented until they were acquainted well with the procedure. They were instructed to look at the screen and name the stable target item as soon as possible, which appeared after an array of elements consisting of maskers and the prime types. The stimulus stayed on the screen for 2000 ms within which they had to name the target stimulus. Between the presentations of each program a hiatus of 5 – 10 minutes was given and they were asked to sit for not more than thirty minutes continuously for the completion of the study. For each participant, the completion of the experiment took 6 – 7 days, at the end of which they received edible tokens as a kind gesture for taking part in the study.

Phases of the study

The study was carried out in two phases. Phase 1, included a pilot study where 10 participants were tested with the following syllable structures - CVC, CCVC, CVCC, CCVCC, CVCVC and CVCCVC presented via DMDX software. The prime-targets in each of the structures were tested from 25 milliseconds to 400 milliseconds. On the basis of the results of the pilot, nine out of the thirty programmes were eliminated for the main study as they did not exhibit any segmental overlap effect.

Table 1

Outcome of the pilot

Syllable Structure / Prime Duration	25 ms	50 ms	100 ms	200 ms	400 ms
CVC	N	N	Y	Y	Y
CCVC	N	Y	Y	Y	Y
CVCC	N	N	Y	Y	Y
CVCVC	N	N	Y	Y	Y
CCVCC	N	Y	Y	Y	Y
CVCCVC	N	Y	Y	Y	Y

Note. Y- Present for the main study, N- eliminated from the main study

Phase 2 of the study consisted of the main experiment where 36 participants were required to complete twenty one programmes which were - CCVC, CCVCC and CVCCVC for prime durations 50 ms, 100 ms, 200 ms and 400 ms and CVC, CVCC and CVCVC for prime durations 100 ms, 200 ms and 400 ms.

Analysis

The responses obtained from DMDX were analyzed with the help of CheckVocal, visual-perceptual and auditory scrutiny software with facility to mark latency. The reaction time of each target was analysed from the onset of response seen through the spectrogram / waveform and heard over the speaker. The response latencies obtained beyond 1200 ms were discarded as late onset responses. Dysfluencies like repetition of a syllable or part of a word, phonemic errors like transposition of the syllables, omission, and addition of a syllable were not considered for further analyses (error: < 2 percent). The responses that were considered correct were enlisted separately for each type of primes across durations for each participant. The average of the raw scores of each participant was computed and considered for group analysis of the data using the Statistical Package for Social Sciences software.

CHAPTER IV

RESULTS AND DISCUSSION

The current research sought to study the effect of segmental overlap on speeded word naming across six syllable types and five prime durations. Phase I of the study examined the possibilities for a presence of segmental overlap related naming speed changes across all the considered syllable structures and prime durations on a small sample of ten participants. The outcome of this experiment would eventually determine the selection of those syllable structure and prime duration combinations that elicit some effect of segmental overlap, for detailed experimentation on 36 participants in Phase II. The following were the objectives of the study:

i. To study the effect of segmental overlapping primes on speeded **CVC** word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations
ii. To study the effect of segmental overlapping primes on speeded **CCVC** word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations
iii. To study the effect of segmental overlapping primes on speeded **CVCC** word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations
iv. To study the effect of segmental overlapping primes on speeded **CVCVC** word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations
v. To study the effect of segmental overlapping primes on speeded **CCVCC** word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations
vi. To study the effect of segmental overlapping primes on speeded **CVCCVC** word naming across 25, 50, 100, 200 and 400 milliseconds' prime durations

An overview of the outcome of Phase I and Phase II is provided and the results pertaining to each of the objectives are discussed under their respective syllable structures.

Phase I (Pilot)

The average naming reaction times of the ten participants for each combination of syllable structure and prime duration was compared across their corresponding prime types (e.g.: C%%-CVC vs. CV%-CVC vs. CVC-CVC vs. %%%-CVC at 25 milliseconds). The following syllable structure and prime duration combinations did not yield any difference (with repeated measures ANOVA at $p<0.05$) between naming speeds across prime types indicating an absence of segmental overlap based facilitation: CVC, CVCC, CCVC, CCVCC, CVCVC, CVCCVC at 25 milliseconds and CVC, CVCC, CVCVC at 50 milliseconds. Thus, only twenty one syllable structure and prime duration combinations were considered for the main experiment. They were CCVC, CCVCC, CVCCVC at 50 milliseconds and CVC, CVCC, CCVC, CCVCC, CVCVC, CVCCVC at 100, 200, 400 milliseconds.

The findings of the pilot phase revealed that a prime duration as short as 25 milliseconds is insufficient to elicit segmental overlap facilitation irrespective of the syllable structure of the target or the extent of overlap between them. The findings at 50 milliseconds point to an emergence of segmental overlap effects across some types of syllables at this duration. Among the six structures under consideration, with the exception of CVCCVC, only those structures with a vowel segment in the second letter position yielded no segmental overlap facilitation while all the structures with consonant clusters as initial segments exhibited some degree of segmental overlap effects. This difference becomes more apparent on the observation that both four and five letter words followed this trend. It remains to be seen, however, whether such a difference extends to words constituted by five letters and beyond. As far as the current study is concerned, the pilot study confirmed the conditions that had to be evaluated in greater detail to test the segmental overlap hypothesis.

Phase II (Main Experiment)

The raw data that was obtained from the 21 syllable structure and prime duration combinations i.e. 12 prime conditions for CVC (%%%, C%%, CV%, CVC for 100, 200, 400 milliseconds), 15 for CVCC (%%%%, C%%%, CV%%, CVC%, CVCC for 100, 200, 400 milliseconds), 20 for CCVC (%%%%, C%%%, CC%%, CCV%, CCVC for 50, 100, 200, 400 milliseconds), 24 for CCVCC (%%%%%, C%%%%, CC%%%, CCV%%, CCVC%, CCVCC for 50, 100, 200, 400 milliseconds), 18 for CVCVC (%%%%%, C%%%%, CV%%%, CVC%%, CVCV%, CVCVC for 100, 200, 400 milliseconds) and 28 for CVCCVC (%%%%%%, C%%%%%, CV%%%%, CVC%%%, CVCC%%, CVCCV%, CVCCVC for 50, 100, 200, 400 milliseconds) was subjected to statistical analysis. The mean and standard deviation values were calculated for each structure, across prime type and duration. The data were subjected to two-way repeated measures ANOVA eliciting significant main and interaction effects. In order to decipher the specifics that led to these overall differences, repeated measures ANOVA was performed for comparison across prime types and prime durations for each syllable structure independently. Post hoc analysis was done using Bonferroni's pair-wise comparison.

For ease of understanding, the results are represented with reference to each syllable structure, in turn addressing the stated objectives of the study.

CVC

The raw scores of CVC were subjected to statistical analysis to obtain mean and SD values; the results of which are displayed in Table 2.

Table 2

Mean and SD values of primed CVC naming latency across prime types and durations

prime type	**100 ms**		**200 ms**		**400 ms**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**

%%%	531.86	14.77	534.77	14.05	540.55	14.49
C%%	519.20	17.22	507.54	16.60	499.17	13.54
CV%	490.57	15.91	478.67	17.94	460.04	18.18
CVC	469.24	15.59	414.78	18.06	257.90	19.55

The mean values are indicative of the speeding of naming responses with every additional segment of the word being presented. The absolute values across prime durations are such that an increase in prime duration causes a greater shift in the onset of naming, with each prime type in CVC words.

