Articles

Cognitive Processes in Second Language Word Association

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This study utilizes a word association (WA) paradigm to infer similarities and differences between processes used to access the mental lexicons of native speakers (NS) and Japanese nonnative speakers of English (NNS). Three hypotheses were examined: a) grammatical word stimuli will elicit proportionately fewer paradigmatic responses than will content words; b) the proportion of phonologically-related responses will increase when stimuli are presented aurally rather than in written format; and c) NNS responses to infrequent words will not differ from responses to common words if a loan word equivalent exists in their first language (L1). Generally speaking, results concurred with established findings. Where results failed to validate the hypotheses, cognitive models are outlined to account for the data. In particular, a process model involving access to explicit knowledge of grammar rules is presented to account for the fact that NNS were less likely to respond to grammatical word stimuli with syntagmatic responses than were NS ($\chi^2 = 15.22$, $p < .001$, $df = 1$). Also, during aural presentation, only NNS responses, not NS responses, displayed more phonological similarities to their stimuli, suggesting the NNS rely on phonological cues in the absence of semantic knowledge. Similarly, NNS produced fewer semantic associates to low-frequency nouns with loan word equivalents than they did to commonly occurring nouns ($\chi^2 = 3.89$, $p < .05$, $df = 1$). In fact, NNS produced marginally *more* semantic responses to low-frequency nouns without loan word equivalents at all. A model postulating competition between cognitive processes that precipitate semantic responses and those instigated by the salience of phonological similarities between the stimuli and their loan word equivalents is proposed.

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語連想による第二言語の認知処理の検証

本研究は言語連想法を使い、英語の母語話者と非母語話者（日本語を母語とする英語学習者）のメンタル・レクシコンへのアクセスの過程の類似点と相違点を検証したものである。単語を被験者に提示し、それに対して返された連想語を文法、意味、音声の観点から分析した。総じて従来行われてきた調査結果とほぼ同様の結果が得られたが、中には異なる結果もあった。これまでとの相違点については、認知モデルに基づいて再解釈した。

A large body of knowledge has accumulated concerning the nature of the mental lexicon, the storehouse of vocabulary in the human mind (for overviews, see Aitchison, 2003; McCarthy, 1990, chap. 3; Singleton, 1999). Research findings in areas as diverse as neuropsychology and linguistics as well as the development of electronic databases have enabled theorists to infer a great deal about the ways in which we store language. Research to date has primarily involved participants' first language (L1) mental lexicons. Recently, however, extensive research and theory have attempted to reveal the nature of learners' second language (L2) lexicon as well. Among the many methodologies available to researchers in this field, and one of the simplest to implement, is word association (WA). The WA paradigm consists simply of the presentation of lexical stimuli to which participants respond with either written or verbal responses. Examination of these stimulus-response pairs allows researchers to make inferences concerning the ways in which lexical items are stored in human memory. This study, too, attempts to utilize word association as a means of inferring similarities and differences between the mental lexicons of native speakers (NS) and Japanese nonnative speakers (NNS) of English, as well as the relationship between the L1 and L2 lexicons within learners themselves.

L1 Lexical Organization

The complexity of the relationship between L1 and L2 lexicons is seen in the diversity of researchers' opinions. Some have argued for the similarities between the two (e.g., Wolter, 2001), while others have highlighted the differences (e.g., Meara, 1983). Still others have focused on the connections between the two (e.g., Channell, 1988; de Groot, 2002; Hall, 1992). To elucidate the nature of this complex relationship, it is necessary to first examine the manner in which L1 vocabulary items are connected

within the mind. The most common links between words in our mental store are semantic and phonological connections.

Although word meaning itself tends to be a "slippery customer" with "fuzzy," fluid boundaries (Aitchison, 2003, chap. 4), many semantic connections have been revealed through L1 word association studies (Aitchison, 2003, chap. 8; Carter, 1998, chap. 2; McCarthy, 1990, chap. 2). Of all the semantic links to be discovered between words in the L1 mental lexicon, Aitchison (2003) considers coordination, collocation, superordination, and synonymy to be the "most important" (p. 86). McCarthy (1990) adds encyclopaedic knowledge to this list.

For native speakers, coordination, or cohyponymy (Carter, 1998), is the most common link between words, involving "words which cluster at the same level of detail" (Aitchison, 2003, p. 86). This type of connection includes such associates as *salt-pepper*, *butterfly-moth*, and *black-green*, as well as antonymous pairs (e.g., *left-right*, *on-off*). Collocation refers to words which appear together regularly in normal text or speech. These include associates that appear in direct sequential relation such as *butterfly-net*, *salt-water*, or *bright-red*. Superordinates, also called hypernyms (Carter, 1998), are cover words or categorical descriptors often used in defining the more specific associate. Thus, *flower* is the superordinate of *rose* or *tulip*. Synonymy refers to links between words that have the same or similar meanings (e.g., *hungry-famished*, *discover-find*, *begin-start*). Finally, encyclopaedic knowledge refers to the "web-like set of associations" that all human beings develop in their L1 mental lexicons through personal experience, "origins, causes, effects, histories, and contexts" (McCarthy, 1990, p. 41). An example of such an encyclopaedic link from my own mental lexicon is the connection between *sunny* and *slide*. These two words are linked to a childhood memory of when I stood on top of a slide and looked up at the sun. As these kinds of links are clearly idiosyncratic to the individual respondent, classifying this kind of connection can be difficult for the researcher.

