The Spanish Journal of Psychology
2005, Vol. 8, No. 2, 157-179

ISSN 1138-7416

Lexical Processing of Ambiguous Words: Dominance or Associative Strength?

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Four experiments examined the role of meaning frequency (dominance) and associative strength (measured by associative norms) in the processing of ambiguous words in isolation. Participants made lexical decisions to targets words that were associates of the more frequent (dominant) or less frequent (subordinate) meaning of a homograph prime. The first two experiments investigated the role of associative strength at long SOAs (Stimulus Onset Asynchrony) (750 ms.), showing that meaning is facilitated by the targets' associative strength and not by their dominance. The last two experiments traced the role associative strength at short SOAs (250 ms), showing that the manipulation of the associative strength has no effect in the semantic priming. The conclusions are: on the one hand, semantic priming for homographs is due to associative strength manipulations at long SOAs. On the other hand, the manipulation of the associative strength has no effect when automatic processes (short SOAs) are engaged for homographs.
Keywords: homographs, associative strength, dominance, lexical decision task, SOA, automatic and strategic processes

A través de cuatro experimentos, se examinó el papel de la frecuencia del significado (dominancia) y de la fuerza asociativa (medida mediante normas asociativas) en el procesamiento de palabras ambiguas aisladas. Los participantes tomaron decisiones léxicas acerca de palabras meta que eran las asociadas del significado más frecuente (dominante) o menos frecuente (subordinado) de un homógrafo primo. Los primeros dos experimentos investigaron el papel de la fuerza asociativa en las SOAs (asincronía del comienzo del estímulo) largas (750 ms), demostrando que el significado se ve facilitado por la fuerza asociativa de la meta y no por su dominancia. Los segundos experimentos trazaron el papel de la fuerza asociativa en las SOAs cortas (250 ms), demostrando que la manipulación de la fuerza asociativa no influye en la ceba semántica. Se concluye que: (a) la ceba semántica para homográficos se debe a las manipulaciones de la fuerza asociativa en las SOAs largas y (b) la manipulación de la fuerza asociativa no tiene ningún efecto cuando los procesos automáticos (SOAs cortas) están ocupados para los homógrafos.
Palabras clave: homógrafos, fuerza asociativa, dominancia, tarea de decisión léxica, SOA, procesos automáticos y estratégicos

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The main purpose of reading is to access a particular thought, idea or meaning from the perceptual analysis of some arbitrary set of graphic lines (words). Such a recognition process is most likely achieved by matching the available perceptual information to representations stored in memory that we can then use to access semantics. This is what probably happens when we read a word, such as *table*, and understand it.

A crucial question arises in the case of homograph words, where the same letter pattern is associated with more than one meaning. In this situation, the context normally helps to disambiguate the word, so that we may not even be aware of any other candidate meanings. If when talking about beer, we use the word *glasses*, it will not probably occur to us that the same word can also mean corrective lenses. The association with the idea of a drink container might be provided automatically by the context. In terms of interactive activation-base models (McClelland & Rumelhart, 1981), we can think of the context as providing additional activation to the appropriate meaning, which is then selected by some activation-sensitive process. There is a great debate, however, about the role of the context in the activation of the meaning of ambiguous words. Some researchers (e.g., Coolen, Jaarsueld, & Schreuder, 1993; Glucksberg, Kreuz, & Rho, 1986; Paul, Kellas, Martin, & Clark, 1992; Schvaneveldt, Meyer, & Becker, 1976; Simpson, 1981; Simpson & Krueger, 1991, Simpson, Krueger, Kang, & Elofson, 1994; Tabossi, 1988; Van Petten & Kutas, 1987) propose that the initial activation of the ambiguous word meaning is due to the context, as the context only primes the meaning that is consistent with it, making it unnecessary to access the other meanings. Other researchers (Conrad, 1974; Holley-Willcox & Blank, 1980; Kinoshita, 1985; Kintsch & Mross, 1985; Love & Swinney, 1996; Lucas, 1987; Onifer & Swinney, 1981; Seidenberg, Tanenhaus, Leiman, & Bienkowski, 1982; Simpson & Burgess, 1985; Simpson & Foster, 1986; Swinney, 1979; Tanenhaus, Leiman, & Seidenberg, 1979) have found that when an ambiguous word is presented, all its meanings are activated, and the context selects the meaning consistent with it. As we can see, the effect of the context is still an open question.

We are interested in ambiguity resolution when the homograph is presented isolatedly, without the context. That is, when we present an ambiguous word (*bank*) alone, after an elapse of time, what is the selected meaning? And what meaning(s) is (are) activated? This is the case of the works of Simpson and Burgess (1985) and Nievas and Justicia (2004). Simpson and Burgess used a lexical decision task on the ambiguity resolution. In the standard single lexical decision task, the *prime* (*bank*) is first presented during a period of time. (e.g., 100 ms). The participant must pay attention to it because it will help to make a later decision on the *target*. Subsequently, the target is presented at a certain stimulus onset asynchrony (SOA). The interval between the prime and the target onset, which is considered the SOA, may be manipulated. Fifty percent of the targets are words (e.g., *money*) and the other fifty per cent are pseudowords (e.g., *menoy*) (words that sound like a pronounceable word but they have no meaning). When the target is a word, it can be related (e.g., *money* or *sand*) or unrelated (*cat*) to the prime. Participants must decide whether the target is a word or a pseudoword by pressing a different letter on the computer keyboard (e.g., *C* for no and *M* for yes). When a target is related to the prime, it can be related to the dominant (*money*) or the subordinate (*sand*) meaning of the homograph.

How are the dominant and subordinate meanings obtained? One strategy is to ask the students to tell us the first word that comes to their mind after having been presented the homograph word alone (*bank*). Then, the percentage of participants that has responded to each meaning (e.g., *money, save, rich*, etc. for one meaning, and *sand, fish, water*, etc. for the other meaning) is computed (see Table 1). The dominant meaning has a higher percentage than the subordinate meaning.

The dependant variables correspond to the reaction time to the target decision and the error proportion. The difference between the related and unrelated targets is known as *semantic priming* or *facilitation* because related targets usually have faster reaction times than unrelated targets. The Simpson and Burgess (1985) results showed that, at short SOA (e.g., 100 ms), both dominant and subordinate meanings were activated, that is, positive semantic priming was found in both. The dominant meaning was higher than the subordinate one in positive semantic priming only at 16 ms (SOA). At long SOAs (e.g., 750 ms), only the dominant meaning had positive semantic priming, whereas the subordinate one had no priming. These results indicated that when a prime word (homograph) was presented isolatedly at short SOA, both meanings were activated. At long SOA, only the dominant meaning was activated.

Another result pattern was obtained by Frost and Bentin (1992) in Experiments 3a and 3b. These authors used the same lexical decision task as Simpson and Burgess (1985), although their results were different. They showed that both meanings were activated when SOA was short as well as when it was long. In the work of Simpson and Burgess, the subordinate meaning at long SOA had no positive semantic priming, whereas in that of Frost and Bentin, both the subordinate and dominant meaning had positive priming. Frost and Bentin explained these results arguing that the resolution of the ambiguity process in Hebrew could be different from the one in English. Therefore, one of our main goals is to test whether in Spanish we will obtain the same results as Simpson and Burgess did.

Nevertheless, we examined both articles in detail and we found another variable that could explain the differences in the results. In Simpson and Burgess (1985), the associative strength between the prime (*bank*) and the target (*money*) was not controlled. That is, the degree of relationship between prime and target was not equaled; perhaps Simpson and

Table 1
Associative Strength for Associates from a Homograph

RÉGIMEN (homograph)			
Dominant meaning (associates)	**%**	**Subordinate meaning** (associates)	**%**
adelgazar (to slim)	15.7	dictadura (dictatorship)	9.8
dieta (diet)	9.8	política (political)	8.8
comida (meal)	7.8	dictador (dictator)	2.0
hambre (hunger)	6.9	abierto (open)	2.0
gordo (fat)	5.9	democrático (democratic)	2.0
gordura (stoutness)	1.0	Franco (Spanish dictator)	2.0
lechuga (lettuce)	1.0	sociedad (society)	1.0
disciplina (discipline)	1.0	militar (military)	1.0
plan (plan)	1.0	liberal (liberal)	1.0
nutrición (nutrition)	1.0	fascista (fascist)	1.0
obligación (obligation)	1.0	condena (condemn)	1.0
alimentar (to feed)	1.0	antiguo (antique)	1.0
delgado (slim)	1.0	interno (intern)	1.0
adelgazamiento (weight loss)	1.0	forma (form)	1.0
alimenticio (alimentary)	1.0	agrario (agrarian)	1.0
extinción (extinction)	1.0		
comer (to eat)	1.0		
verduras (greens)	1.0		
engordar (to fatten)	1.0		
anorexia (anorexia)	1.0		
fuerza (strength)	1.0		
duro (hard)	1.0		
Total	62.8	Total	35.3
Blank	2.0		

Note. In free associative tasks, participants were presented a (homograph) word and asked to write down the first word that came to mind. Associative strength is the percentage of participants who respond to the same word. This example was taken from Nievas and Cañas (1993) norms.

Burgess selected the highest associates of both meanings. For example, as can be seen from Table 1, the highest associative strength for dominant meaning for the homograph (*regime* = *régimen*) is (*to slim* = *adelgazar*), with associative strength 15.7%; whereas the associative strength for the subordinate (*dictatorship* = *dictadura*) is 9.8%. Simpson and Burgess did not report the associative strength of the associates; they only indicated that the related targets were associates.