Two-way repeated measures ANOVA on the data yielded main effects with respect to prime type, duration and their interaction as follows: F (3, 105) = 297.33, F (2, 70) = 27.39 and F (6, 210) = 138.76 at p < 0.001, respectively.

For comparisons across prime types for each duration, repeated measures ANOVA was done which revealed the presence of significant differences at 100, 200 and 400 milliseconds at p < 0.001, as follows: F (3, 105) = 86.651, F (3, 105) = 136.12 and F (3, 105) = 277.098, respectively. Bonferroni's pair-wise comparison was then made and the results are represented in Table 3.

Table 3

Pair-wise comparison of primed CVC naming latency across prime types in each prime duration

Prime	**C%%**			**CV%**			**CVC**			**%%%**		
	b	**c**	**d**	**b**	**c**	**d**	**b**	**c**	**d**	**b**	**c**	**d**
C%%	-	-	-	S	S	S	S	S	S	N	S	S*
CV%	-	-	-	-	-	-	S	S	S	S	S	S
CVC	-	-	-	-	-	-	-	-	-	S	S	S
%%%	-	-	-	-	-	-	-	-	-	-	-	-

Note. b, c, d – prime durations 100, 200, 400 milliseconds; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

The segmental overlap hypothesis receives tremendous support from this data. With the exception of the single letter prime at 50 ms, all prime types across durations facilitate word naming as a function of the extent of segmental overlap.

In order to compare across prime durations in CVC for each prime type separately, repeated measures ANOVA was done and the results were as follows: C%% - no statistically significant difference at $p < 0.05$; CV% - statistically significant difference [F (2, 70) = 5.831] at $p < 0.01$; CVC - statistically significant difference [F (2, 70) = 133.069] at $p < 0.001$; %%% - no statistically significant difference at $p < 0.05$. Bonferroni's pair-wise comparison was then made and the results are represented in Table 4.

Table 4

Pair-wise comparison of primed CVC naming latency across prime durations for each prime type

Prime	**100**				**200**				**400**			
	t	**u**	**v**	**W**	**t**	**u**	**v**	**w**	**t**	**u**	**v**	**w**
100	-	-	-	-	N	N	S	N	N	S*	S	N
200	-	-	-	-	-	-	-	-	N	S*	S	N
400	-	-	-	-	-	-	-	-	-	-	-	-

Note. t, u, v, w – prime types C%%, CV%, CVC, %%%; S – statistically significant difference at $p < 0.001$; S* – statistically significant difference at $p < 0.05$; N – no statistically significant difference

First, that the no prime naming responses are independent of the duration of %%% primes confirm that the procured data is reliable. The current findings with primed CVC words across prime durations do not support the idea of increased facilitation by overlapping segments with every corresponding increase in prime duration. Only complete identity primes (CVC) follow this pattern. When two segments are found to be overlapping (CV%), there appears a subtle degree of inclination towards duration dependent priming after 200 ms. The reason for C%% primes to not elicit incremental priming with duration in spite of them being facilitative in comparison with %%% primes, particularly at 200 and 400 ms is unclear. It may be possible that the nature of the overlapping segment (in this case, a single consonant) may not be sufficient to promote any further lexical activation or naming related activation (as the case may be) beyond the degree to which a 200 ms prime does. However, in the case of CV primes, greater lexical ambiguity may be resolved or better naming formulation may be possible, as supported by the concept of pre-activation of syllable in WEAVER based accounts (Roelofs, 1997).

CCVC

The raw scores of CCVC were subjected to statistical analysis to obtain mean and SD values; the results of which are displayed in Table 5.

Table 5

Mean and SD values of primed CCVC naming latency across prime types and durations

prime type	50 ms		100 ms		200 ms		400 ms	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
%%%%	567.96	18.80	552.20	14.63	552.37	15.79	560.75	15.79
C%%%	552.50	18.66	523.38	16.68	518.74	15.92	514.61	15.92
CC%%	545.44	18.99	516.36	16.86	494.44	16.95	481.72	16.95
CCV%	548.96	18.90	506.54	17.45	474.65	18.27	444.38	18.27
CCVC	538.08	18.83	481.80	15.17	420.75	20.08	288.71	20.08

The mean scores obtained on CCVC naming are almost perfectly in consonance with segmental overlap. The only exception to this pattern may be noted at 50 ms between CC%%% and CCV%. It is important to note that CCVC is the first structure in terms of absolute length to have shown facilitation through segmental overlap. Also, the gap between succeeding primes increases with increase in prime duration.

Two-way repeated measures ANOVA on the data yielded main effects with respect to prime type, duration and their interaction as follows: F (4, 140) = 377.905, F (3, 105) = 45.41 and F (12, 420) = 111.469 at p < 0.001, respectively.

For comparisons across prime types for each duration, repeated measures ANOVA was done which revealed the presence of significant differences at 50, 100, 200 and 400 milliseconds at p < 0.001, as follows: F (4, 140) = 16.812, F (4, 140) = 47.39, F (4, 140) = 147.46 and F (4, 140) = 331.74, respectively. Bonferroni's pair-wise comparison was then made and the results are represented in Table 6.

Table 6

Pair-wise comparison of primed CCVC naming latency across prime types in each prime duration

Prime	**C%%%**				**CC%%**				**CCV%**				**CCVC**				**%%%%**			
	a	**b**	**c**	**d**	**a**	**b**	**c**	**d**	**a**	**b**	**c**	**d**	**a**	**b**	**c**	**d**	**a**	**b**	**c**	**d**
C%%%	-	-	-	-	N	N	N	N	N	S*	S	S	S	S	S	S	S*	S	S	S
CC%%	-	-	-	-	-	-	-	-	S	N	S*	S	S	S	S	S	N	S	S	S
CCV%	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S	S*	S	S	S
CCVC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S	S
%%%%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. a, b, c, d – prime durations 50, 100, 200, 400 milliseconds; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

The outcome of the analyses of CCVC naming latencies revealed an almost perfect segmental overlap pattern at 100, 200 and 400 ms. Even at 50 ms, barring CC%% prime, the effect is retained. Another exception is the single-letter overlap prime (C%%%) that does not differ from the two-overlap prime (CC%%) at any prime duration. Thus, in a CCVC form, the second consonant in a consonant cluster does not yield additional facilitation than the first alone.

In order to compare across prime durations in CCVC for each prime type separately, repeated measures ANOVA was done and the results were as follows: C%%% - statistically significant difference [F (3, 105) = 9.604] at p < 0.001; CC%% - statistically significant difference [F (3, 105) = 19.26] at p < 0.001; CCV% - statistically significant difference [F (3, 105) = 36.19] at p < 0.001; CCVC - statistically significant difference [F (3, 105) = 167.88] at p < 0.001; %%%% - no statistically significant difference at p < 0.05. Bonferroni's pair-wise comparison was then made and the results are represented in Table 7.

Table 7

Pair-wise comparison of primed CCVC naming latency across prime durations for each prime type

Prime	**50**					**100**					**200**					**400**				
	t	**u**	**v**	**w**	**x**	**t**	**u**	**v**	**w**	**x**	**t**	**u**	**v**	**w**	**x**	**t**	**u**	**v**	**w**	**x**
50	-	-	-	-	-	S*	S*	S	S	N	S*	S	S	S	N	S*	S	S	S	N
100	-	-	-	-	-	-	-	-	-	-	N	S*	S*	S	N	N	S*	S	S	N
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	N	S*	S	N

Note. t, u, v, w, x – prime types C%%%, CC%%, CCV%, CCVC, %%%%; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

The values of the no prime condition across prime durations do not differ, verifying the aptness of the data. The effect caused by each prime type at 50 ms differs from that of their effects at 100, 200 and 400 ms. The single-letter overlap primes at 100, 200 and 400 ms do not differ from each other in their elicited latency enhancement, and two-letter overlap primes deliver similar facilitation at 200 and 400 ms. These aspects indicate that the incremental effect of prime duration (Jacobs, Grainger, & Ferrand, 1995) is preserved only under the context of the extent of segmental overlap. Greater the overlap more is the increment associated with prime duration.