Besides the semantic connections outlined above, there is a great deal of evidence revealing phonological links between words in the L1 mental lexicon as well. WA studies involving NS children show that rhyming responses, alliterative responses, or responses with similarly prominent consonant clusters are common for children up to 7 years of age (Meara, 1983). Phonological connections have also been inferred from a number of studies of slips of the tongue or pen. In particular, studies of malapropisms (i.e., errors in speech or in writing in which the intended word and the mistaken word have no semantic similarities) provide clear evidence of phonological links in the mind. For example, Fay and Cutler (1977)

found that the majority of these slips have the same number of syllables (87%) and the same stress pattern (98%) as the words participants had intended to say or write. Examples of word pairs displaying both of these properties include *determination - denomination*, *tambourines - trampolines*, and *operations - occupations* (from Fay and Cutler's 1977 corpus). From the fact that such semantically unrelated slips can occur, researchers have posited that a single, phonologically arranged mental lexicon exists and it is accessed by two different networks, one phonological and one semantic (Channell, 1988; Fay & Cutler, 1977). Indeed, it seems unlikely that both semantically related and unrelated errors could occur without such an arrangement. Further evidence for phonological links between items in the L1 mental lexicon comes from studies in which phonological features of words are remembered despite the apparent absence of links to their meanings (see Aitchison, 2003, for an overview).

Word Association Research

Typical analyses of word association data categorize responses according to combinations of the types of links discussed above. Two types of semantically related response are distinguished: paradigmatic and syntagmatic (e.g., Meara, 1983; Soderman, 1993; Wolter, 2001). Paradigmatic responses belong to the same word class (grammatic paradigm) as the stimulus (Greidanus & Nienhuis, 2001; Meara, 1983). In the case of nouns, then, this would include cohyponyms, superordinates, subordinates, synonyms, antonyms, and so forth. A syntagmatic response, on the other hand, is similar to a collocation in that it forms "an obvious sequential link with the stimulus" (Meara, 1983; also Read, 1993, 2004). Responses that share phonological features (rhymes, assonance, etc.) with the stimulus, but have no apparent semantic connection, are referred to as *clang responses* (Meara, 1983; Soderman, 1993). A fourth category of response type is simply referred to as *errors*. These associates are elicited in response to mistaken words sharing similar phonological or orthographical features to the actual stimuli. For example, *disclose* may elicit responses such as *door* or *far*. In these cases, participants are responding to *close* (as in *to shut*) and *close* (as in *near*) respectively, rather than the actual stimulus word. Finally, a null response category is used when respondents fail to produce a response at all. With these association types clearly defined it is possible to examine word association research results in detail.

Of particular relevance to the current study are the differences between responses of native (NS) and nonnative speakers (NNS) of English.

While NS tend to produce a preponderance of paradigmatic responses, a number of researchers (e.g., Meara, 1983; Piper & Leicester, 1983; Schmitt & Meara, 1997; Soderman, 1993) have found that NNS produce larger proportions of syntagmatic and clang responses than paradigmatic responses. Clang responses are common for young L2 learners, but are gradually replaced by meaning-based responses as L2 proficiency improves (Schmitt & Meara, 1997). A similar "shift" is seen in the fact that syntagmatic responses are gradually replaced by paradigmatic responses as learner proficiency increases (Meara, 1983; Soderman, 1993). Similarly, NNS and NS children also produce more errors than do NS adults (Meara, 1983; Schmitt & Meara, 1997). These findings indicate that mature NS responses are predominantly paradigmatic in nature. Differences in learners' response patterns have been attributed to age, language proficiency, and the relative unfamiliarity of stimuli to learners (Soderman, 1993).

By varying the types of stimuli presented to respondents, researchers have found that WA responses are to some extent dependent upon the word class to which their stimuli belong. Strong intraclass links have been revealed in error analyses of native speakers (Aitchison, 2003) and lexical database research has confirmed that semantic relations and lexical organization differ according to word class (Miller & Fellbaum, 1991). Similarly, L2 WA studies have shown that bilinguals "respond to nouns with nouns and adjectives with adjectives, even across languages, more frequently than they make syntagmatic associations" (Channell, 1988, p. 92). Aitchison (2003) confirms these findings, citing WA studies where nouns elicited nouns 80% of the time, while verbs and adjectives elicited their respective word classes in at least 50% of cases. Piper and Leicester (1983) found that significantly more paradigmatic responses were elicited by verbs ($F = 3.68$, $p < .05$) and adjectives ($F = 6.259$, $p < .01$) in NS than in beginning L2 learners. However, this difference was not found in the case of nouns. On the contrary, Soderman (1993), while finding a connection between paradigmatic responses and L2 proficiency overall, failed to find differences between NS and NNS in the number of paradigmatic responses to adjectives. To account for this anomaly, Soderman postulated that each word must pass through different stages of development regardless of the proficiency of the respondent. Thus the timing of the shift toward paradigmatic responses would differ for each word. Soderman's conclusions account for the minor discrepancies in the results cited above, and allow for the conclusion that content words produce a relatively high proportion of paradigmatic responses.