However, Frost and Bentin (1992) explicitly measured and controlled the degree of relation between prime and related targets. It is known that degrees of relation and associative strength are related (e.g., Experiment 3 in Nievas & Justicia, 2003); that is, the higher the degree of relation, the more associative strength. Other studies showed that an increase in associative strength produced an increase in positive priming (Cañas, 1990; Chiarello, Burgess, Richards, & Pollock, 1990; De Groot, Thomassen, & Hudson, 1982; Fischler, 1977; Lupker, 1984; Perea & Rosa, 2002).

In short, there is a difference between Simpson and Burgess (1985) and Frost and Bentin (1992). One could ask the following question: Do homographs have the same pattern as ordinary words? That is, are the processes engaged in ordinary visual word recognition the same as homograph word recognition?

Neely (1991) disclosed the semantic priming tasks and the theories that could explain these results. He showed that, when the SOA is short, the spreading activation theories (Anderson, 1976, 1983; Collins & Loftus, 1975; Collins & Quillian, 1969; MacKay[1], 1987; 1990; Neely, 1977; Posner & Snyder, 1975) may explain more semantic priming effects, but these theories cannot predict "instruction-induced priming" or "list-context priming" effects, because these effects are under strategic control that is observed at long SOAs.

Spreading activation theories are based on the assumption that semantically or associatively related nodes are stored close together (or linked via strong links). Activation in the

[1] In this theory, activation does not spread, but there is an analogous process that has the same behavior. This process is called priming.

word node spreads to the nodes of semantically related targets, thereby reducing the time required for the activation levels in those related nodes that exceed their recognition threshold. As a result, the less strongly related the target and prime are, the smaller is the facilitation.

For example, Collins and Loftus (1975) assumed that semantic knowledge is organized as a complex network of associated concepts. Within the normal semantic network, concepts that have many attributes in common are more strongly associated than those that share fewer attributes. Specific attributes of a concept serve a dual purpose: (a) They provide the means for grouping concepts into categories; and (b) they distinguish among the various exemplars that constitute a given category. According to this network model of semantic memory, each component of a speech utterance activates associated semantic concepts within a neural network. The model asserts that concepts activated in a semantic network facilitate the spread of activation to other related concepts. Activation of semantic units remains for a short period of time and then either decays or is inhibited (e.g., Neely, 1977; Nievas & Marí-Beffa, 2002).

However, Neely (1991) proposed that, at long SOAs, semantic priming could be explained better by expectancy theories than by spreading activation theories. In the expectancy theories, semantic priming can be explained by strategic processes in which attention processes are involved (Becker, 1980; 1985; Neely, 1991). Expectancy theories account for the standard priming effect by assuming that participants use the prime to generate an expectancy set that consists of potential targets related to that prime. Targets included in this expectancy set are recognized more quickly than those that are not. When a prime word precedes a target word, an expectancy set is generated from that prime word. In the typical priming experiment, this expectancy set contains nodes corresponding to words related to the prime. The composition and size of the expectancy set can vary depending on stimulus conditions. For example, according to Cañas (1990), if the stimulus list includes a great proportion of highly related associate prime-target pairs, it is probable that the expectancy set will only include a few highly related words; but if the stimulus list includes strong and weak pairs, the expectancy set should be larger and include both types of words.

Can these theories of word recognition be applied to homograph word recognition? Can the expectancy set theory explain the results at long SOAs using homographs in word recognition?

The discrepant results at long SOAs between Simpson and Burgess (1985) and Frost and Bentin (1992) could be explained by the composition of the expectancy set. In the case of lexical ambiguity, there are two ways to generate the expectancy set. On the one hand, the expectancy set could be built by selecting one meaning, the dominant or the subordinate, and including congruent candidates in that selected meaning. If one of the meanings has been selected (e.g., dominant) to build the expectancy set, no matter what words are related to this meaning, they will be facilitated, regardless of the associative strength of each word with the prime. On the other hand, the expectancy set could be built by selecting particular candidates by their associative strength between the prime and the target, which can belong to the dominant or subordinate meaning. In this case, there are a lot of prime and target pairs with a weak associative strength, the expectancy set will probably include all the related words (weak and strong). Therefore, it will include candidate words related to dominant and subordinate meanings.

Our main goal is to determinate how the expectancy set is built in homograph word recognition.

Experiment 1a

In this first experiment, we explored how the expectancy set is built. On the one hand, the expectancy set could be built by selecting one of the meanings (e.g., dominant). If this hypothesis were true, all the related words that belong to that meaning would be facilitated. Thus, we could have words in the expectancy set with different associative strengths that belong to the same meaning. On the other hand, the expectancy set could be built by selecting particular candidates by their associative strength between the prime and the target, which can belong to the dominant or subordinate meaning.

In this first experiment, the associative strength between prime (homograph) and target (associate) was the same (10%). All the associates of the dominant meaning had 10% associative strength, as did all the associates of the subordinate meaning. If the expectancy set were only built by including words that belong to the selected meaning, we should only find positive semantic priming for targets related to the dominant meaning, because the dominant meaning has a higher frequency. If this way of forming the expectancy set were correct, the results should be analogous to those of Simpson and Burgess (1985); that is, at long SOAs, only dominant targets should show semantic priming, whereas subordinate targets should not show any semantic priming.

But if the expectancy set were built by selecting particular candidates according to their associative strength, we should obtain in this first experiment positive semantic priming for both the dominant and the subordinate meanings, as they all have the same associative strength (10%).

Method

Participants

Participants were 40 volunteers from an Introductory Psychology course at the University of Granada (Spain). They received course credits for their participation. All were native

Spanish speakers with normal or corrected-to-normal vision.

Stimuli

One hundred twelve homographs (see Appendix VIII) were selected from the homograph association norms of Nievas and Cañas (1993). Fifty-six were used for word-word trials (see Appendixes IV and V) and the other 56 for word-pseudoword trials (see Appendix IX). On word-word trials, two associates were selected for each homograph. One was related to the homograph through its dominant meaning and one through a subordinate meaning (see Appendixes I and II). For 28 of the homographs, dominant associates accounted for at least 81% of the total associations (unbalanced homographs), whereas for the other 28, dominant associates accounted for no more than 55% of the total (balanced homographs).

Two-way analyses of variance were performed on target length, subjective printed usage frequency (Gordon, 1985), and associative strength, with balance and dominance as factors. No effect in either analysis was significant, indicating that targets related to the two meanings did not differ in length, printed usage frequency, or associative strength (see Table 2).

On word-pseudoword trials, the targets were formed by replacing letters (only vowels) of words while maintaining pronounceability (see Appendix IX).

Design and procedure

A within-participants factorial design was used, with factors corresponding to dominance (dominant and subordinate associates), and relatedness (related and unrelated trials) (see Appendixes VI and VII). It should be noted that although the distinction between dominant and subordinate associates is meaningless for unrelated trials, the complete crossing of these factors is maintained to ensure that comparisons between the related and unrelated conditions are based on the same stimulus items. Unrelated pairs were created by randomly repairing prime and targets (see Appendix III).

Four stimulus lists were formed so that, across lists, each homograph was followed once by each of the four types of the targets: subordinate-unrelated, subordinate-related, dominant-unrelated, and dominant-related. Thus, although no participant saw any prime or target more than once, all ambiguous words occurred with the same frequency across participants, under all the possible Dominance × Relatedness combinations. Each of the four sets of stimuli formed by this combination was seen by ten participants. Each participant saw the stimuli in a different order.

Participants were tested individually, seated approximately 60 cm from the screen of an 80386 IBM microcomputer. The maximum horizontal visual angle subtended by a target word was 1.5º. Participants rested their index fingers on two buttons of the computer keyboard. “M” for word and “C” for pseudoword. On each trial, a warning signal (a period) appeared on the screen during one second, after that, the prime appeared. Participants were instructed that they were not to respond to the prime, but that they should pay attention to it because it would help them to make the lexical decision to the target. The prime was on the screen for 100 ms and was followed by a blank interval (650 ms), therefore, the SOA was 750 ms. After that, the presentation of the target initiated a millisecond timer, which was stopped when the participant responded WORD by pressing the “M” key, and PSEUDOWORD by pressing the “C” key. If the participant did not respond in less than a 2-second interval, this trial was computed as error. The response terminated the display and began a 3-second intertrial interval. Before the experiment began, participants were given practice trial until there were 16 consecutive correct responses. The practice list was formed by 8 word-word pairs and 8 word-pseudoword pairs analogous to the experimental list. Stimulus presentation and all timing events were controlled by the computer. The electron beam was controlled by a subroutine (Dlhopolsky, 1989).

Results

Mean lexical decision latencies for correct *word* responses, along with corresponding error proportions for this experiment are shown in Table 3. Reaction times were analyzed by two ANOVAs, one with participants as the random variable (F_1), and the other with items as the random variable (F_2). In the participant analysis, the mean was

Table 2
Subjective Printed Usage Frequency, Length of Words, and Associative Strength for Targets Depending on Balance and Dominance For Experiment 1a

	Balanced		Unbalanced	
	Dominant	Subordinate	Dominant	Subordinate
Dominance	55.3%	34.4%	81.1%	14.4%
PUF	2.80	2.82	2.80	2.88
Length	6.0	5.9	5.8	6.7
AS	10.0	10.6	10.0	8.3

Note. PUF = Printed Usage Frequency; Length = number of letters in a word; AS = Associative Strength.

calculated and treated as a single observation for each participant and condition, whereas in the item analysis, the mean was calculated for each target and condition. In the participant analysis, reaction times were submitted to a 2 (Dominance: dominant vs. subordinate) × 2 (Relatedness: related vs. unrelated) within-participants analysis of variance.