CVCC

The raw scores of CVCC were subjected to statistical analysis to obtain mean and SD values; the results of which are displayed in Table 8.

Table 8

Mean and SD values of primed CVCC naming latency across prime types and durations

prime type	**100 ms**		**200 ms**		**400 ms**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
%%%%	567.36	14.00	562.49	13.19	567.03	13.70
C%%%	551.16	15.88	533.59	15.89	529.14	15.47
CV%%	551.41	16.84	520.42	17.19	513.63	17.83
CVC%	526.88	16.55	480.44	17.75	440.46	21.31
CVCC	511.51	15.11	422.95	14.63	285.20	18.55

Observation of the mean data is indicative of general facilitation by overlapping segments. The 100 ms primes do not seem to be as discrete in their priming effects compared to those at 200 and 400 ms, respectively. Also, longer prime durations elicit correspondingly faster naming with every segmental prime type.

Two-way repeated measures ANOVA on the data yielded main effects with respect to prime type, duration and their interaction as follows: F (4, 140) = 333.408, F (2, 70) = 37.127 and F (8, 280) = 125.2 at $p < 0.001$, respectively.

For comparisons across prime types for each duration, repeated measures ANOVA was done which revealed the presence of significant differences at 100, 200 and 400 milliseconds at $p < 0.001$, as follows: F (4, 140) = 45.01, F (4, 140) = 180.77 and F (4, 140) = 299.56, respectively. Bonferroni's pair-wise comparison was then made and the results are represented in Table 9.

Table 9

Pair-wise comparison of primed CVCC naming latency across prime types in each prime duration

Prime	**C%%%**			**CV%%**			**CVC%**			**CVCC**			**%%%%**		
	b	**c**	**d**	**b**	**c**	**d**	**b**	**c**	**d**	**b**	**c**	**d**	**b**	**c**	**d**
C%%%	-	-	-	N	N	N	S	S	S	S	S	S	S*	S	S
CV%%	-	-	-	-	-	-	S	S*	S	S	S	S	N	S	S
CVC%	-	-	-	-	-	-	-	-	-	S	S	S	S*	S	S
CVCC													S	S	S
%%%%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. b, c, d – prime durations 100, 200, 400 milliseconds; S – statistically significant difference at $p < 0.001$; S* – statistically significant difference at $p < 0.05$; N – no statistically significant difference

The present analyses leads to two important observations in addition to the overall presence of segmental overlap facilitation in CVCC words, across durations. First, 100 ms primes do not seem to exhibit a comfortable degree of facilitation by overlapping primes until the identity repetition prime is presented. Also, these is no serial positioning effect observed at 100 ms, with C%%% primes causing some facilitation while CV%% primes do not. Second, C%%% and CV%% primes do not differ from each other in terms of their generated effect irrespective of prime duration. Although, this does not imply a lack of segmental overlap effect, it does point towards the relative importance of CV units and their components. Based on the current findings, it appears that the occurrence of a second consonant (CVC%) was necessary to propel the process of naming beyond a level that the first consonant had achieved, with the vowel playing a subsidiary role in the process in CVCC words. The acknowledged complementary role of vowels in word identification may be held in support of this finding (e.g.: Lee, Rayner, & Pollatsek, 2001).

In order to compare across prime durations in CVCC for each prime type separately, repeated measures ANOVA was done and the results were as follows: C%%% - statistically significant difference [F (2, 70) = 3.428] at $p < 0.05$; CV%% - statistically significant difference [F (2, 70) = 9.542] at $p < 0.01$; CVC% - statistically significant difference [F (2,

70) = 31.928] at p < 0.001; CVCC - statistically significant difference [*F* (2, 70) = 172.723] at p < 0.001; %%%% - no statistically significant difference at p < 0.05. Bonferroni's pair-wise comparison was then made and the results are represented in Table 10.

Table 10

Pair-wise comparison of primed CVCC naming latency across prime durations for each prime type

Prime	**100**					**200**					**400**				
	t	**u**	**v**	**w**	**x**	**t**	**u**	**v**	**w**	**x**	**t**	**u**	**v**	**w**	**x**
100	-	-	-	-	-	N	S*	S	S	N	N	S*	S	S	N
200	-	-	-	-	-	-	-	-	-	-	N	N	S	S	N
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. t, u, v, w, x – prime types C%%%, CV%%, CVC%, CVCC, %%%%; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

The no prime conditions do not differ across prime durations and act as testimony to the reliability of the data. The current output does not support incremental priming between 100 and 400 ms across all prime types. It appears that only primes disclosing more than or equal to three segments in a four letter word show an increment in the speed of naming with an increase in prime duration with reference to CVCC words.

CVCVC

The raw scores of CVCVC were subjected to statistical analysis to obtain mean and SD values; the results of which are displayed in Table 11.

Table 11

Mean and SD values of primed CVCVC naming latency across prime types and durations

prime type	**100 ms**		**200 ms**		**400 ms**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**
%%%%%	625.17	14.22	614.89	12.35	657.87	15.045

C%%%%	628.40	14.54	622.88	16.91	612.77	15.973
CV%%%	610.78	15.19	598.81	16.87	570.91	14.790
CVC%%	608.18	16.79	582.36	18.79	540.23	16.798
CVCV%	608.02	17.7	555.63	19.70	496.65	19.409
CVCVC	566.40	15.61	503.27	19.09	342.46	19.091

The mean values across the three prime durations are suggestive of overlapping segmental primes playing a role in enhancing naming speed when the primes are presented for 200 and 400 ms, respectively. At 100 ms, the mean scores do not appear to discern any speed enhancement with every segmental increase in the prime. Only the repetition prime elicits a reduced naming latency.

Two-way repeated measures ANOVA on the data yielded main effects with respect to prime type, duration and their interaction as follows: F (5, 175) = 214.113, F (2, 70) = 22.45 and F (10, 350) = 91.95 at $p < 0.001$, respectively.

For comparisons across prime types for each duration, repeated measures ANOVA was done which revealed the presence of significant differences at 100, 200 and 400 milliseconds at $p < 0.001$, as follows: F (5, 175) = 31.95, F (5, 175) = 59.89, F (5, 175) = 258.20, respectively. Bonferroni's pair-wise comparison was then made and the results are represented in Table 12.