Frequency of stimulus words is also a determining factor in what types of response will be elicited. Postman (1970) found that NS respond to infrequently occurring words with responses typical of NNS (i.e., larger proportions of clang responses). Presumably, a lack of familiarity with the meanings of these words led participants to make connections to phonological characteristics of the stimuli, rather than semantic ones.

Purpose and Hypotheses

The purpose of this study was to examine areas not fully covered in the WA research literature to date. As cited above, studies examining word class have found that content words typically elicit paradigmatic responses (i.e., content words). The use of grammar-function words as stimuli, however, has not been actively pursued in WA research thus far. One of the purposes of this study is to address this gap. There are two reasons to assume that such function words will produce proportionately fewer paradigmatic responses than content words. First, given the relatively small number and fixed nature of membership in this class, there are simply fewer intra-class words from which to choose a response. Second, functional words hold no inherent meaning of their own. They only acquire meaning in relation to the words around them as they appear in discourse. Thus, to make sense of these terms, they must be placed in the context of other words (i.e., in syntagmatic relations). While *the* seems incomplete on its own, it begins to make sense in constructs like *the gang*, *the cake*, or *the city*. Thus, one of the purposes of this study (Hypothesis 1 below) was to determine if, in fact, function words elicit proportionately more syntagmatic responses than do content words.

Another area of research yet to be deeply explored concerns the modes by which WA stimuli are presented to participants and by which responses are expressed. The overwhelming majority of word association research to date has been conducted in written-written (i.e., written presentation/written response) mode. Generally speaking, L1 responses elicited in this manner tend to be semantically related to their stimuli. That is, there is a preponderance of paradigmatic and syntagmatic responses. Relatively few clang responses are elicited. Although Kudo and Thagard (1999) conducted their research in aural-oral (aural presentation/oral response) mode, they did not utilize a written-written comparison group, thus failing to draw conclusions concerning differences in response types as a function of mode of presentation. This study, on the contrary, attempts to compare responses elicited by written-written vs. aural-oral modes

of presentation. It is expected (Hypothesis 2) that as phonological characteristics of the stimuli are made more salient (via aural presentation), responses will become more phonologically rather than semantically related to their stimuli. That is, the relative proportion of clang responses will increase in relation to paradigmatic and syntagmatic responses.

A third area of interest in this study concerns the unique place that loan words hold in the L2 mental lexicons of Japanese learners of English. As cited above, relatively infrequent words tended to produce proportionately more clang responses than do common words as far as native-speaking respondents are concerned (Postman, 1970). This NNS-like response pattern was attributed to a lack of familiarity with the meanings of the cues. In the case of NNS whose L1 is Japanese, however, research into the effects of word frequency on associations may be confounded by the presence of a great many English loan words in the Japanese language. Words such as *helicopter* and *asbestos*, which are quite unfamiliar to many L2 learners, already exist as *herikoputa* and *asubesuto* in Japanese. Thus, strong semantic connections to these terms should already exist in the L2 lexicon of native Japanese. These terms should elicit approximately the same number of semantic responses as those elicited by such common everyday words as, for example, *tree* and *car* (Hypothesis 3).

In accordance with these purposes, and in light of the research findings cited above, this study was designed to test the following hypotheses:

1. Function word stimuli will elicit proportionately fewer paradigmatic responses than will content words.
2. The proportion of phonologically related responses will increase when stimuli are presented aurally rather than in written format.
3. NNS responses to infrequent words will not differ from responses to common words if a loan word equivalent exists in the L1.

Method

Participants

Forty-four participants took part in this study: 11 native English speakers (NS; mean age, 31.1), 11 adult Japanese learners of English as a second language (NNS-Adult; mean age, 49.3), and 22 Japanese university students (NNS-University; mean age, 19.4). Although no objective

test of vocabulary or language ability was administered, a subjective evaluation of the NNS groups' language abilities was made. Participants were also asked to report the period of time during which they had studied English. The NNS-Adult group were evaluated as intermediate to high-intermediate; mean length of English study was 13.5 years. NNS-University respondents were judged to be high beginners; mean length of English study was 7.5 years.

Lexical Items and Procedure

The basic design of this study is based upon a task suggested by McCarthy (1990, p. 152), in which a number of words from differing word classes are used as cues in a word association study. McCarthy suggested that responses be evaluated in light of previous findings from WA research, and to make inferences concerning the development of the L2 mental lexicon. In fact, words were presented via two modes of presentation: an interview to elicit verbal responses, and a printed form on which written responses were recorded. (An example form appears in the Appendix.) There were 16 lexical items in each presentation. Lexical items were selected from categories suggested by McCarthy (1990): grammatical/function words, everyday items from the physical environment, low frequency items, and other word classes. The actual number of items employed was increased to improve reliability and generalizability of results. Grammatical words included articles, prepositions, conjunctions, and pronouns. To test Hypothesis 3, low frequency items included two types of nouns: four items for which the Japanese equivalent term was phonetically unrelated: *hospital* (*byouin*), *morning* (*asa*), *rabbit* (*usagi*), and *November* (*juichigatsu*) and four items whose equivalent terms were loan words borrowed from English: *helicopter* (*herikoputa*), *asbestos* (*asubesuto*), *orchestra* (*okesutora*), and *escalator* (*esukareta*). The stimuli appear in Table 1.