The main effect of Relatedness was significant, $F_1(1, 39) = 5.45$, $MSE_1 = 1857.62$, $p_1 < .03$, and $F_2(1, 110) = 10.77$, $MSE_2 = 2009.99$, $p_2 < .00$, so reaction times to the related targets were lower than to unrelated targets. The main effect of Dominance was not significant, $F_1 < 1$ and $F_2 < 1$, that is, the reaction times to the dominant targets were not different from the reaction times to the subordinate ones. Moreover, the interaction Dominance × Relatedness was not significant, $F_1 < 1$ and $F_2(1, 110) = 1.03$, $MSE_2 = 2009.99$, $p_2 < .31$, thus, reaction times to the dominant and subordinate targets were not different in the related condition.

The analysis on proportions showed significant effect for Relatedness, $F_1(1, 39) = 4.89$, $MSE_1 = 0.004$, $p_1 < .03$, and $F_2(1, 110) = 5.32$, $MSE_2 = 0.005$, $p_2 < .02$. Error proportion was higher in the Unrelated than in the Related condition. The Dominance factor was significant in participant analysis, $F_1(1, 39) = 4.45$, $MSE_1 = 0.002$, $p_1 < .04$, but was not significant in the item analysis, $F_2(1, 110) = 1.53$, $MSE_2 = 0.007$, $p_2 < .22$. The interaction Dominance × Relatedness was not significant, $F_1(1, 39) = 1.36$, $MSE_1 = 0.001$, $p_1 < .25$, and $F_2(1, 110) < 1$.

Discussion

The results of the first experiment have shown that the semantic priming of the dominant and subordinate targets was not different. However, in their first experiment at long SOAs (750 ms), Simpson and Burgess (1985) indicated that there was semantic priming for dominant targets (26 ms) but not for subordinate targets (0 ms). Our results, nevertheless, are analogous to those of Frost and Bentin (1992), as they found equal semantic priming for dominant (14 ms) and subordinate targets (10 ms).

These data support the hypothesis that the expectancy set is built by selecting the stimuli taking into account their associative strength. In this experiment, both dominant and subordinate targets formed the expectancy set. If the expectancy set were formed by the frequency of meaning, only dominant targets should be facilitated, but this is not the case, as the semantic priming of the dominant and subordinate targets was not different.

If this hypothesis were correct, it would be possible to find similar results to those of Simpson and Burgess (1985) under the conditions in which the dominant meaning has a strong- associate set and the subordinate meaning has a weak one. Cañas (1990) has shown that the composition of the stimulus list determines the candidate words that will form the expectancy set. If a large number of pairs with strong relationship are included in the list, the expectancy set will be formed by strong associate words. On the other hand, if the experimental list includes a large number of pairs with weak relationship (as in Experiment 1a), the expectancy set will also include weak associate words (Cañas, 1990; Cañas & Bajo, 1994). Subsequently, if dominant targets have high associative strength, the expectancy set should be formed by associate words with high associative strength. As a result, these high-associate words that belong to the expectancy set will show facilitation effect, whereas weak targets will not show facilitation because they are not in the expectancy set. The next experiment was designed to test this hypothesis.

Experiment 1b

In this experiment, the dominant targets had 20% associative strength, whereas the subordinate targets had 10% (see Appendixes II and V). Under these conditions, differences must appear between the dominant and subordinate targets, due to the increment of the associative strength for a large number of pairs of the experimental list. Therefore, the expectancy set will only be formed by strong associates from the dominant meaning. Unlike the first experiment, in this second one, there should be facilitation for the dominant targets but not for the subordinate targets.

Table 3
Mean Lexical Decision Latencies (in ms) and Error Proportions for Each Target Condition in Experiment 1a

	Dominance			
	Dominant		Subordinate	
	RT	Error	RT	Error
Related	613.9	.028	621.7	.021
Unrelated	635.1	.057	632.4	.030
Priming effect	21.2*		10.7*	

Note. Error = Error Proportions.

* Significant RTs; there were no significant differences between them.

Method

Participants

A new group of participants were 40 volunteers from an Introductory Psychology course at the University of Granada (Spain). They received course credits for their participation. All were native Spanish speakers with normal or corrected-to-normal vision.

Stimuli

The stimuli for the subordinate condition were the same as in Experiment 1a. They had an associative strength mean (9.5%). A new set of associates with an associative strength mean (20.1%) was selected as dominant targets. Printed usage frequency, balance, and word length (see Table 4) were controlled as in the first experiment (see Appendix V).

Design and procedure

The design and procedure were the same as in the first experiment. The SOA is equal to that used in Experiment 1a (750 ms).

Results

Mean lexical decision latencies for correct *word* responses, along with corresponding error proportions for this second experiment are shown in Table 5.

The main effect of Relatedness was significant, $F_1(1, 39) = 13.59$, $MSE_1 = 1525.61$, $p_1 < .00$, and $F_2(1, 110) = 13.22$, $MSE_2 = 2172.87$, $p_2 < .00$. Therefore, the semantic priming effect was present. The main Dominance effect was not significant, $F_1(1, 39) < 1$, and $F_2(1, 110) < 1$. The interaction Dominance × Relatedness was significant, $F_1(1, 39) = 5.30$, $MSE_1 = 1556.36$, $p_1 < .03$, and $F_2(1, 110) = 6.43$, $MSE_2 = 2172.87$, $p_2 < .01$; that is, there were differences between dominant and subordinate targets in the Related condition. Fisher's LSD test was 17.8 ms, indicating facilitation only for the dominant meaning.

Analysis of errors showed that the main effect of Relatedness was significant, $F_1(1, 39) = 4.21$, $MSE_1 = 0.004$, $p_1 < .05$, and $F_2(1, 110) = 6.28$, $MSE_2 = 0.003$, $p_2 < .01$. The main effect of Dominance was significant in the analysis of participants, $F_1(1, 39) = 6.34$, $MSE_1 = 0.002$, $p_1 < .02$, but not by items, $F_2(1, 110) = 2.52$, $MSE_2 = 0.009$, $p_2 < .12$. The interaction Dominance × Relatedness was not significant, $F_1 < 1$ and $F_2 < 1$.

Table 4
Subjective Printed Usage Frequency, Length of Words and Associative Strength for Targets Depending on Balance and Dominance for Experiment 1b

	Balanced		Unbalanced	
	Dominant	Subordinate	Dominant	Subordinate
Dominance	55.3%	33.4%	81.1%	14.4%
PUF	2.95	2.82	3.00	2.88
Length	6.0	5.9	5.6	6.7
AS	19.1	10.6	21.0	8.3

Note. PUF = Printed Usage Frequency; Length = number of letters in a word; AS = Associative Strength.

Table 5
Mean Lexical Decision Latencies (in ms) and Error Proportions for Each Target Condition for the Experiment 1b

	Dominance			
	Dominant		Subordinate	
	RT	Error	RT	Error
Related	607.0	.041	624.3	.023
Unrelated	644.1	.062	632.7	.041
Priming effect	37.1*	8.4		

Note. Error = Error Proportions.
* = significant.

Discussion

The results of Experiment 1b have shown a similar pattern to the one obtained by Simpson and Burgess (1985) at SOA of 750 ms. There was facilitation for the dominant meaning, but not for the subordinate meaning. Our results suggest that the Simpson and Burgess (1985) data were not due to meaning frequency, but to differences in associative strength between primes and targets. These data support the views of Becker (1980) and Cañas (1990) about strategic facilitation at long SOAs. When the associative strength of the targets (dominant targets in Experiment 1b) is increased, only strong associates are included in the expectancy set; thus, they are facilitated. The weak associates (subordinate targets in Experiment 1b) are not included in the expectancy set. Therefore, they are not facilitated.

These strategic manipulations of the associative strength only have to show an effect when the SOA is long. At short SOAs, it is assumed that only automatic processes are engaged, because strategic processes are slower and they need time to develop (Posner & Snyder, 1975). Consequently, if the prime and target intervals are short, the participants will have no time to build the expectancy set, and the variable manipulations will have no effect. If the SOA is short (e.g., 250 ms), facilitation will be automatic, and the associative-strength manipulation will not alter the effect of dominance.

Experiment 2a

The associative strength was controlled in this experiment, so that dominant targets had 10.0% associative strength and subordinate targets had 9.5%, as in Experiment 1a. But the SOA utilized was 250 ms; as this is a short interval, the strategic processes should be absent.

We expect to obtain facilitation for subordinate and dominant meanings, as did Simpson and Burgess (1985) and Frost and Bentin (1992) when the SOA was short.

This experiment was identical to Experiment 1a, except for the SOA , which was lower (250 ms).

Method

Participants

A new group of participants were 40 volunteers from an Introductory Psychology course at the University of Granada (Spain). They received course credits for their participation. All were native Spanish speakers with normal or corrected-to-normal vision.

Stimuli

The stimuli were the same as in Experiment 1a.

Design and procedure

The design and procedure were identical to the ones of Experiment 1a, except for the SOA, which was 250 ms.

Results

Mean lexical decision latencies for correct *word* responses, along with corresponding error proportions for this third experiment are shown in Table 6.

The main effect of Relatedness was significant, $F_1(1, 39) = 20.42$, $MSE_1 = 2731.01$, $p_1 < .00$, and $F_2(1, 110) = 38.68$, $MSE_2 = 2150.64$, $p_2 < .00$. However, the Dominance main effect was nonsignificant, $F_1 < 1$ and $F_2 < 1$. The interaction Dominance x Relatedness was significant ,$F_1(1, 39) = 5.35$, $MSE_1 = 1565.21$, $p_1 < .03$, and $F_2(1, 110) = 5.14$, $MSE_2 = 2150.64$, $p_2 < .03$. Fisher's LSD test was 17.9 ms.