Table 12

Pair-wise comparison of primed CVCVC naming latency across prime types in each prime duration

Prime	**C%%%%**			**CV%%%**			**CVC%%**			**CVCV%**			**CVCVC**			**%%%%%**		
	b	**c**	**d**	**b**	**c**	**D**	**b**	**c**	**d**	**b**	**c**	**d**	**b**	**c**	**d**	**b**	**c**	**d**
C%%%%	-	-	-	S*	S	S	S*	S	S	S*	S	S	S	S	S	N	N	S
CV%%%	-	-	-	-	-	-	N	S*	S	N	S	S	S	S	S	N	N	S
CVC%%	-	-	-	-	-	-	-	-	-	N	S	S	S	S	S	N	N	S
CVCV%													S	S	S	N	S	S

CVCVC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	S	S
%%%%%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. b, c, d – prime durations 100, 200, 400 milliseconds; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

The result reveals that the segmental overlap hypothesis holds good with CVCVC words only when then the primes are presented atleast for 200 ms. The effect is definitely most pronounced at 400 ms. At 200 ms, although the primes differ from one another in terms of their generated effects in a serial manner with greater overlapping primes yielding shorter latencies, they do not necessarily cause facilitation in comparison with the no prime condition unless the primes constitute CVCV or CVCVC segments. At 100 ms, no partial segmental overlap leads to a pronounced facilitation in comparison with the no prime. Considering the findings at 200 and 400 ms, the current findings do not support the results of Ferrand et al., (1997) where both possible syllable primes of ambisyllabic words elicited equivalent effects, as the facilitation was more a function of segmental overlap in this case, and not syllabic in nature.

In order to compare across prime durations in CVCC for each prime type separately, repeated measures ANOVA was done and the results were as follows: C%%%% - no statistically significant difference at $p < 0.05$; CV%%% - statistically significant difference [F (2, 70) = 6.26] at $p < 0.005$; CVC%% - statistically significant difference [F (2, 70) = 12.90] at $p < 0.001$; CVCV% - statistically significant difference [F (2, 70) = 32.99] at $p < 0.001$; CVCVC - statistically significant difference [F (2, 70) = 138.77] at $p < 0.001$; %%%%% - no statistically significant difference at $p < 0.05$. Bonferroni's pair-wise comparison was then made and the results are represented in Table 13.

Table 13

Pair-wise comparison of primed CVCVC naming latency across prime durations for each prime type

Prime	**100**						**200**						**400**					
	t	**u**	**v**	**w**	**x**	**y**	**t**	**u**	**v**	**w**	**X**	**y**	**t**	**u**	**v**	**w**	**x**	**y**
100	-	-	-	-	-	-	N	N	N	S*	S	N	N	N	S	S	S	N
200	-	-	-	-	-	-	-	-	-	-	-	-	N	S*	S*	S*	S	N
400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. t, u, v, w, x, y – prime types C%%%%, CV%%%, CVC%%, CVCV%, CVCVC, %%%%%; S – statistically significant difference at $p < 0.001$; S* – statistically significant difference at $p < 0.05$; N – no statistically significant difference

The no prime condition retains its lack of difference across prime exposure time ensuring that the data is accurately elicited. Prime duration as a factor in its contribution to segmental overlap is evident with CVCVC words too. However, the effect is not linear. The outcome indicates that with increase in prime duration the segmental overlap effect caused by overlapping primes escalate in a manner such that the increment becomes more evident when the primes approach the identity of the target. When the prime is CVCV%, there exists a difference between 100, 200 and 400 ms; but when the prime is C%%%%, the only difference is between 100 and 400 ms. It implies that just an increase in exposure duration is insufficient to speed the process of naming with the extent of segmental overlap also playing a role.

CCVCC

The raw scores of CCVCC were subjected to statistical analysis to obtain mean and SD values; the results of which are displayed in Table 14.

Table 14

Mean and SD values of primed CCVCC naming latency across prime types and durations

prime type	**50 ms**		**100 ms**		**200 ms**		**400 ms**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
%%%%%	579.84	16.03	575.35	17.92	564.83	15.40	582.65	17.20

C%%%%	563.55	15.54	553.03	17.95	525.26	16.31	531.05	16.96
CC%%%	548.47	15.00	537.02	18.00	504.96	17.86	499.06	17.95
CCV%%	547.42	16.13	530.68	17.63	490.72	18.67	480.12	20.09
CCVC%	551.46	15.86	515.55	18.62	458.91	19.64	412.93	22.99
CCVCC	541.74	15.51	502.65	17.20	430.04	18.09	293.56	21.54

The mean data is similar to that obtained from CCVC words in that 100, 200 and 400 ms primes clearly indicate a step-wise reduction in time with increasing overlap. The 50 ms primes do not show any clear pattern indicating the same. Like the prior structures, the reaction times reduce more as the prime durations increase.

Two-way repeated measures ANOVA on the data yielded main effects with respect to prime type, duration and their interaction as follows: F (5, 175) = 339.12, F (3, 105) = 42.629 and F (15, 525) = 97.382 at $p < 0.001$, respectively.

For comparisons across prime types for each duration, repeated measures ANOVA was done which revealed the presence of significant differences at 50, 100, 200 and 400 milliseconds at $p < 0.001$, as follows: F (5, 175) = 22.274, F (5, 175) = 47.09, F (5, 175) = 108.3, F (5, 175) = 329.38, respectively. Bonferroni's pair-wise comparison was then made and the results are represented in Table 15 (for 50 and 100 ms) and 16 (for 200 and 400 ms).

Table 15

Pair-wise comparison of primed CCVCC naming latency across prime types at 50 and 100 ms

Prime	**C%%%%**		**CC%%%**		**CCV%%**		**CCVC%**		**CCVCC**		**%%%%%**	
	a	**b**	**a**	**B**	**a**	**b**	**a**	**b**	**a**	**b**	**a**	**b**
C%%%%	-	-	S*	S*	S*	S	N	S	S	S	S*	S*
CC%%%	-	-	-	-	N	N	N	S	N	S	S	S
CCV%%	-	-	-	-	-	-	N	S*	N	S	S	S
CCVC%	-	-	-	-	-	-	-	-	N	N	S	S
CCVCC	-	-	-	-	-	-	-	-	-	-	S	S
%%%%%	-	-	-	-	-	-	-	-	-	-	-	-

Note. a, b – prime durations 50, 100 milliseconds; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

Table 16

Pair-wise comparison of primed CCVCC naming latency across prime types at 200 and 400 ms

Prime	C%%%%		CC%%%		CCV%%		CCVC%		CCVCC		%%%%%	
	c	**d**	**c**	**D**	**c**	**d**	**c**	**d**	**c**	**d**	**c**	**d**
C%%%%	-	-	S	S	S	S	S	S	S	S	S	S
CC%%%	-	-	-	-	N	S*	S	S	S	S	S	S
CCV%%	-	-	-	-	-	-	S	S	S	S	S	S
CCVC%	-	-	-	-	-	-	-	-	S*	S	S	S
CCVCC	-	-	-	-	-	-	-	-	-	-	S	S
%%%%%	-	-	-	-	-	-	-	-	-	-	-	-

Note. c, d – prime durations 200, 400 milliseconds; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

The findings exclusively demonstrate a complete facilitation caused by all overlapping segments at all durations from 50 to 400 ms. Although the facilitation is absolute, the segmental overlap based step-wise priming is almost totally lacking at 50 ms and marginally affected at 100 ms. At 200 and 400 ms, the successive primes are more facilitative than their predecessors with only one exception; where at 200 ms, the addition of the vowel (CCV%%%) to a two-letter overlap (CC%%%%) does not change the latency much. At 100 ms, a few interesting observations may be made. As with 200 ms, the additional vowel does not create greater impact than the CC%%% prime, possibly explained through the relatively lesser degree of importance associated to vowels in a lexical process. A unique lack of discrimination between the effect caused by the repetition prime and four-letter overlap prime (CCVC%) is noticed at 100 ms. If the segments are analysed, unlike the CVCC condition where CVC% primes are discernable from the CVCC primes, a longer word in CCVCC probably does not attribute a similar degree of importance to the second consonant in a consonant cluster in the final position. This explanation remains to be tested.