Written and verbal cues were presented to each participant in one of eight randomly selected orders respectively, making 64 possible presentation orders for each respondent, substantially eliminating the influences of priming and order effects. For the same reasons, respondents were randomly placed in either "aural-first" or "written-first" order of presentation. Written instructions informed them to answer with the first English word that came to mind. They were told that they need not respond to any items they did not understand or for which no response readily came to mind. They were also informed not to be concerned about correct spelling to ensure that the first word they thought of (rather than a word that was easier to spell) was entered. Instructions appeared in

Table 1. Word Association Stimuli

	Written items	Verbal items
Grammatical / Function words	the	a
	of	at
	and	but
	he or she	this or that
Items from the everyday physical environment	table	store
	car	desk
	tree	house
	pen	spoon
Relatively low-frequency words	helicopter	orchestra
	asbestos	escalator
	hospital	rabbit
	morning	November
Verbs	eat	sleep
	walk	jump
Adjectives	happy	bright
	soft	heavy

both Japanese and English for ease of understanding, and all participants received identical instructions to increase reliability across respondents. The aural presentation interview consisted of the researcher's reading the list of cues and waiting for a verbal response to each. If the respondent failed to respond after approximately 5 seconds, the item was repeated. If the participant still failed to respond, a null response was recorded and the next item was presented.

Results and Discussion

Two separate analyses of the data were conducted. The first, to examine Hypotheses 1 and 3, involves the categorization of syntagmatic, paradigmatic, and clang responses as defined above. These categories incorporate the response types suggested by Aitchison (2003) and McCarthy (1990): Coordination, superordination, and synonymy are types

of paradigmatic responses. Collocational responses are syntagmatic. Responses based on sound similarities in the absence of clear semantic links were coded as clang responses. A fourth category, null responses, includes errors, cases where the participant did not respond at all, and the kinds of responses McCarthy (1990) refers to as encyclopaedic. Encyclopaedic links are presumed to be semantic links based on the subjective experience of the respondents, but without a measure to assess this connection they cannot be attributed to any other category. Responses to the stimulus word *November* were not included in these analyses as it became clear that Japanese learners usually learn the months of the year as an ordered list. Thus it was impossible to classify common responses such as *December* as either paradigmatic or syntagmatic in nature.

To test Hypothesis 2, a second analysis was conducted in which responses were coded according to phonological characteristics shared with their respective stimuli. Examined phonological features included number of syllables and whether either the first or last phoneme matched those of the stimulus. These were selected as they are typical phonological features to be examined in lexical research (see Aitchison, 2003). Another common measure of phonological similarity, the examination of stress patterns, was not conducted as the majority of stimulus words were one syllable in length.

Analysis 1: Response Type

Figure 1 shows the percentages of response types per participant group for both written and verbal responses. It is clear that paradigmatic responses are predominant. Generally speaking, response patterns appear to be similar for all groups (paradigmatic > syntagmatic > clang). It should be noted, however, that NS produced syntagmatic responses (e.g., *tree-green*, *walk-home*) significantly more often ($\chi^2 = 21.83$, $p < .001$, $df = 1$) than the L2 learners, while making slightly fewer paradigmatic responses as well. Very few clang responses were produced by any of the groups while null responses were much more prominent for L2 learners than for NS. These results are in line with previous findings, suggesting that semantic links in the L2 lexicon are somewhat tenuous, leading NNS respondents to mistakenly respond to phonologically similar but misperceived stimuli. Similarly, a combination of paradigmatic and syntagmatic scores shows that NS are more likely ($\chi^2 = 19.74$, $p < .001$, $df = 1$) to respond with semantic associates than are the NNS groups. A comparison of Figures 2 and 3 allows for a more detailed examination of this data.

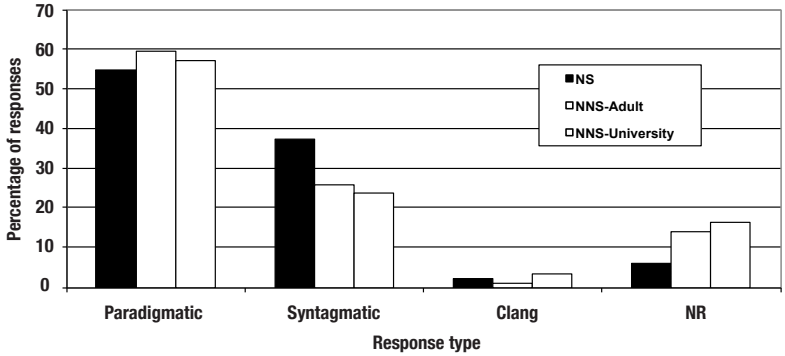

Figure 1. Percentage of response types per group

Figure 2 shows that responses to content words do not deviate substantially from the overall response pattern illustrated in Figure 1. Participants are more likely to respond to content words paradigmatically (e.g., *table-chair*) whether they are native speakers or not. Conversely, Figure 3 illustrates how native speakers are more likely to respond to grammatical-function words with syntagmatic responses (e.g., *and-you*) rather than