Analysis of errors showed that the main effect of Relatedness was nonsignificant, $F_1 < 1$ and $F_2 < 1$, as was the main effect of Dominance, $F_1 < 1$and $F_2 < 1$, and the interaction Dominance × Relatedness, $F_1(1, 39) = 2.64$, $MSE_1 = 0.001$, $p_1 < .11$, and $F_2(1, 110) = 1.72$, $MSE_2 = 0.003$, $p_2 < .19$.

Table 6
Mean Lexical Decision Latencies (in ms) and Error Proportions for Each Target Condition in Experiment 2a

	Dominance			
	Dominant		Subordinate	
	RT	Error	RT	Error
Related	624.5	.026	641.9	.030
Unrelated	676.3	.032	664.7	.018
Priming effect	51.8*	22.8*		

Note. Error = Error Proportions.
* Significant RTs; there were significant differences between them.

Discussion

The results of this experiment showed that both dominant and subordinate meanings were facilitated at short SOAs (250 ms), making them available for processing. The dominant targets were facilitated more than the subordinate targets. The dominant meaning seemed to receive more automatic activation than the subordinate meaning. In Experiment 1a, the dominant meaning did not have more facilitation than the subordinate targets; however in Experiment 2a, the dominant meaning had more facilitation at short SOAs (250 ms). Simpson and Burgess (1985, Experiment 1) and Frost and Bentin (1992, Experiments 3a and 3b) reached the same conclusion: Both dominant and subordinate targets had significant facilitation at short SOAs (100 ms).

One of the main purposes of the following experiment was to determine the degree to which the processing of ambiguous word meanings might be under the participant's strategic o automatic control. Experiments 1a and 1b showed that facilitation took place under associative strength control at long SOAs. At short SOAs, the expectancy set had no time in which to be formed, and therefore, facilitation will be the same in spite of the associative strength manipulation. In Experiment 2a, at short SOAs (250 ms), we found more facilitation for the dominant meaning than the subordinate one, with equal associative strength for both. As a consequence, if we manipulate the associative strength between dominant and subordinate targets at short SOAs (250 ms), we will obtain the same result as in Experiment 2a, because the expectancy set will not have time in which to be built. At short SOAs, facilitation is due to the spreading activation; as this is an automatic process, it will not be affected by the associative strength manipulations.

In short, if we increase the associative strength to 20% for the dominant targets and to 10% for the subordinate ones, at short SOAs, we should obtain the same results as in Experiment 2a.

Experiment 2b

The main goal of this experiment is to determine whether the associative strength manipulation affects facilitation at short SOAs. The expectancy model states that, at short SOAs, the participants do not have time to build the expectancy set; therefore, facilitation is only due to automatic processes. These automatic processes will not be affected by manipulations of the associative strength; so in this experiment, the associative strength of dominant targets was changed to 20% and that of the subordinate targets to 10%. We expect the same results as in Experiment 2a.

Method

Participants

A new group of participants were 40 volunteers from an Introductory Psychology course at the University of Granada (Spain). They received course credits for their participation. All were native Spanish speakers with normal or corrected-to-normal vision.

Stimuli

The stimuli were the same as in Experiment 1b.

Design and procedure

The design and procedure were as in Experiment 1b, except for the SOA, which was 250 ms.

Results

Mean lexical decision latencies for correct *word* responses, along with corresponding error proportions for this experiment are shown in Table 7.

Table 7
Mean Lexical Decision Latencies (in ms) and Error Proportions for Each Target Condition in Experiment 2b

	Dominance			
	Dominant		Subordinate	
	RT	Error	RT	Error
Related	601.4	.032	616.3	.039
Unrelated	643.2	.053	637.3	.048
Priming effect	41.8*		21.0*	

Note. Error = Error Proportions.
* Significant RTs; there were significant differences between them.

The main effect of Relatedness was significant, $F_1(1, 39) = 21.11$, $MSE_1 = 1867.77$, $p_1 < .00$, and $F_2(1, 110) = 23.99$, $MSE_2 = 2638.5$, $p_2 < .00$. However, the Dominance main effect was nonsignificant, $F_1 < 1$ and $F_2 < 1$. The interaction Dominance × Relatedness was marginally significant, $F_1(1, 39) = 2.69$, $MSE_1 = 1605.09$, $p_1 < .11$, and significant by items, $F_2(1, 110) = 3.79$, $MSE_2 = 2638.50$, $p_2 < .05$. Fisher's LSD test was 19.4 ms.

Analysis of errors showed that the main effect of Relatedness was marginally significant, $F_1(1, 39) = 3.40$, $MSE_1 = 0.003$, $p_1 < .07$, and $F_2(1, 110) = 2.68$, $MSE_2 = 0.005$, $p_2 < .11$. The main effect of Dominance was not significant, $F_1 < 1$ and $F_2 < 1$, nor was the interaction Dominance x Relatedness, $F_1 < 1$ and $F_2 < 1$.

Discussion

The results of this experiment showed that, at short SOAs (250 ms), facilitation effects appeared for both meanings, although the dominant meaning was facilitated more than the subordinate one. These results reveal the same patterns as in Experiment 2a, even with the associative strength manipulation. We can assert that meaning frequency, or dominance, is a variable that seems to affect the automatic processes, whereas associative strength is related to the strategic processes.

General Discussion

We were interested in meaning resolution when ambiguous words are presented isolatedly. In the case of lexical ambiguity, there are two ways to generate the expectancy set. On the one hand, the expectancy set could be built by selecting one meaning, the dominant or the subordinate, and including congruent candidates in that selected meaning. If one of the meanings has been selected (e.g., dominant) to build the expectancy set, no matter what words are related with this meaning, they will be facilitated, regardless of the associative strength of each word with the prime. On the other hand, the expectancy set could be built by selecting particular candidates by the associative strength between the prime and the target, which can belong to the dominant or subordinate meaning. In this case, there are many prime and target pairs with a weak associative strength, so the expectancy set will probably include all the related words (weak and strong). Therefore, it will include candidate words related to dominant and subordinate meanings. The results of Experiments 1a and 1b support this last hypothesis, that is, the expectancy set is built by selecting particular candidates by the associative strength between the prime and target for homographs. Experiments 2a and 2b suggest that the associative strength manipulation had no effect at short SOAs.

The Simpson and Burgess (1985) results showed that the dominant meaning was activated and selected at long SOAs, whereas the subordinate meaning was not facilitated. Frost and Bentin (1992), on the other hand, showed that both meanings were facilitated at long SOAs, arguing that there were language-specific components involved. The results of Experiments 1a and 1b showed that this explanation was wrong, and the results could be better explained if we assumed that ambiguous word recognition behaves the same as ordinary word recognition. Both studies, Simpson and Burgess (1985) and Frost and Bentin (1992), seemed to be different regarding associative strength between associates. Whereas the associative strength between primes and targets was not controlled in Simpson and Burgess' (1985) study, in Frost and Bentin's (1992) study, it was. So, in Experiment 1a, at long SOAs (750 ms), we controlled the associative strength between dominant and subordinate targets and found that the expectancy set was formed by selecting particular candidates by their associative strength. Both dominant and subordinate targets were facilitated, and there were no differences between them.

When we manipulated the associative strength, as in Experiment 1b, targets with higher associative strength (dominant meaning) had higher facilitation. That is, the dominant meaning had an associative strength of 20%, and the subordinate had 10%. The expectancy theory states that under these conditions, the expectancy set will be formed by the targets with the highest associative strength. In short, the associative strength composition of the stimulus list at long SOAs determines which targets will be included in the expectancy set. Only targets included in the expectancy set will be facilitated.

The results of the first two experiments showed that facilitation at long SOAs was due to the associative strength of the associates, whereas in Experiments 2a and 2b, at short SOAs (250 ms), the associative strength manipulation of the list had no effect on facilitation. The results of Experiments 2a and 2b were the same: Experiment 2a had equal associative strength for dominant and subordinate, and Experiment 2b had 20% of associative strength for dominant targets and 10% for subordinate targets. These two experiments had the same result pattern, that is, both meanings were facilitated.

The results of these experiments support the idea that the automatic and strategic processes could explain facilitation effects on lexical decision tasks (Neely, 1977, 1991). At short SOAs, the spreading activation theories can explain more semantic priming effects than the expectancy theories (Neely, 1991). These theories assume that the semantic memory is organized by a net in which the related concepts are nearer than the unrelated. When a word (prime) is presented, its node is activated and spreads through the net, activating the nearest nodes to some extent. When a target is presented, its node has already been activated, thereby facilitation is produced. The manipulations of the associative strength on the list have no effect on facilitation because only the automatic processes are engaged at short

SOAs. Experiments 2a and 2b show that this manipulation has no effect on semantic priming at short SOAs.

Neely (1991) showed that spreading activation theories cannot explain the "list-context effects," as in Experiments 1a and 1b. Semantic facilitation at long SOAs (e.g., 750 ms) is better explained by the expectancy theories (Becker, 1980; Neely, 1991). These theories assume that the participant uses the prime to form the expectancy set, which includes the potential stimuli related with the prime. Only the stimuli in the expectancy set are facilitated. The composition of the stimulus list can modify the expectancy set. If the list has strong associates, the expectancy set will only include strong associates, but if it has many weak associates, the expectancy set will include all types (strong and weak) of associates (Cañas, 1990; Cañas & Bajo, 1994). The results of Experiments 1a and 1b showed this effect. In Experiment 1b, the stimulus list had strong associates (20%) and the expectancy set included only these strong associates (dominant meaning). In the first experiment, the list had only weak associates, therefore, the expectancy set was built with all of them. Both dominant and subordinate targets were facilitated. These selections were established taking into account the associative strength of the candidates and not the meaning frequency. If the associative strength were not controlled (Burgess & Simpson, 1988; Simpson & Burgess, 1985), there would be differences in facilitation between dominant and subordinate targets. However, expectancy theories cannot explain the result of Experiments 2a and 2b, as pointed out by Neely (1991).