In order to compare across prime durations in CCVCC for each prime type separately, repeated measures ANOVA was done and the results were as follows: C%%%% - statistically significant difference [F (3, 105) = 8.85] at p < 0.001; CC%%% - statistically significant difference [F (3, 105) = 13.17] at p < 0.001; CCV%% - statistically significant difference [F (3, 105) = 20.16] at p < 0.001; CCVC% - statistically significant difference [F (3, 105)= 54.22] at p < 0.001; CCVCC - statistically significant difference [F (3, 105) = 160.79] at p < 0.001; %%%%% - no statistically significant difference at p < 0.05. Bonferroni's pair-wise comparison was then made and the results are represented in Table 17.

Table 17

Pair-wise comparison of primed CCVCC naming latency across prime durations for each prime type

Prime	**100**						**200**						**400**					
	t	**u**	**v**	**w**	**x**	**y**	**T**	**u**	**v**	**w**	**x**	**y**	**t**	**u**	**v**	**w**	**x**	**y**
50	N	N	N	S*	S*	N	N	S	S	S	S	N	S*	S	S	S	S	N
100	-	-	-	-	-	-	S*	S*	S	S	S	N	N	S*	S*	S	S	N
200	-	-	-	-	-	-	-	-	-	-	-	-	N	N	N	S*	S	N

Note. t, u, v, w, x, y – prime types C%%%%, CC%%%, CCV%%, CCVC%, CCVCC, %%%%%; S – statistically significant difference at p < 0.001; S* – statistically significant difference at p < 0.05; N – no statistically significant difference

The no prime condition is devoid of any difference across all the prime durations. The data can hence be safely considered for further interpretation. The findings reveal that the effects caused by longer prime durations become elaborate as the number of segments in the primes increase. There is no absolute linearity in this increment. It is the four-letter overlap prime onwards that incremental priming (e.g.: Ziegler, Ferrand, Jacobs, Rey, & Grainger, 2000) becomes flawless along all the four durations.

CVCCVC

The raw scores of CVCCVC were subjected to statistical analysis to obtain mean and SD values; the results of which are displayed in Table 18.

Table 18

Mean and SD values of primed CVCCVC naming latency across prime types and durations

prime type	50 ms		100 ms		200 ms		400 ms	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
%%%%%%	638.52	17.16	621.39	18.74	615.10	17.30	615.82	16.13
C%%%%%	633.98	18.61	613.03	19.75	595.55	18.06	588.83	17.75
CV%%%%	634.90	18.18	609.39	20.49	592.42	19.30	578.85	18.65
CVC%%%	632.70	20.02	601.00	20.54	562.30	21.60	522.73	21.35
CVCC%%	619.69	18.71	584.99	21.84	539.03	23.27	490.87	22.86
CVCCV%	630.92	19.54	595.98	22.53	528.63	22.29	455.33	24.97
CVCCVC	603.75	19.15	552.80	19.99	466.94	20.57	322.41	21.87

In the first bisyllabic word form under consideration, the mean values appear to follow a segmental overlap based reading only at 200 ms. In fact, only the 400 ms condition clearly presents a step-wise reduction in naming speed with each segmental addition in the prime. The 50 and 100 ms primes follow no specific order.

Two-way repeated measures ANOVA on the data yielded main effects with respect to prime type, duration and their interaction as follows: F (6, 210) = 224.83, F (3, 105) = 55.01 and F (18, 630) = 95.69 at $p < 0.001$, respectively.

For comparisons across prime types for each duration, repeated measures ANOVA was done which revealed the presence of significant differences at 50, 100, 200 and 400 milliseconds at $p < 0.001$, as follows: F (6, 210) = 15.33, F (6, 210) = 39.78, F (6, 210) = 115.46, F (6, 210) = 231.99, respectively. Bonferroni's pair-wise comparison was then made and the results are represented in Table 19 (for 50 and 100 ms) and 20 (for 200 and 400 ms).

Table 19

Pair-wise comparison of primed CVCCVC naming latency across prime types at 50 and 100 ms

Prime	C%%%%%		CV%%%%		CVC%%%		CVCC%%		CVCCV%		CVCCVC		%%%%%%	
	a	b	a	b	a	b	a	b	a	b	a	b	a	B
C%%%%%	-	-	N	N	N	N	S*	S	N	S*	S	S	N	N
CV%%%%	-	-	-	-	N	N	S*	S	N	N	S	S	N	N
CVC%%%	-	-	-	-	-	-	N	N	N	N	S	S	N	S*
CVCC%%	-	-	-	-	-	-	-	-	N	N	S*	S	S*	S
CVCCV%	-	-	-	-	-	-	-	-	-	-	S	S	N	S*
CVCCVC	-	-	-	-	-	-	-	-	-	-	-	-	S	S
%%%%%%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. a, b – prime durations 50, 100 milliseconds; S – statistically significant difference at $p < 0.001$; S* – statistically significant difference at $p < 0.05$; N – no statistically significant difference

Table 20

Pair-wise comparison of primed CVCCVC naming latency across prime types at 200 and 400 ms

Prime	C%%%%%		CV%%%%		CVC%%%		CVCC%%		CVCCV%		CVCCVC		%%%%%%	
	c	d	c	d	c	d	c	d	c	d	c	d	c	d
C%%%%%	-	-	N	N	S	S	S	S	S	S	S	S	N	S*
CV%%%%	-	-	-	-	S	S	S	S	S	S	S	S	N	S*
CVC%%%	-	-	-	-	-	-	S	S	S	S	S	S	S	S
CVCC%%	-	-	-	-	-	-	-	-	N	S	S	S	S	S
CVCCV%	-	-	-	-	-	-	-	-	-	-	S	S	S	S
CVCCVC	-	-	-	-	-	-	-	-	-	-	-	-	S	S
%%%%%%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note. c, d – prime durations 200, 400 milliseconds; S – statistically significant difference at $p < 0.001$; S* – statistically significant difference at $p < 0.05$; N – no statistically significant difference

The findings on this structure are subtly different from the earlier structures. Only 400 millisecond primes facilitate word naming (comparison with no prime) with all prime types. 200 and 100 ms primes yield facilitation only beyond CVC%%% overlap primes. With reference to the 50 ms primes, only CVCC%% and CVCCVC are facilitating. The common parameter across all these starting primes of facilitation (CVC%%%, CVCC%% and CVCCVC) is the consonant ending in each of the primes. The superiority of consonant segments which were evidenced occasionally in the previous structures has been more salient with CVCCVC words. Also, instances where vowel inclusive primes do not differ from their preceding primes (e.g.: CVCC%% and CVCCV% at 200 ms) confirm the presence of this consonant effect as a variable. No prime duration in entirety offers step-wise segmental overlap based facilitation for CVCCVC words. Even at 400 ms, C%%%%% prime does not differ from CV%%%%. An adjunct to the consonant effect comes at 50 and 100 ms where CVC%%% and CVCC%% do not differ in their effects opening a possibility to study the structural role of a second consonant in a cluster. The variations in the consonant cluster effects caused by CCVC, CCVCC and CVCCVC words are to be explored further. An alternate explanation may be provided for the findings at 50 and 100 ms. It may be a case of the syllabic influence surfacing amidst the segmental overlap with significant changes in facilitation observed only on the prime that completes its status as a syllable (Savin & Bever, 1970; Mehler et al., 1981; Ferrand et al., 1996), which also happens to be a coda consonant. As the only non-ambisyllabic bisyllabic word under consideration in the study this explanation should not be generalized.