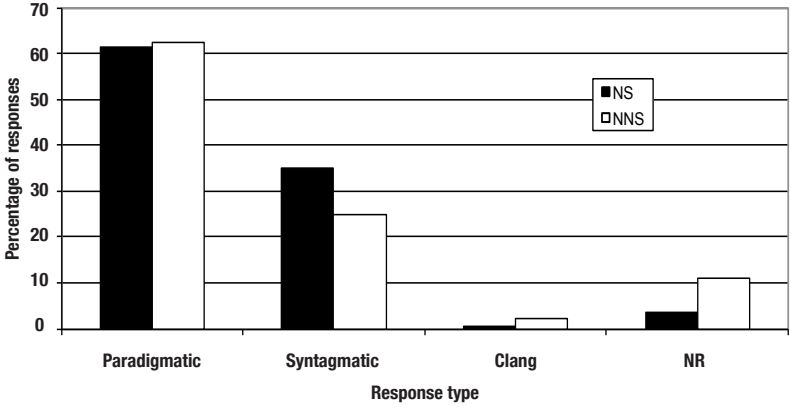

Figure 2. Responses to content word stimuli

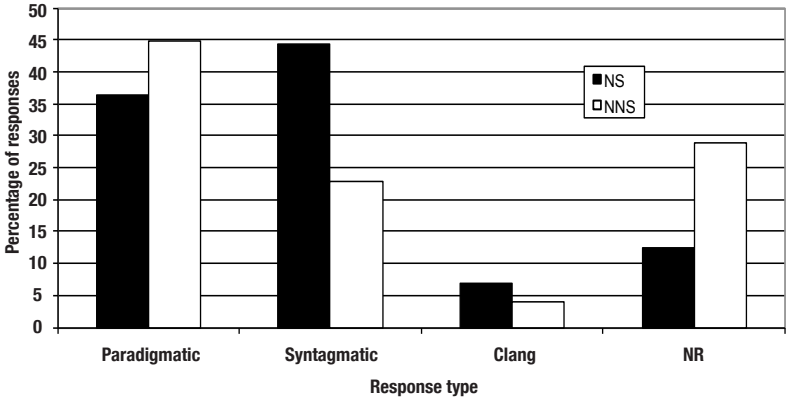

Figure 3. Responses to grammatical word stimuli

paradigmatic ones (e.g., *and-but*). The proportionately fewer paradigmatic responses seen in Figure 3 lend support to Hypothesis 1 which predicted higher percentages of paradigmatic responses in the case of function-word stimuli. Chi-square tests demonstrated statistically significant differences in frequency of syntagmatic responses as a function of group membership ($\chi^2 = 15.22$, $p < .001$, $df = 1$) as well as marginal differences in frequencies of paradigmatic responses ($\chi^2 = 1.88$, $p < .25$, $df = 1$).

From a linguistic perspective, the fact that NS respond to grammatical-function items with proportionately more syntagmatic than paradigmatic responses can be interpreted as a function of the relatively small and fixed membership of the grammatical word class. In other words, there are simply fewer function words from which to select a (paradigmatic) response. Thus responses are retrieved from other word classes. This interpretation, however, does not account for the high levels of paradigmatic responses in the case of NNS. A cognitive interpretation may better account for these findings: As grammatical-function stimuli are relatively meaningless in isolation, it would appear that native speakers impose meaning on them by generating contexts in which these words occur. That is, they produce the necessary collocations within which function words acquire their meaning and thus respond with collocational associates, (i.e., syntagmatic responses). This process is illustrated in the upper half of Figure 4 where the function word *and* elicits the syntagmatic response *pepper* as a result of the respondent's having generated the context phrase *salt and pepper*. Thus, responding syntagmatically to grammatical

word stimuli is contingent upon the respondent's working knowledge of the stimuli's occurrence in text.

Certainly NNS have less experience with authentic English text than native speakers. With the exception of very advanced learners, then, they would have less knowledge of the contexts in which function words occur. Thus, with limited knowledge of collocations to draw upon, NNS must rely instead on some other mechanism by which to impose meaning on these stimuli. In this case, learners may consult explicit knowledge of grammatical rules to make sense of function words. In so doing they may access lists of other words adhering to these rules (cohyponyms) and respond accordingly, with paradigmatic responses (e.g., *and-but*). This process is illustrated