On the one hand, it is assumed that processing is automatic at short SOAs; therefore, activation spreads without the control of the participant and it is fast. On the other hand, it is assumed that processing at long SOAs is under the participant's control and it is slow (it needs time to build the expectancy set).

As a conclusion, we can point out that on the one hand, semantic priming for homographs is due to associative strength manipulations at long SOAs. On the other hand, the manipulation of the associative strength has no effect when automatic processes (short SOAs) are engaged.

References

Anderson, J.R. (1976). *Language, memory, and thought*. Hillsdale, NJ: Erlbaum.

Anderson, J.R. (1983). *The architecture of cognition*. Cambridge, MA: Harvard University Press.

Becker, C.A. (1980). Semantic context effects in visual word recognition: An analysis of semantic strategies. *Memory and Cognition. 8,* 493-512.

Becker C.A. (1985). What do we really know about semantic context effects during reading? In D. Besner, T.G. Waller, & E.M. Mackinnon (Eds.), *Reading research: Advances in theory and practice,* Vol. 5 (pp. 126-166). Toronto: Academic Press.

Cañas, J J. (1990). Associative strength effects in the lexical decision task. *The Quarterly Journal of Experimental Psychology, 42A,* 121-145.

Cañas, J.J., & Bajo, M.T. (1994). Strategic associative priming in the lexical decision task. *The Quarterly Journal of Experimental Psychology. 47A,* 383-405.

Chiarello, C., Burgess, C. Richards, L., & Pollock, A. (1990). Semantic and associative priming in the cerebral hemispheres: Some words do, some words don't... sometimes, some places. *Brain and Language, 38,* 75-104.

Collins, A.M., & Loftus, E.F. (1975). A spreading-activation theory of semantic processing. *Psychological Review, 82,* 407-428.

Collins, A.M., & Quillian, M.R. (1969). Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behaviour, 8,* 240-247.

Conrad, C. (1974). Context effects in sentence comprehension: A study of the subjective lexicon. *Memory and Cognition, 2,* 130-138.

Coolen, R., Jaarsveld, H.J., & Schreuder, R. (1993). Processing novel compounds: Evidence for interactive meaning activation of ambiguous nouns. *Memory and Cognition, 21,* 235-246.

De Groot, A.M.B., Thomassen, A.J.W.M., & Hudson, P.T.W. (1982). Associative facilitation of word recognition as measured from a neutral prime. *Memory and Cognition, 10,* 358-370.

Dlhopolsky, J.G. (1989). Synchronizing stimulus displays with millisecond timer software for the IBM PC. *Behavior Research Methods, Instruments and Computers. 21, 4,* 441-446.

Fischler, I. (1977). Semantic facilitation without association in a lexical decision task. *Memory and Cognition, 5,* 335-339.

Frost, R., & Bentin, S. (1992). Processing phonological and semantic ambiguity: Evidence from semantics priming at different SOAs. *Journal of Experimental Psychology: Learning, Memory and Cognition, 18,* 58-68.

Glucksberg, S., Kreuz, R.J., & Rho, S.H. (1986). Context can constrain lexical access: Implications for models of language comprehension. *Journal of Experimental Psychology: Learning, Memory and Cognition, 12,* 323-335.

Gordon, B. (1985). Subjective frequency and the lexical decision latency function: Implications for mechanisms of lexical access. *Journal of Memory and Language, 24,* 631-645.

Holley-Wilcox, P., & Blank, M.A. (1980). Evidence for multiple access in the processing of isolated words. *Journal of Experimental Psychology: Human Perception and Performance, 6,* 75-84.

Kinoshita, S. (1985). Sentence context effects on lexically ambiguous words: Evidence for a post access inhibition process. *Memory and Cognition, 13,* 579-595.

Kintsch, W., & Mross, E.F. (1985). Context effects in word identification. *Journal of Memory and Language, 24,* 336-349.

Love, T., & Swinney, D. (1996). Coreference processing and levels of analysis in object-relative constructions: Demonstration of antecedent reactivation with the cross-modal priming paradigm. *Journal of Psycholinguistic Research,* 25, 5-24.

Lucas, M.M. (1987). Frequency effects of the processing of ambiguous words in sentence context. *Language and Speech, 30,* 25-46

Lupker, S.J. (1984). Semantic priming without association: A second look. *Journal of Verbal Learning and Verbal Behavior, 23,* 709-733.

Mackay, D.G. (1987). *The organization of perception and action: A theory for language and other cognitive skills*. New York: Springer-Verlag.

MacKay, D.G. (1990). Perception, action and awareness: A three-body problem. In O. Newmann & W. Prinz (Eds.), *Relationships between perception and action* (pp 269-304). Berlin: Springer-Verlag.

McClelland, J.L., & Rumelhart, D.E. (1981). An interactive activation model of context effects in letter perception: 1. An account of basic findings. *Psychological Review, 88,* 375-407.

Neely, J.H. (1977). Semantic priming and retrieval from lexical memory: Roles of inhibitionless spreading activation and limited-capacity attention. *Journal of Experimental Psychology: General, 106,* 226-254.

Neely, J.H. (1991). Semantic priming effects in visual word recognition: A selective review of current findings and theories. In D. Besner & G.W. Humphreys (Eds.), *Basic processes in reading, visual word recognition* (pp. 264-336). Hillsdale, NJ: Erlbaum.

Nievas, F., & Cañas, J.J. (1993). Asociados de una base de homógrafos. *Psicológica, 14,* 269-279.

Nievas, F., & Justicia, F. (2003). Development of memory structures for homographs using Pathfinder network representations. *The Spanish Journal of Psychology, 6,* 12-27.

Nievas, F., & Justicia, F. (2004). A cross-sectional study about meaning access processes for homographs. *Cognitive Development, 19,* 95-109.

Nievas, F., & Marí-Beffa, P. (2002). Negative priming from the non-selected meaning of the homograph. *British Journal of Psychology, 93,* 47-66.

Onifer, W., & Swinney, D. A. (1981). Accessing lexical ambiguities during sentence comprehension: Effects of frequency of meaning and contextual bias. *Memory and Cognition, 9,* 225-236.

Paul, S.T., Kellas, G., Martin, M., & Clark, M.B. (1992). The influence of contextual features on the activation of ambiguous word meanings. *Journal of Experimental Psychology: Learning, Memory and Cognition, 18,* 703-717.

Perea, M., & Rosa, E. (2002). The effects of associative and semantic priming in the lexical decision task. *Psychological Research, 66,* 180-194.

Posner, M.I., & Snyder, C.R.R. (1975). Attention and cognitive control. In R.L. Solso (Ed.), *Information processing and cognition: The Loyola Symposium*. Hillsdale, NJ: Erlbaum.

Schvaneveldt, R.W., Meyer, D.E., & Becker, C.A. (1976). Lexical ambiguity, semantic context and visual word recognition. *Journal of Experimental Psychology: Human Perception and Performance. 2,* 243-256.

Seidenberg, M.S., Tanenhaus, M.K., Leiman, J.M., & Bienkowski, M. (1982). Automatic access of the meanings of ambiguous words in context: Some limitations of knowledge-based processing. *Cognitive Psychology, 14,* 489-537.

Simpson, G.B. (1981). Meaning dominance and semantic context in the processing of lexical ambiguity. *Journal of Verbal Learning and Verbal Behavior, 20,* 120-136.

Simpson, G.B., & Burgess, C. (1985). Activation and selection processes in the recognition of ambiguous words. *Journal of Experimental Psychology: Human Perception and Performance, 22,* 147-154.

Simpson, G.B., & Foster, M.R. (1986). Lexical ambiguity and children's word recognition. *Developmental Psychology, 22,* 147-154.

Simpson, G.B., & Krueger, M.A. (1991). Selective access of homograph meanings in sentence context. *Journal of Memory and Language, 30,* 627-643.

Simpson, G.B., Krueger, M.A. Kang, H., & Elofson, A.C. (1994). Sentence context and meaning frequency effects in children's processing of ambiguous words. *Journal of Research in Reading, 17,* 62-72.

Swinney, D.A. (1979). Lexical Access during sentence comprehension: (Re)consideration of context effects. *Journal of Verbal Learning and Verbal Behavior, 18,* 645-659.

Tabossi, P. (1988). Accessing lexical ambiguity in different types of sentential context. *Journal of Memory and Language, 27,* 324-340.

Tanenhaus, M.K., Leiman, J.M., & Seidenberg, M.S. (1979). Evidence for multiple stages in the processing of ambiguous words in syntactic contexts. *Journal of Verbal Learning and Verbal Behavior, 18,* 427-440.

Van Petten, C., & Kutas, M. (1987). Ambiguous words in context: An event-related potential analysis of the time course of meaning activation. *Journal of Memory and Language, 26,* 188-208.

Received January 27, 2004
Revision received March 11, 2005
Accepted March 31, 2005

Appendix I

Balanced and unbalanced homograph words with their dominant and subordinate associates. Both dominant and subordinate associates have similar associative strength (10%), as in Experiments 1a and 2a.