In order to compare across prime durations in CVCCVC for each prime type separately, repeated measures ANOVA was done and the results were as follows: C%%%%% - statistically significant difference [F (3, 105) = 9.16] at $p < 0.001$; CV%%%% - statistically significant difference [F (3, 105) = 12.78] at $p < 0.001$; CVC%%% - statistically significant difference [F (3, 105) = 36.79] at $p < 0.001$; CVCC%% - statistically significant difference [F (3, 105) = 38.03] at $p < 0.001$; CVCCV% - statistically significant difference [F (3, 105) = 73.22] at $p < 0.001$; CVCCVC - statistically significant difference [F

(3, 105) = 160.79] at $p < 0.001$; %%%%% - no statistically significant difference at $p < 0.05$. Bonferroni’s pair-wise comparison was then made and the results are represented in Table 21.

Table 21

Pair-wise comparison of primed CVCCVC naming latency across prime durations for each prime type

Prime	100							200							400						
	t	**u**	**v**	**w**	**x**	**y**	**z**	**T**	**u**	**v**	**w**	**x**	**y**	**z**	**t**	**u**	**v**	**w**	**x**	**y**	**z**
50	N	S*	S	S*	S*	S	N	S*	S*	S	S	S	S	N	S*	S	S	S	S	S	N
100	-	-	-	-	-	-	-	N	N	S	S*	S	S	N	N	S*	S	S	S	S	N
200	-	-	-	-	-	-	-	-	-	-	-	-	-	-	N	N	S*	S*	S	S	N

Note. t, u, v, w, x, y, z – prime types C%%%%%, CV%%%%, CVC%%%, CVCC%%, CVCCV%, CVCCVC, %%%%%%; S – statistically significant difference at $p < 0.001$; S* – statistically significant difference at $p < 0.05$; N – no statistically significant difference

The reliability of the experimental output is established through the finding that the ‘no prime’ condition does not differ across prime durations. The effect of prime duration is more noticeable in CVCCVC word naming with even three-letter overlap prime creating a complete serial increment effect with an increase in prime duration. Beyond the three-letter overlap prime (CVC%%%), all primes follow the path of incremental priming. When lesser number of segments constitute the prime, the incremental priming effect is absent between 100, 200 and 400 ms for CV%%%% primes and between 50 and 100 ms primes too, for C%%%%% primes.

General Discussion

The present research was undertaken to test the presence of the segmental overlap hypothesis in second language users of English through primed word naming of six word types referring to different syllable structures with primes varied from 25 to 400 milliseconds. The basis for the current study was sought from evidence in support of the segmental overlap hypothesis in bisyllabic words in English, the addition of the onset criteria to it, a small scale study of segmental overlap in second language users of English using monosyllables, the presence of sub-lexical priming, the absence of syllable priming, the masked onset priming effect, and the response competition hypothesis among others. Keeping a check on constraints such as letter position, onset presence, serial ordering, absence of form mismatch and absence of distracters in the primes, the study was conceptualized to study the influence of native languages (if any) on the process of speeding a naming response to a written word in English through the prior presentation of letters as 'segments' in a series. Since no specific prime duration had been conclusively earmarked for such an experiment, a range from 25 ms to 400 ms was incorporated.

The results of the experiments have confirmed that the segmental overlap hypothesis (Schiller, 2000, 2004) is a true effect even in second language users of English. Most importantly, the effect is governed by prime duration. This governance is also not exclusive as it varies with the type of syllable structure. CVC syllable structure is suited to absolute segmental overlap, i.e. facilitation by each of the prime types and discernable difference between each successive prime effect, when the priming is through 200 or 400 milliseconds. CVCC is not suited to absolute segmental overlap at any duration. The first and two-segment overlap primes do not elicit differential effects in terms of degree although they are all facilitative at 200 and 400 milliseconds. CCVC also follows the CVCC structure in not exhibiting absolute segmental overlap in spite of being facilitative at 100, 200 and 400 milliseconds. The CVCVC structure abides by all the conditions of segmental overlap at 400 milliseconds and the CCVCC follows the principles at 100, 200 and 400 milliseconds. The CVCCVC structure resembles the pattern of CCVC and CVCC structures. In summary, three and five letter words exhibit absolute overlap effects while four and six letter words do not. However, all structures do exhibit some degree of segmental overlap effects. It may also be safe to state that increased prime duration across all syllable structures led to instances of greater priming effects, variable on the basis of syllable structure and extent of segmental overlap. In terms of the latter, two facets may need more experimentation. Vowels and consonants in clusters across positions have been found to influence the broad effects of segmental overlap, with no exact pattern evidenced in these experiments. The absence of ambisyllabic syllable prime similarities in CVCVC and possible influence of syllabic segmentation in CVCCVC could be considered in future studies. An additional lateral inference that may be drawn is based on the absolute duration of naming latencies across the syllable structures. While the shorter words (words with lesser letters) by and large had faster naming responses than the longer ones, as supported by Spieler and Balota (2000), the bisyllabic CVCVC was in general slower than the monosyllabic CCVCC. Thus, a scope to investigate word length effects across syllables in ESL speakers emerges. Barring certain inconsistencies, segmental overlap is largely determined by the structure of the syllable / word under question and the duration for which an overlapping segment/s is/are presented.

Limitations of the study

Although the participants of the study were all native speakers of a Dravidian language, either Kannada or Malayalam, the possible influence exerted by the differences that exist between the two languages may have surfaced in the outcome. The experiment per se, was particularly lengthy. Possibilities of an intrinsic practice effect on tasks presented subsequently or boredom effects, irrespective of breaks between tasks, could exist. The English proficiency of the participants was not assessed in greater depth across domains, which may not necessarily influence the results tremendously considering exposure related homogeneity; but it may have enhanced the strength of the interpretation, if considered.

CHAPTER V

SUMMARY AND CONCLUSIONS

Intra-word constituent processing has been a topic of keen interest to researchers investigating the effects of the components of a word on its naming process. The segmental overlap hypothesis with an additive onset-effect has been appreciated as a strong predictor of word naming performance. Under a masked priming paradigm, segments of word, i.e. letter and letter combinations, have been presented as primes prior to a word target that is to be named. When the preceding primes are components of the word, they have been found to exhibit facilitation in naming speed. The extent of overlap is supposed to determine the extent of priming. The present study attempted to delineate the effects of segmental overlap across six syllable structures. The primes were presented across five durations to check for their impact on naming speed. The participants were native speakers of Kannada or Malayalam with English as their medium of instruction in schooling.

The study was conducted in two phases. In Phase I, ten participants were subjected to thirty masked priming programmes pertaining with CVC, CVCC, CCVC, CVCVC, CCVCC, and CVCCVC word types, each one of them with overlapping primes (example, for CVCC, the primes were C%%%, CV%%, CVC%, CVCC) and a set of no primes (%%%%) presented at 25, 50, 100, 200 and 400 milliseconds. The primes were sandwiched between forward and backward maskers (#### - number of symbols equal to the number of letters in the target) of 500 and 15 milliseconds, respectively. The participants were given a practice reading of the target words and a trial on the laptop, and were instructed to name the target word as soon as possible having kept ones' vision on the screen from the time an initiation point '*' was displayed for 500 milliseconds. The naming response window was timed at 2000 milliseconds. On completion of this pilot phase of the study, nine syllable structure and prime duration combinations were eliminated as they did not lead to any segmental overlap based facilitation.