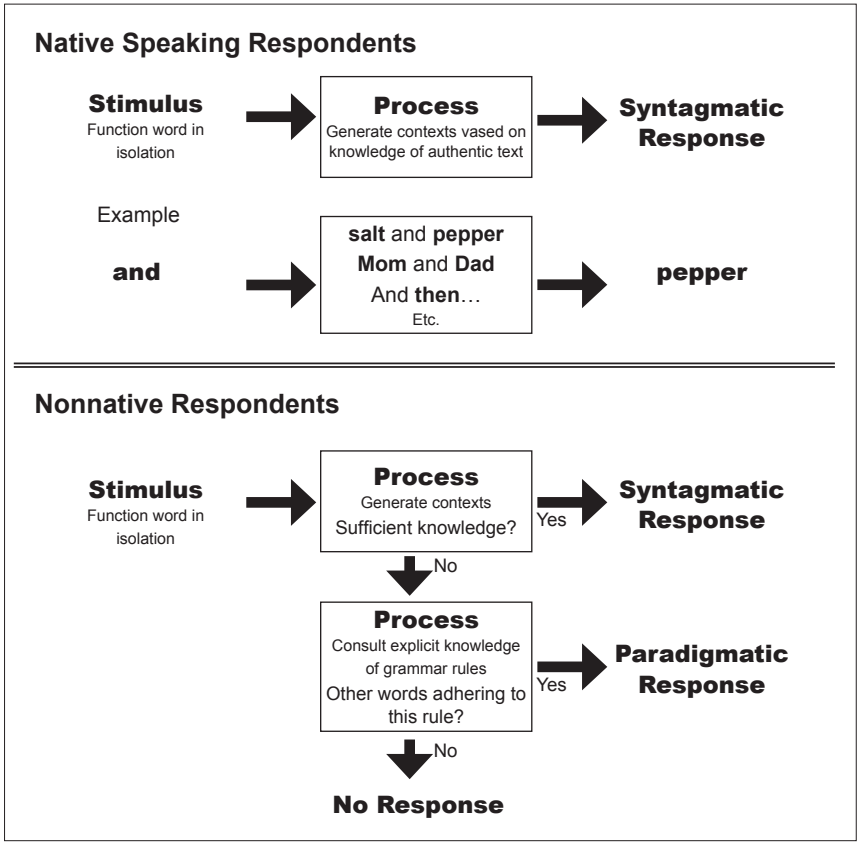

Figure 4. A cognitive model for word associations involving functional-word stimuli

in the lower half of Figure 4 where the NNS respondent with sufficient knowledge of the contexts in which the stimuli might appear can respond with a syntagmatic response. One can imagine the grammatical word *the* eliciting a train of thought like "I always see *the* in '*The end.*'" Hence, the stimulus would elicit the collocation *end*, a syntagmatic response. Where collocational knowledge is insufficient or where syntagmatic connections in the L2 mental lexicon are weak, a secondary process is initiated. Here, the NNS respondent consults explicit knowledge of grammar rules and thus encounters other words adhering to these rules. Again, in the case of the stimulus *the*, for example, the respondent's thinking may resemble "*The* goes in front of nouns like *a* does." Thus *the* would elicit the paradigmatic response *a*. The difficulty in successfully completing both of these processes is reflected in the inordinately large number of null responses for NNS (28.8%) as illustrated in Figure 3. In these cases, nonnative respondents may simply be giving up en route to discovering possible cohyponymous responses to grammatical stimuli as their cognitive resources become taxed. Undoubtedly, numerous other cognitive and motivational factors affect this process as well, though it is beyond the scope of this paper to further elaborate on them here.

Word frequency. In the case of native speakers, proportions of response types did not significantly differ as a function of word frequency. This finding was expected, as the low frequency nouns (*helicopter*, *asbestos*, *hospital*, *morning*, *orchestra*, *escalator*, and *rabbit*) had been selected for their relative unfamiliarity to the NNS groups. It was assumed that all of these terms are very familiar to native speakers of English. NNS groups, on the contrary, showed marginal, but statistically insignificant differences ($\chi^2 = 1.62$, $p < .25$, $df = 1$) in the proportion of semantic responses as a function of stimulus frequency. That is, infrequent stimuli elicited slightly fewer semantic responses from NNS. Presumably, the lack of familiarity with the meanings of these words led respondents to respond with phonologically related associates or no response at all. Utilizing even less frequently occurring stimuli could potentially produce statistically significant effects.

To further examine the effects of word frequency, low-frequency stimuli were split into two categories: those for which an equivalent loan word exists in Japanese (*helicopter*, *asbestos*, *orchestra*, and *escalator*) and those items perceived as unique to English (*hospital*, *morning*, and *rabbit*). A comparison of NNS responses to these two types of stimuli as well as to the high-frequency nouns allows a test of Hypothesis 3 which stated that NNS response patterns to infrequent stimuli for which a loan word

equivalent existed in Japanese would not differ from response patterns elicited by commonly occurring stimuli. In fact, a chi-square test revealed statistically significant differences ($\chi^2 = 3.89$, $p < .05$, $df = 1$) between NNS responses to high-frequency stimuli and to low-frequency stimuli despite the presence of loan word equivalents in Japanese to the low-frequency nouns. Specifically, NNS produced significantly *fewer* semantic associates to low-frequency nouns with loan word equivalents than they did to commonly occurring nouns. Further, a comparison of responses to the two types of low-frequency nouns shows that NNS produce *more* paradigmatic and syntagmatic responses to nouns *without* a loan word equivalent (e.g., *hospital-sick*). Albeit only a statistically insignificant difference ($\chi^2 = 2.56$, $p < .25$, $df = 1$), this trend opposes that predicted by Hypothesis 3: NNS do not in fact respond to low-frequency nouns with loan word equivalents as they do to high-frequency nouns. In fact, NNS respond more often to low-frequency nouns with semantic responses than they do to high-frequency stimuli.