UNBALANCED HOMOGRAPH	DOMINANT ASSOCIATE	SUBORDINATE ASSOCIATE	BALANCED HOMOGRAPH	DOMINANT ASSOCIATE	SUBORDINATE ASSOCIATE
presente	ahora	regalo	apéndice	índice	dolor
llama	calor	animal	mango	asa	fruta
gota	grifo	enfermedad	especular	bolsa	hablar
ganado	animales	perdido	tocar	guitarra	palpar
gemelos	niños	camisa	grano	espinilla	trigo
parte	porción	médico	bote	lata	barco
pendiente	adorno	asignatura	ante	piel	delante
pila	energía	lavar	cardenal	cura	morado
solitario	triste	cartas	mama	papa	pecho
tanque	cañón	agua	pasaje	avión	libro
trompa	agua	borrachera	cola	pegar	rabo
tienda	comestibles	campaña	importar	traer	interesar
voto	elecciones	castidad	parábola	curva	Jesucristo
mina	minero	lápiz	reparo	vergüenza	arreglo
portero	casa	fútbol	término	palabra	fin
sirena	pez	ambulancia	régimen	dieta	dictadura
quinto	número	cerveza	raso	vestido	cielo
soplo	aire	corazón	rollo	aburrido	lío
frente	cara	guerra	segundo	tercero	minuto
yema	clara	dedo	abonar	dar	campo
acarrear	carro	problema	farol	calle	mentira
batería	música	cocina	salero	comida	gracia
botín	tesoro	zapato	metro	centímetro	tren
curiosidad	cotilla	gato	objetivo	meta	subjetivo
medio	entero	ambiente	mate	color	ajedrez
apuntar	anotar	señalar	sierra	nieve	cortar
virgen	santo	mujer	piquete	manifestación	sangre
asta	cuerno	bandera	real	verdadero	rey

Appendix II

Balanced and unbalanced homograph words with their dominant and subordinate associates. Associative strength is 20% for dominant associates and 10% for subordinate associates as in Experiments 1b and 2b.

UNBALANCED HOMOGRAPH	DOMINANT ASSOCIATE	SUBORDINATE ASSOCIATE	BALANCED HOMOGRAPH	DOMINANT ASSOCIATE	SUBORDINATE ASSOCIATE
presente	pasado	regalo	apéndice	libro	dolor
llama	fuego	animal	mango	sartén	fruta
gota	lluvia	enfermedad	especular	bolsa	hablar
ganado	vaca	perdido	tocar	guitarra	palpar
gemelos	iguales	camisa	grano	espinilla	trigo
parte	trozo	médico	bote	lata	barco
pendiente	adorno	asignatura	ante	piel	delante
pila	radio	lavar	cardenal	iglesia	morado
solitario	solo	cartas	mama	papa	pecho
tanque	cañón	agua	pasaje	avión	libro
trompa	agua	borrachera	cola	pegamento	rabo
tienda	ropa	campaña	importar	exportar	interesar
voto	elecciones	castidad	parábola	curva	Jesucristo
mina	carbón	lápiz	reparo	vergüenza	arreglo
portero	casa	futbol	término	palabra	fin
sirena	mar	ambulancia	régimen	dieta	dictadura
quinto	sexto	cerveza	raso	tela	cielo
soplo	viento	corazón	rollo	aburrido	lío
frente	cabeza	guerra	segundo	primero	minuto
yema	clara	dedo	abonar	pagar	campo
acarrear	llevar	problema	farol	luz	mentira
batería	música	cocina	salero	sal	gracia
botín	tesoro	zapato	metro	centímetro	tren
curiosidad	cotilla	gato	objetivo	meta	subjetivo
medio	mitad	ambiente	mate	brillo	ajedrez
apuntar	anotar	señalar	sierra	nieve	cortar
virgen	religión	mujer	piquete	huelga	sangre
asta	cuerno	bandera	real	verdadero	rey

Appendix III

This is an example of how to build the four lists from homographs and their associates.

UNBALANCED HOMOGRAPH	DOMINANT ASSOCIATE	SUBORDINATE ASSOCIATE
apéndice	índice	dolor
mango	asa	fruta
especular	bolsa	hablar
tocar	guitarra	palpar

Condition	List 1	List 2	List 3	List 4
	Prime-Target	Prime-Target	Prime-Target	Prime-Target
D-R	apéndice-índice	mango-asa	especular-bolsa	tocar-guitarra
S-R	mango-fruta	apéndice-dolor	tocar-palpar	especular-hablar
D-U	especular-guitarra	tocar-bolsa	apéndice-asa	mango-índice
S-U	tocar-hablar	especular-palpar	mango-dolor	apéndice-fruta

Note. D = Dominant; S = Subordinate; R = Related; U = Unrelated.

Appendix IV

Prime-target pairs in word-word trials for Experiments 1a and 2a. Dominance (D = 1 dominant target, D = 0 subordinate target); Balance (B = 1 unbalanced meaning, B = 0 balanced meaning); Letter length of the target (LL); Subjective printed usage frequency of the target (SPUF); Associative strength between prime and the target (AS); Meaning frequency in percentage (MF).

Prime-target	D	B	LL	SPUF	AS	MF
LIST 1						
presente-ahora	1	1	5	3.33	17.7	91.2
gemelos-niños	1	1	5	3.46	5.9	82.3
solitario-triste	1	1	6	2.97	6.9	82.4
voto-elecciones	1	1	10	2.82	19.6	83.3
quinto-número	1	1	6	3.15	8.8	71.6
acarrear-carro	1	1	5	2.28	10.8	78.4
medio-entero	1	1	6	2.86	14.7	76.5
LIST 2						
llama-calor	1	1	5	3.03	6.9	90.2
parte-porción	1	1	7	2.66	5.9	87.3
tanque-cañón	1	1	5	2.46	2.0	86.3
mina-minero	1	1	6	2.22	3.9	80.4
soplo-aire	1	1	4	3.09	28.4	76.5
bateria-música	1	1	6	3.09	14.7	70.6
apuntar-anotar	1	1	6	2.74	12.8	72.6
LIST 3						
gota-grifo	1	1	5	2.53	4.9	92.2
pendiente-adorno	1	1	6	2.28	5.9	83.3
trompa-agua	1	1	4	3.43	9.8	84.3
portero-casa	1	1	4	3.45	10.8	84.3
frente-cara	1	1	4	3.00	13.7	74.5
botín-tesoro	1	1	6	2.72	13.7	79.4
virgen-santo	1	1	5	2.43	9.8	74.5
LIST 4						
ganado-animales	1	1	8	3.35	8.8	87.3
pila-energía	1	1	7	2.95	4.9	84.3
tienda-comestibles	1	1	11	2.52	3.9	88.2
sirena-pez	1	1	3	2.74	7.8	79.4
yema-clara	1	1	5	2.59	2.0	84.3
curiosidad-cotilla	1	1	7	1.94	10.8	75.5
asta-cuerno	1	1	6	2.29	13.7	70.6
Mean			**5.8**	**2.80**	**10.0**	**81.1**

Prime-target	D	B	LL	SPUF	AS	MF
LIST 1						
apéndice-índice	1	0	6	2.72	5.9	48.0
grano-espinilla	1	0	9	2.22	13.7	46.1
mama-papa	1	0	4	2.67	20.6	53.9
parábola-curva	1	0	5	2.73	9.8	60.8
raso-vestido	1	0	7	2.95	5.9	52.9
farol-calle	1	0	4	3.18	3.9	68.6
mate-color	1	0	5	3.19	10.8	58.8
LIST 2						
mango-asa	1	0	3	2.22	4.9	37.3
bote-lata	1	0	4	2.51	13.7	56.8
pasaje-avión	1	0	5	2.99	6.9	42.2
reparo-vergüenza	1	0	9	2.71	15.7	56.9
rollo-aburrido	1	0	8	2.63	8.8	41.2
salero-comida	1	0	6	3.08	5.9	65.7
sierra-nieve	1	0	5	2.77	14.7	64.7
LIST 3						
especular-bolsa	1	0	5	2.66	7.8	47.1
ante-piel	1	0	4	2.97	18.6	52.9
cola-pegar	1	0	5	2.60	8.8	38.2
término-palabra	1	0	7	3.52	22.6	55.9
segundo-tercero	1	0	7	2.87	3.9	60.8
metro-centímetro	1	0	10	2.63	8.8	64.7
piquete-manifestación	1	0	13	2.61	3.9	64.7
LIST 4						
tocar-guitarra	1	0	8	2.56	9.8	41.2
cardenal-cura	1	0	4	2.69	6.9	62.8
importar-traer	1	0	5	2.94	10.8	61.8
régimen-dieta	1	0	5	2.61	9.8	62.8
abonar-dar	1	0	3	3.20	6.9	69.3
objetivo-meta	1	0	4	2.89	10.8	55.9
real-verdadero	1	0	9	3.05	8.8	56.9
Mean			**6.0**	**2.80**	**10.0**	**55.3**

Prime-target	D	B	LL	SPUF	AS	MF
LIST 1						
llama-animal	0	1	6	3.36	4.9	5.9
parte-médico	0	1	6	3.18	5.9	11.8
tanque-agua	0	1	4	3.15	7.8	9.8
mina-lápiz	0	1	5	2.74	10.8	13.7
soplo-corazón	0	1	7	3.09	11.8	14.7
batería-cocina	0	1	6	2.81	15.7	17.7
apuntar-señalar	0	1	7	2.97	10.8	26.5
LIST 2						
presente-regalo	0	1	6	2.73	8.8	8.8
gemelos-camisa	0	1	6	2.77	4.9	11.8
solitario-cartas	0	1	6	2.73	6.9	11.8
voto-castidad	0	1	8	2.11	6.9	11.8
quinto-cerveza	0	1	7	2.60	7.8	10.8
acarrear-problema	0	1	8	3.06	8.8	21.6
medio-ambiente	0	1	8	3.19	7.8	17.7
LIST 3						
ganado-perdido	0	1	7	2.82	4.9	12.8
pila-lavar	0	1	5	2.88	5.9	9.8
tienda-campaña	0	1	7	2.68	5.9	11.8
sirena-ambulancia	0	1	10	2.58	6.9	17.7
yema-dedo	0	1	4	2.89	13.7	15.7
curiosidad-gato	0	1	4	2.99	9.8	20.6
asta-bandera	0	1	7	2.70	7.8	24.5
LIST 4						
gota-enfermedad	0	1	10	3.21	4.9	7.8
pendiente-asignatura	0	1	10	2.82	6.9	9.8
trompa-borrachera	0	1	10	2.38	8.8	10.8
portero-fútbol	0	1	6	2.51	8.8	15.7
frente-guerra	0	1	6	3.24	7.8	7.8
botín-zapato	0	1	6	2.90	13.7	19.6
virgen-mujer	0	1	5	3.58	7.8	25.5
Mean			**6.7**	**2.88**	**8.3**	**14.4**