Phase II of the study began with thirty six participants being tested on the same programmes used in the pilot with the exception of those that failed to achieve any segmental overlap based facilitation. Thus, CVC, CVCC, CCVC, CCVCC, CVCVC and CVCCVC structures were tested across 100, 200, 400; 100, 200, 400; 50, 100, 200, 400; 50, 100, 200, 400; 100, 200, 400; and 50, 100, 200, 400 milliseconds, respectively. The naming latencies were marked using CheckVocal and the raw data was complied for further statistical treatment with SPSS.

The results revealed that each of the structures followed segmental overlap facilitation to varying degrees across prime durations. While some structures achieved segmental overlap increments in naming at lower prime durations, some others needed long prime presentation durations to elicit similar effects. Structures with four and six letters as in CVCC, CCVC and CVCCVC did not exhibit the same discreteness that three and five letter structures in CVC, CCVCC, CVCVC did pertaining to each segments' speed enhancement effect. In general, all the structures exhibited improved naming speed when comparisons were made between successive prime types. For instance, a CVC%% prime elicited faster naming than a CV%%% prime. This tendency became more apparent and the gap between naming speeds of such successive primes widened as the duration of the prime was stretched. Additionally, certain vowels and consonants in clusters, by virtue of their positions in their respective words, were found to be less emphatic in their role in influencing target word reading. The role of each letter as a segment causing a degree of facilitation was proven under the constraints of structure and prime duration, in second language users of English. Hence, it may be concluded that the segmental overlap hypothesis with its onset effect does hold good in second language speakers of English provided the apt combination of syllable structure and prime duration is achieved for experimentation.

Implications

The outcome clarifies that each letter or segment of a word in English does play a role in the process of word naming for second language speakers of the language. Hence, cueing strategies in enhancing word naming could involve letter-based strategies. On an educational front, letter based instruction in teaching English receives support. The findings of the study may be utilized as data to support modelling of word naming processes in the target population. The variability in the segmental overlap based on structure of the syllable and duration of the prime opens avenues for future research to look for additional factors contributing to the variation.

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APPENDIX 1

1 bat
2 bag
3 bed
4 can
5 cud
6 dam
7 dub
8 fen
9 fun
10 gad
11 gel
12 hap
13 ham
14 hum
15 jib
16 kid
17 lap
18 led
19 mad
20 met
21 nut
22 nor
23 per
24 pan
25 rut
26 rot
27 sod
28 sum
29 tan
30 tic
31 big
32 ben
33 bet
34 con
35 cap
36 dog
37 dib
38 fag
39 fob
40 get
41 got
42 hen
43 hid
44 hem
45 jab
46 keg
47 lit
48 lot
49 men
50 mor
51 nog
52 pen
53 pot
54 ret
55 rap
56 rig
57 sop
58 sad
59 tin
60 tap
61 bug
62 bid
63 bop
64 cut
65 cat
66 dap
67 don
68 fed
69 fib
70 gun
71 gat
72 hob
73 hog
74 jog
75 job
76 kop
77 lip
78 mar
79 mop
80 nab
81 nib
82 pod
83 peg
84 rob
85 red
86 rug
87 set
88 sic
89 ton
90 tip
91 bed
92 dam
93 fun
94 hap
95 jib
96 led
97 nut
98 pan
99 sod
100 tic
101 bet
102 dog
103 fob
104 hen
105 jab
106 lot
107 nog
108 ret
109 sop
110 tap
111 bop
112 dap
113 fib
114 hob
115 job
116 mar
117 nib
118 rob
119 set
120 tip

APPENDIX 2

1 band
2 best
3 bond
4 bust
5 cask
6 curl
7 darn
8 dump
9 farm
10 font
11 gens
12 gulp
13 hark
14 hilt
15 hump
16 just
17 kind
18 last
19 link
20 lost
21 mint
22 must
23 pelt
24 pink
25 rapt
26 rink
27 sect
28 silk
29 tang
30 tilt
31 belt
32 bold
33 burn
34 carl
35 conk
36 curt
37 dart
38 dung
39 fast
40 fund
41 gent
42 gust
43 harl
44 hint
45 hung
46 kart
47 kink
48 limb
49 long
50 milk
51 mort
52 pact
53 pend
54 pomp
55 rasp
56 risk
57 self
58 silt
59 tank
60 ting
61 bend
62 bolt
63 burp
64 carp
65 curb
66 damp
67 dorp
68 fact
69 fink
70 funk
71 germ
72 haft
73 harm
74 hist
75 hunk
76 kerb
77 lamb
78 limp
79 lord
80 milt
81 most
82 past
83 pimp
84 rang
85 rift
86 salt
87 send
88 sing
89 task
90 tint
91 bent
92 bomb
93 busk
94 cart
95 curd
96 dark
97 duct
98 fang
99 fond
100 gelt
101 gulf
102 hard
103 hent
104 hold
105 hunt
106 kerf
107 lamp
108 ling
109 lorn
110 mind
111 murk
112 pelf
113 ping
114 rank
115 ring
116 sark
117 sild
118 tamp
119 term
120 tump
121 bust
122 dump
123 gulp
124 just
125 lost
126 pink
127 silk
128 bold
129 curt
130 fund
131 hint
132 limb
133 pact
134 risk
135 ting
136 carp
137 fact
138 haft
139 kerb
140 milt
141 rang
142 sing
143 bomb
144 dark
145 gelt
146 hold
147 ling
148 pelf
149 sark
150 tump

APPENDIX 3

1 blab
2 blip
3 brat
4 brit
5 clog
6 crab
7 drag
8 drop
9 flan
10 flip
11 fret
12 from
13 glut
14 grig
15 plan
16 plop
17 prod
18 scat
19 skim
20 slab
21 slit
22 slot
23 snag
24 snob
25 sped
26 spud
27 step
28 stub
29 tram
30 trim
31 blam
32 blob
33 bred
34 clad
35 clop
36 crag
37 dram
38 drub
39 flab
40 flap
41 flit
42 frig
43 glad
44 grab
45 grim
46 plat
47 plot
48 prog
49 scop
50 skin
51 slag
52 slob
53 slub
54 snap
55 snub
56 spin
57 spun
58 stet
59 stud
60 trap
61 blat
62 bloc
63 brig
64 clam
65 clot
66 cram
67 drib
68 drug
69 flat
70 floc
71 frit
72 glib
73 gram
74 grin
75 pled
76 plug
77 prom
78 scot
79 skip
80 slam
81 slog
82 slug
83 snip
84 snug
85 spit
86 spur
87 stir
88 stum
89 trek
90 trod
91 bleb
92 blot
93 brim
94 clan
95 club
96 crap
97 drip
98 drum
99 fled
100 flog
101 frog
102 glim
103 grid
104 grip
105 plod
106 plum
107 prop
108 scud
109 skid
110 slap
111 slop
112 slum
113 snit
114 spam
115 spot
116 stab
117 stun
118 trig
119 trot
120 trip
121 brit
122 drop
123 from
124 plop
125 slab
126 snob
127 stub
128 blob
129 crag
130 flap
131 grab
132 prog
133 slob
134 spin
135 trap
136 clam
137 drug
138 glib
139 plug
140 slam
141 snug
142 stum
143 blot
144 crap
145 flog
146 grip
147 scud
148 slum
149 stab
150 trip