These results can perhaps best be accounted for by inferring cognitive interference between the dominant processes that usually result in semantic responses and an alternative process instigated by the salience of phonological similarities between the English stimulus and its loan word equivalent. This model is illustrated in Figure 5. When encountering a noun with a loan word equivalent (e.g., *asbestos*), a respondent aware of the stimulus' similarity to the loan word (*asubesuto*) initiates a phoneme-by-phoneme phonological check to confirm this similarity ("*Is* asbestos *really* asubesuto?"). This is shown as Process 1 in Figure 5. Only after enough similarity has been recognized ("*This word must be the same thing as* asubesuto.") will the next process be initiated. If comprehension of the loan word is confirmed in the second process ("*I know what this means*"), then strong semantic ties to the word prompt either a syntag-

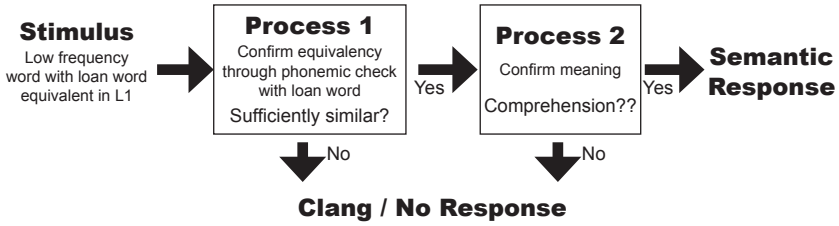

Figure 5. A cognitive model for NNS word association responses to low frequency stimuli with L1 loan word equivalents

matic or paradigmatic response (e.g., *dangerous* or *insulation*). If loan word similarity is not recognized in Process 1, or if the respondent gives up en route to this decision (because, say, motivation is insufficient or cognitive resources become taxed), then clang or null responses result. In the case of stimuli that do not alert respondents to the possibility of a loan word equivalent, only a process similar to Process 2 would be initiated. This second process, that of confirming the meaning of a stimulus and responding with a semantic associate, is the fundamental mechanism in all word association.

Analysis 2: Phonological features

The analysis of phonological features was based in part on memory research findings that first and last sounds of words are remembered better than those in the middle positions (see Aitchison, 2003). Comparisons were made between stimulus-response pairs in regards to numbers of syllables, and whether the first or last phonemes were identical. All valid (i.e., non-null) responses were examined. Results showed that shared phonological characteristics between the stimuli and the responses of NS were uniformly less frequent than those of NNS. These results are illustrated in Figure 6. For each measure, NS displayed noticeably lower percentages of phonologically similar responses than did the combined NNS groups. Chi-square tests were used to test the significance of these differences. Results of these tests appear in Table 2 where each cell represents the test score for differences between that particular NNS group's scores and those of the NS group. It is clear that more experienced learn-

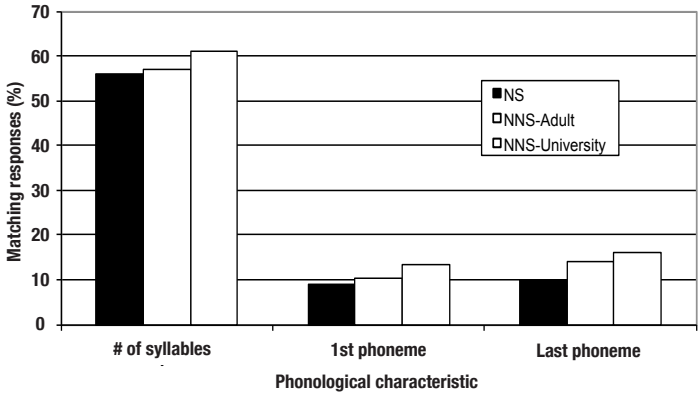

Figure 6. Phonological similarities between associates

ers (NNS-A) were less likely to respond to phonological cues than were less experienced learners (NNS-U). The first and last phonemes of NNS-U responses matched the stimuli's first and last phonemes significantly more often than did those of the NS responses. It would appear then that NNS are at least sometimes utilizing phonological characteristics of the stimuli as cues in generating responses. NS and experienced learners with stronger semantic connections to the words find it less necessary to rely on these kinds of cues. These three measures appear to support researchers' intuitions about learners' reliance upon phonological characteristics in the absence of strong semantic ties to the stimuli.

Table 2. Chi-square Test Results Comparing Differences in Phonologically Similar Response Patterns to NS Responses

	Total NNS	NNS-Adult	NNS-University
Number of syllables	1.38	0.10	2.23
First phoneme	2.78	0.45	3.90*
Final phoneme	5.67**	2.29	6.37**

Note. $Df = 1$ in all cells.
*$p < .05$. **$p < .025$.