Prime-target	D	B	LL	SPUF	AS	MF
LIST 1						
mango-fruta	0	0	5	3.10	25.5	34.3
bote-barco	0	0	5	2.97	11.8	35.3
pasaje-libro	0	0	5	3.44	5.9	26.5
reparo-arreglo	0	0	7	2.42	8.8	32.4
rollo-lío	0	0	3	2.32	6.9	12.8
salero-gracia	0	0	6	2.46	14.7	34.3
sierra-cortar	0	0	6	2.94	7.8	34.3
LIST 2						
apéndice-dolor	0	0	5	3.02	9.8	48.0
grano-trigo	0	0	5	2.50	13.7	43.1
mama-pecho	0	0	5	2.65	17.7	43.1
parábola-Jesucristo	0	0	10	3.16	8.8	32.4
raso-cielo	0	0	5	2.99	9.8	29.4
farol-mentira	0	0	7	2.85	8.8	31.4
mate-ajedrez	0	0	7	2.40	11.8	25.5
LIST 3						
tocar-palpar	0	0	6	2.16	9.8	38.2
cardenal-morado	0	0	6	2.23	12.8	36.3
importar-interesar	0	0	9	3.03	9.8	36.3
régimen-dictadura	0	0	9	2.86	9.8	35.3
abonar-campo	0	0	5	3.05	7.9	30.7
objetivo-subjetivo	0	0	9	2.77	12.8	25.5
real-rey	0	0	3	2.86	7.8	21.6
LIST 4						
especular-hablar	0	0	6	3.27	6.9	44.1
ante-delante	0	0	7	3.07	6.9	43.1
cola-rabo	0	0	4	2.15	8.8	20.6
término-fin	0	0	3	3.12	14.7	39.2
segundo-minuto	0	0	6	3.15	14.7	35.3
metro-tren	0	0	4	2.92	6.9	34.3
piquete-sangre	0	0	6	3.13	4.9	31.4
Mean			**5.9**	**2.82**	**10.6**	**33.4**

Appendix V

Prime-target pairs in word-word trials for Experiments 1b and 2b. Dominance (D = 1 dominant target, D = 0 subordinate target); Balance (B = 1 unbalanced meaning, B = 0 balanced meaning); Letter length of the target (LL); Subjective printed usage frequency of the target (SPUF); Associative strength between prime and the target (AS); Meaning frequency in percentage (MF).

Prime-target	D	B	LL	SPUF	AS	MF	Prime-target	D	B	LL	SPUF	AS	MF
LIST 1							**LIST 1**						
presente-pasado	1	1	6	3.29	20.6	91.2	apéndice-libro	1	0	5	3.62	30.4	48.0
gemelos-iguales	1	1	7	3.14	25.5	82.3	grano-espinilla	1	0	9	2.53	13.7	46.1
solitario-solo	1	1	4	3.21	9.8	82.4	mama-papa	1	0	4	3.38	29.6	53.9
voto-elecciones	1	1	10	3.46	19.6	83.3	parábola-curva	1	0	5	2.73	9.8	60.8
quinto-sexto	1	1	5	2.48	15.7	71.6	raso-tela	1	0	4	2.88	21.6	52.9
acarrear-llevar	1	1	6	3.41	36.3	78.4	farol-luz	1	0	3	3.39	46.1	68.6
medio-mitad	1	1	5	3.20	32.4	76.5	mate-brillo	1	0	5	2.42	19.6	58.8
LIST 2							**LIST 2**						
llama-fuego	1	1	5	3.14	61.8	90.2	mango-sartén	1	0	6	2.61	14.7	37.3
parte-trozo	1	1	5	2.94	28.4	87.3	bote-lata	1	0	4	2.63	13.7	56.8
tanque-cañón	1	1	5	2.46	2.0	86.3	pasaje-avión	1	0	5	2.99	6.9	42.2
mina-carbón	1	1	6	2.57	26.5	80.4	reparo-vergüenza	1	0	9	3.19	15.7	56.9
soplo-viento	1	1	6	3.17	32.4	76.5	rollo-aburrido	1	0	8	2.96	8.8	41.2
bateria-música	1	1	6	3.27	14.7	70.6	salero-sal	1	0	3	2.94	28.4	65.7
apuntar-anotar	1	1	6	2.74	12.8	72.6	sierra-nieve	1	0	5	2.77	14.7	64.7
LIST 3							**LIST 3**						
gota-lluvia	1	1	6	3.37	17.7	92.2	especular-bolsa	1	0	5	3.09	7.8	47.1
pendiente-adorno	1	1	6	2.28	5.9	83.3	ante-piel	1	0	4	3.00	18.6	52.9
trompa-agua	1	1	4	3.43	9.8	84.3	cola-pegamento	1	0	9	2.63	19.6	38.2
portero-casa	1	1	4	3.60	10.8	84.3	término-palabra	1	0	7	3.54	22.6	55.9
frente-cabeza	1	1	6	3.25	37.3	74.5	segundo-primero	1	0	7	3.52	31.4	60.8
botín-tesoro	1	1	6	2.72	13.7	79.4	metro-centímetro	1	0	10	2.63	8.8	64.7
virgen-religión	1	1	8	2.93	10.8	74.5	piquete-huelga	1	0	6	3.01	34.3	64.7
LIST 4							**LIST 4**						
ganado-vaca	1	1	4	2.74	34.3	87.3	tocar-guitarra	1	0	8	2.56	9.8	41.2
pila-radio	1	1	5	3.19	23.5	84.3	cardenal-iglesia	1	0	7	3.07	30.4	62.8
tienda-roopa	1	1	4	3.27	27.5	88.2	importar-exportar	1	0	8	2.55	18.6	61.8
sirena-mar	1	1	3	3.38	27.5	79.4	régimen-dieta	1	0	5	2.61	9.8	62.8
yema-clara	1	1	5	2.59	2.0	84.3	abonar-pagar	1	0	5	3.38	30.7	69.3
curiosidad-cotilla	1	1	7	2.59	10.8	75.5	objetivo-meta	1	0	4	2.80	10.8	55.9
asta-cuerno	1	1	6	2.29	13.7	70.6	real-verdadero	1	0	9	3.28	8.8	56.9
Mean			**5.6**	**3.00**	**21.0**	**81.1**	**Mean**			**6.0**	**2.95**	**19.1**	**55.3**

Prime-target	D	B	LL	SPUF	AS	MF
LIST 1						
llama-animal	0	1	6	3.36	4.9	5.9
parte-médico	0	1	6	3.18	5.9	11.8
tanque-agua	0	1	4	3.15	7.8	9.8
mina-lápiz	0	1	5	2.74	10.8	13.7
soplo-corazón	0	1	7	3.09	11.8	14.7
batería-cocina	0	1	6	2.81	15.7	17.7
apuntar-señalar	0	1	7	2.97	10.8	26.5
LIST 2						
presente-regalo	0	1	6	2.73	8.8	8.8
gemelos-camisa	0	1	6	2.77	4.9	11.8
solitario-cartas	0	1	6	2.73	6.9	11.8
voto-castidad	0	1	8	2.11	6.9	11.8
quinto-cerveza	0	1	7	2.60	7.8	10.8
acarrear-problema	0	1	8	3.06	8.8	21.6
medio-ambiente	0	1	8	3.19	7.8	17.7
LIST 3						
ganado-perdido	0	1	7	2.82	4.9	12.8
pila-lavar	0	1	5	2.88	5.9	9.8
tienda-campaña	0	1	7	2.68	5.9	11.8
sirena-ambulancia	0	1	10	2.58	6.9	17.7
yema-dedo	0	1	4	2.89	13.7	15.7
curiosidad-gato	0	1	4	2.99	9.8	20.6
asta-bandera	0	1	7	2.70	7.8	24.5
LIST 4						
gota-enfermedad	0	1	10	3.21	4.9	7.8
pendiente-asignatura	0	1	10	2.82	6.9	9.8
trompa-borrachera	0	1	10	2.38	8.8	10.8
portero-fútbol	0	1	6	2.51	8.8	15.7
frente-guerra	0	1	6	3.24	7.8	7.8
botín-zapato	0	1	6	2.90	13.7	19.6
virgen-mujer	0	1	5	3.58	7.8	25.5
Mean			**6.7**	**2.88**	**8.3**	**14.4**

Prime-target	D	B	LL	SPUF	AS	MF
LIST 1						
mango-fruta	0	0	5	3.10	25.5	34.3
bote-barco	0	0	5	2.97	11.8	35.3
pasaje-libro	0	0	5	3.44	5.9	26.5
reparo-arreglo	0	0	7	2.42	8.8	32.4
rollo-lío	0	0	3	2.32	6.9	12.8
salero-gracia	0	0	6	2.46	14.7	34.3
sierra-cortar	0	0	6	2.94	7.8	34.3
LIST 2						
apéndice-dolor	0	0	5	3.02	9.8	48.0
grano-trigo	0	0	5	2.50	13.7	43.1
mama-pecho	0	0	5	2.65	17.7	43.1
parábola-Jesucristo	0	0	10	3.16	8.8	32.4
raso-cielo	0	0	5	2.99	9.8	29.4
farol-mentira	0	0	7	2.85	8.8	31.4
mate-ajedrez	0	0	7	2.40	11.8	25.5
LIST 3						
tocar-palpar	0	0	6	2.16	9.8	38.2
cardenal-morado	0	0	6	2.23	12.8	36.3
importar-interesar	0	0	9	3.03	9.8	36.3
régimen-dictadura	0	0	9	2.86	9.8	35.3
abonar-campo	0	0	5	3.05	7.9	30.7
objetivo-subjetivo	0	0	9	2.77	12.8	25.5
real-rey	0	0	3	2.86	7.8	21.6
LIST 4						
especular-hablar	0	0	6	3.27	6.9	44.1
ante-delante	0	0	7	3.07	6.9	43.1
cola-rabo	0	0	4	2.15	8.8	20.6
término-fin	0	0	3	3.12	14.7	39.2
segundo-minuto	0	0	6	3.15	14.7	35.3
metro-tren	0	0	4	2.92	6.9	34.3
piquete-sangre	0	0	6	3.13	4.9	31.4
Mean			**5.9**	**2.82**	**10.6**	**33.4**

Appendix VI

Prime-target pairs in word-word trials for each list in Experiments 1a and 2a. D = Dominant, S = Subordinate, R = Related, and U = Unrelated conditions.