APPENDIX 4

1 bedim
2 besom
3 borer
4 caper
5 civil
6 conic
7 decal
8 dimer
9 facet
10 forum
11 goner
12 hosel
13 jupon
14 legal
15 liner
16 loner
17 matin
18 metal
19 modal
20 nomad
21 papal
22 petal
23 raven
24 refer
25 resin
26 ruler
27 sedum
28 sizar
29 tenon
30 tonal
31 befit
32 besot
33 boric
34 cedar
35 colon
36 cover
37 denim
38 dowel
39 femur
40 gamin
41 habit
42 hotel
43 lapel
44 lemon
45 lipid
46 lunar
47 mavis
48 meter
49 model
50 nomen
51 paper
52 petit
53 raver
54 refit
55 retem
56 rowan
57 sepal
58 sober
59 tenor
60 toner
61 befog
62 bevel
63 boron
64 cigar
65 comer
66 cower
67 deter
68 dozen
69 feral
70 genic
71 hogan
72 jugal
73 javer
74 lever
75 locus
76 magic
77 mayor
78 metis
79 naked
80 nonet
81 paten
82 poser
83 razor
84 regal
85 revel
86 saber
87 serin
88 sofar
89 tenet
90 tonic
91 began
92 bidet
93 bosom
94 civet
95 comet
96 cozen
97 devil
98 duvet
99 fetid
100 genus
101 hokum
102 jugum
103 layer
104 limit
105 loden
106 manus
107 merit
108 minus
109 nidus
110 panel
111 pedal
112 rabid
113 rebec
114 relic
115 rosin
116 sabin
117 serum
118 sural
119 tepid
120 tonus
121 beget
122 bipod
123 cadet
124 civic
125 comic
126 cupel
127 digit
128 facer
129 fever
130 given
131 homer
132 julep
133 lazar
134 linen
135 logic
136 mason
137 mesic
138 miter
139 nodus
140 panic
141 peril
142 ravel
143 recur
144 reset
145 rotor
146 sedan
147 siren
148 tabun
149 tiger
150 topic
151 civil
152 forum
153 liner
154 nomad
155 resin
156 tonal
157 colon
158 gamin
159 lipid
160 nomen
161 retem
162 toner
163 comer
164 genic
165 locus
166 nonet
167 revel
168 tonic
169 comet
170 genus
171 loden
172 panel
173 rosin
174 tonus
175 comic
176 given
177 logic
178 panic
179 rotor
180 topic

APPENDIX 5

1 bland
2 blimp
3 blurb
4 brant
5 clamp
6 climb
7 craft
8 crept
9 crust
10 dript
11 flint
12 frisk
13 gland
14 grand
15 grump
16 plink
17 prang
18 print
19 scant
20 skelp
21 skulk
22 slept
23 smelt
24 snarl
25 spelt
26 spunk
27 stark
28 sting
29 stump
30 tramp
31 blank
32 blind
33 blurt
34 brent
35 clang
36 cling
37 cramp
38 crimp
39 draft
40 drunk
41 flirt
42 frond
43 glint
44 grant
45 grunt
46 plonk
47 prank
48 prism
49 scarf
50 skimp
51 skunk
52 sling
53 smirk
54 snort
55 spend
56 spurn
57 start
58 stink
59 stunk
60 trend
61 blast
62 blink
63 bract
64 bring
65 clank
66 clink
67 crank
68 crisp
69 drank
70 flank
71 flops
72 front
73 glitz
74 grasp
75 plank
76 plotz
77 prest
78 prong
79 scarp
80 skink
81 slang
82 slink
83 smolt
84 spank
85 spent
86 spurt
87 stent
88 stint
89 stung
90 tromp
91 blend
92 blitz
93 brand
94 brisk
95 clasp
96 clomp
97 craps
98 croft
99 drift
100 flask
101 flung
102 frost
103 graft
104 grind
105 plant
106 plumb
107 primp
108 scalp
109 scold
110 skirl
111 slank
112 slump
113 smarm
114 spark
115 spilt
116 stamp
117 stern
118 stirk
119 stunt
120 trump
121 blest
122 blond
123 brank
124 brunt
125 cleft
126 clump
127 crest
128 crumb
129 drink
130 fling
131 flunk
132 frump
133 gramp
134 grist
135 plebs
136 plump
137 prink
138 scamp
139 scorn
140 skirt
141 slant
142 slung
143 snark
144 specs
145 spitz
146 stand
147 stilt
148 stomp
149 tract
150 trunk
151 clamp
152 dript
153 grump
154 skelp
155 spelt
156 tramp
157 clang
158 drunk
159 grunt
160 skimp
161 spend
162 trend
163 clank
164 flank
165 plank
166 skink
167 spent
168 tromp
169 clasp
170 flask
171 plant
172 skirl
173 spilt
174 trump
175 cleft
176 fling
177 plebs
178 skirt
179 spitz
180 trunk

APPENDIX 6

1 bagman
2 bedlam
3 bumper
4 calcar
5 carpel
6 centum
7 conker
8 cudgel
9 dentil
10 dispel
11 ferbam
12 formal
13 germen
14 hanker
15 hispid
16 jetsam
17 lepton
18 lumber
19 master
20 midleg
21 muster
22 pander
23 petrel
24 portal
25 raptor
26 roster
27 signal
28 sordor
29 tartan
30 tester
31 bagwig
32 bended
33 bunker
34 calpac
35 carpet
36 cermet
37 corbel
38 cultus
39 dentin
40 distal
41 fervid
42 format
43 gifted
44 hansom
45 hobnob
46 jumper
47 liblab
48 lumpen
49 mastic
50 midrib
51 napkin
52 parcel
53 petrol
54 porter
55 rascal
56 runlet
57 signet
58 subgum
59 tartar
60 teston
61 bandog
62 bolson
63 burden
64 candor
65 cartel
66 citron
67 cordon
68 cuspid
69 dermis
70 dulcet
71 festal
72 gambit
73 ginger
74 hectic
75 hornet
76 lactam
77 lignin
78 mantel
79 medlar
80 molten
81 nectar
82 pelmet
83 piglet
84 punter
85 rector
86 secret
87 silver
88 suntan
89 tectum
90 tombac
91 bandit
92 bolter
93 burger
94 canker
95 carten
96 citrus
97 corker
98 custom
99 desman
100 dumlin
101 fester
102 gambol
103 goblet
104 hector
105 hostel
106 lactic
107 limber
108 mantic
109 melton
110 monger
111 nekton
112 pelter
113 pistol
114 purlin
115 redcap
116 sector
117 simnel
118 sutler
119 temper
120 tomcod
121 barter
122 bonbon
123 cabman
124 cantus
125 catnip
126 colter
127 corvid
128 cutlet
129 disbud
130 duster
131 forbid
132 ganger
133 hamper
134 helper
135 jasper
136 lancer
137 litmus
138 margin
139 mescal
140 morgen
141 palpus
142 pencil
143 poplar
144 raglan
145 rictus
146 sensor
147 somber
148 tactic
149 tercel
150 torpid
151 basket
152 bonded
153 cactus
154 canvas
155 catsup
156 combat
157 cosmic
158 dampen
159 discus
160 fabric
161 forget
162 garden
163 hangar
164 henbit
165 jerkin
166 landed
167 lodger
168 marker
169 micron
170 mortal
171 palter
172 penman
173 poplin
174 ragman
175 ringer
176 sepsis
177 sorbet
178 tamper
179 termer
180 torpor
181 centum

182 formal
183 lumber
184 portal
185 tester
186 cermet
187 format
188 lumpen
189 porter
190 teston
191 citron
192 gambit
193 mantel
194 punter
195 tombac
196 citrus
197 gambol
198 mantic
199 purlin
200 tomcod
201 colter
202 ganger
203 margin
204 raglan
205 torpid
206 combat
207 garden
208 marker
209 ragman
210 torpor