The same phonological criteria described above were used to test Hypothesis 2 which stated that the frequency of phonologically related associates would increase when stimuli are presented aurally. In order to determine this effect of mode of presentation on shared phonological characteristics, only responses from first presentations were examined. That is, only responses from the aural-first condition were used in calculating the effects of aural presentation. Aural responses from participants in the written-first condition were not included as they were considered likely to have been influenced by response processes involved during the written presentation. Likewise, the effects of written presentation were measured in the same way. The results of this analysis only partially validated the mode-of-presentation hypothesis: NNS produced responses with the same number of syllables as their stimuli significantly more often when the stimuli were presented aurally ($\chi^2 = 6.46$, $p < .025$, $df = 1$). Likewise, NNS responded with the same first phoneme significantly more often during aural presentations ($\chi^2 = 18.87$, $p < .001$, $df = 1$).

This effect was not observed with final phonemes. Interestingly, mode of presentation had no effect on NS responses as measured by any of these three phonological measures. These results point to the primacy of semantic associations in the responses of native speakers. Regardless of the salience of phonological cues in the stimuli, NS rely primarily on semantic connections in generating word associations. Where semantic ties are more tenuous, as in the case of NNS, salient phonological cues prompt phonologically related associations. This finding concerning L2 learners parallels the results of studies cited above involving L1 learners, that is, NS children (Meara, 1983; Schmitt & Meara, 1997). As learners, NS make more clang responses than they do as adults in the absence of strong semantic associations. The findings described here may indicate that the L2 lexicon also develops from being comprised of predominantly phonological connections to semantic ones.

Summary and Conclusion

This study found at least partial support for its three hypotheses. It was predicted that function word stimuli would elicit fewer paradigmatic responses than would content word stimuli. In fact, only native speakers responded in this manner. NNS produced significantly higher frequencies of paradigmatic responses to grammatical word stimuli than did NS. A cognitive process model was presented to account for these findings, suggesting that NS rely on collocational knowledge to generate syntagmatic responses while NNS rely on knowledge of explicit grammar rules to generate paradigmatic responses. It was also predicted that aural presentation of stimuli would precipitate an increase in phonologically related responses. Here, only NNS responses fit the predicted pattern. Results here were discussed in terms of the strength of semantic connections in the mental lexicons of native speakers and NNS' reliance on phonological cues in the absence of such strong semantic links. Finally, it was predicted that NNS responses to infrequently occurring stimuli for which an L1 loan word equivalent exists would not differ from responses to common stimuli. In fact, NNS responded with fewer semantic responses despite the existence of loan word equivalents. Here too, cognitive processes were inferred to account for the data. In this case, it was suggested that NNS initiate a cognitively taxing phoneme-by-phoneme check when a stimulus is recognized as a potential loan word. Only after this is complete can the usual process of semantic recognition occur.

This study was conducted in an attempt to address certain gaps in word association research to date. It is hoped that the focus on grammatical word stimuli, mode of stimuli presentation, and loan words contributes some interesting findings to the body of WA research knowledge and points to some clear differences between the manner in which L1 and L2 items are stored and accessed in the mental lexicon. Likewise, one hopes that the application of process models to WA data will impart a fresh focus on theorization concerning the mental lexicon and how it is accessed. Without further research, however, the models presented here remain somewhat speculative. In particular, further studies should be designed to uncover which specific word classes account for the effects attributed here to differences between function versus content word responses. Follow-up studies must also replicate these findings with larger respondent samples to ensure reliability of these results.

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Author Note

An alternate version of this paper was submitted to the University of Birmingham in partial fulfillment of the requirements for the degree of MA TEFL/TESL. Portions of the results were presented at the general meeting of the Ibaraki Chapter of JALT, December 10, 2006, and at the Shinshu ELT Research Colloquium, March 4, 2007. Correspondence concerning this article should be addressed to John Racine, 2611-62 Higashi Ishikawa, Hitachinaka City, Ibaraki, 312-0052. E-mail: gaijira@gmail.com

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Appendix

Thank you for agreeing to participate in this study. The Japanese instructions on the right are the same as these written in English. So you may ignore them if you feel more comfortable completing this survey in English. **Instructions**: Read the following list of words and write down the first English word that comes to mind. There is no right or wrong answer, so you don't have to think about it too much. Don't worry about spelling either; just try to write down the first word that comes to mind. If you don't understand a word, you can leave it blank and continue to the next word.	この研究への参加に同意いただきまして、ありがとうございます。 この日本語文は、左側の英語文と同じ文章です。日本語のほうが理解しやすい方は、左側の英語は無視してください。 説明：左側にある単語を見て、一番に思い浮かんだ英単語を書いてください。正しい答えも誤った答えもありません。あまり考える必要はありませんので、最初に思い浮かんだ単語を書いてください。スペルも心配しなくて結構です。思い浮かんだままに書いてください。単語が分からなかった場合は、何も書かなくて結構ですので、次の単語に移ってください。

soft	
asbestos	
car	
helicopter	
tree	
hospital	
she	
eat	

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pen	
the	
morning	
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happy	