LIST 1

D.R.
presente-ahora
gemelos-niños
solitario-triste
voto-elecciones
quinto-número
acarrear-carro
medio-entero
apéndice-índice
grano-espinilla
mama-papa
parábola-curva
raso-vestido
farol-calle
mate-color

D.U.
gota-animales
pendiente-energía
trompa-comestibles
portero-pez
frente-clara
botín-cotilla
virgen-cuerno
especular-guitarra
ante-cura
cola-traer
término-dieta
segundo-dar
metro-meta
piquete-verdadero

S.R.
llama-animal
parte-médico
tanque-agua
mina-lápiz
soplo-corazón
batería-cocina
apuntar-señalar
mango-fruta
bote-barco
pasaje-libro
reparo-arreglo
rollo-lío
salero-gracia
sierra-cortar

S.U.
ganado-enfermedad
pila-asignatura
tienda-borrachera
sirena-fútbol
yema-guerra
curiosidad-zapato
asta-mujer
tocar-hablar
cardenal-delante
importar-rabo
régimen-fin
abonar-minuto
objetivo-tren
real-sangre

LIST 2

D.R.
llama-calor
parte-porción
tanque-cañón
mina-minero
soplo-aire
batería-música
apuntar-anotar
mango-asa
bote-lata
pasaje-avión
reparo-vergüenza
rollo-aburrido
salero-comida
sierra-nieve

D.U.
ganado-grifo
pila-adorno
tienda-agua
sirena-casa
yema-cara
curiosidad-tesoro
asta-santo
tocar-bolsa
cardenal-piel
importar-pegar
régimen-palabra
abonar-tercero
objetivo-centímetro
real-manifestación

S.R.
presente-regalo
gemelos-camisa
solitario-cartas
voto-castidad
quinto-cerveza
acarrear-problema
medio-ambiente
apéndice-dolor
grano-trigo
mama-pecho
parábola-Jesucristo
raso-cielo
farol-mentira
mate-ajedrez

S.U.
gota-perdido
pendiente-lavar
trompa-campaña
portero-ambulancia
frente-dedo
botín-gato
virgen-bandera
especular-palpar
ante-morado
cola-interesar
término-dictadura
segundo-campo
metro-subjetivo
piquete-rey

LIST 3

D.R.
gota-grifo
pendiente-adorno
trompa-agua
portero-casa
frente-cara
botín-tesoro
virgen-santo
especular-bolsa
ante-piel
cola-pegar
término-palabra
segundo-tercero
metro-centímetro
piquete-manifestación

D.U.
presente-calor
gemelos-porción
solitario-cañón
voto-número
quinto-aire
acarrear-música
medio-anotar
apéndice-asa
grano-lata
mama-avión
parábola-vergüenza
raso-aburrido
farol-comida
mate-nieve

S.R.
ganado-perdido
pila-lavar
tienda-campaña
sirena-ambulancia
yema-dedo
curiosidad-gato
asta-bandera
tocar-palpar
cardenal-morado
importar-interesar
régimen-dictadura
abonar-campo
objetivo-subjetivo
real-rey

S.U.
llama-regalo
parte-camisa
tanque-cartas
mina-castidad
soplo-cerveza
batería-problema
apuntar-ambiente
mango-dolor
bote-trigo
pasaje-pecho
reparo-Jesucristo
rollo-cielo
salero-mentira
sierra-ajedrez

LIST 4

D.R.
ganado-animales
pila-energía
tienda-comestibles
sirena-pez
yema-clara
curiosidad-cotilla
asta-cuerno
tocar-guitarra
cardenal-cura
importar-traer
régimen-dieta
abonar-dar
objetivo-meta
real-verdadero

D.U.
llama-ahora
parte-niños
tanque-triste
mina-elecciones
soplo-número
batería-carro
apuntar-entero
mángo-índice
bote-espinilla
pasaje-papa
reparo-curva
rollo-vestido
salero-calle
sierra-color

S.R.
gota-enfermedad
pendiente-asignatura
trompa-borrachera
portero-fútbol
frente-guerra
botín-zapato
virgen-mujer
especular-hablar
ante-delante
cola-rabo
término-fin
segundo-minuto
metro-tren
piquete-sangre

S.U.
presente-animal
gemelos-médico
solitario-agua
voto-lápiz
quinto-corazón
acarrear-cocina
medio-señalar
apéndice-fruta
grano-barco
mama-libro
parábola-arreglo
raso-lío
farol-gracia
mate-cortar

Appendix VII

Prime-target pairs in word-word trials for each list in Experiments 1a and 2a. D = Dominant, S = Subordinate, R = Related, and U = Unrelated conditions.

LIST 1

D.R.
presente-pasado
gemelos-iguales
solitario-solo
voto-elecciones
quinto-sexto
acarrear-llevar
medio-mitad
apéndice-libro
grano-espinilla
mama-papa
parábola-curva
raso-tela
farol-luz
mate-brillo

D.U.
gota-vaca
pendiente-radio
trompa-ropa
portero-mar
frente-clara
botín-cotilla
virgen-cuerno
especular-guitarra
ante-iglesia
cola-exportar
término-dieta
segundo-pagar
metro-meta
piquete-verdadero

S.R.
llama-animal
parte-médico
tanque-agua
mina-lápiz
soplo-corazón
batería-cocina
apuntar-señalar
mango-fruta
bote-barco
pasaje-libro
reparo-arreglo
rollo-lío
salero-gracia
sierra-cortar

S.U.
ganado-enfermedad
pila-asignatura
tienda-borrachera
sirena-fútbol
yema-guerra
curiosidad-zapato
asta-mujer
tocar-hablar
cardenal-delante
importar-rabo
régimen-fin
abonar-minuto
objetivo-tren
real-sangre

LIST 2

D.R.
llama-fuego
parte-trozo
tanque-cañón
mina-carbón
soplo-viento
batería-música
apuntar-anotar
mango-sartén
bote-lata
pasaje-avión
reparo-vergüenza
rollo-aburrido
salero-sal
sierra-nieve

D.U.
ganado-lluvia
pila-adorno
tienda-agua
sirena-casa
yema-cabeza
curiosidad-tesoro
asta-religión
tocar-bolsa
cardenal-piel
importar-pegamento
régimen-palabra
abonar-primero
objetivo-centímetro
real-huelga

S.R.
presente-regalo
gemelos-camisa
solitario-cartas
voto-castidad
quinto-cerveza
acarrear-problema
medio-ambiente
apéndice-dolor
grano-trigo
mama-pecho
parábola-Jesucristo
raso-cielo
farol-mentira
mate-ajedrez

S.U.
gota-perdido
pendiente-lavar
trompa-campaña
portero-ambulancia
frente-dedo
botín-gato
virgen-bandera
especular-palpar
ante-morado
cola-interesar
término-dictadura
segundo-campo
metro-subjetivo
piquete-rey

LIST 3

D.R.
gota-lluvia
pendiente-adorno
trompa-agua
portero-casa
frente-cabeza
botín-tesoro
virgen-religión
especular-bolsa
ante-piel
cola-pegamento
término-palabra
segundo-primero
metro-centímetro
piquete-huelga

D.U.
presente-fuego
gemelos-trozo
solitario-cañón
voto-carbón
quinto-viento
acarrear-música
medio-anotar
apéndice-sartén
grano-lata
mama-avión
parábola-vergüenza
raso-aburrido
farol-sal
mate-nieve

S.R.
ganado-perdido
pila-lavar
tienda-campaña
sirena-ambulancia
yema-dedo
curiosidad-gato
asta-bandera
tocar-palpar
cardenal-morado
importar-interesar
régimen-dictadura
abonar-campo
objetivo-subjetivo
real-rey

S.U.
llama-regalo
parte-camisa
tanque-cartas
mina-castidad
soplo-cerveza
batería-problema
apuntar-ambiente
mango-dolor
bote-trigo
pasaje-pecho
reparo-Jesucristo
rollo-cielo
salero-mentira
sierra-ajedrez

LIST 4

D.R.
ganado-vaca
pila-radio
tienda-ropa
sirena-mar
yema-clara
curiosidad-cotilla
asta-cuerno
tocar-guitarra
cardenal-iglesia
importar-exportar
régimen-dieta
abonar-pegar
objetivo-meta
real-verdadero

D.U.
llama-pasado
parte-iguales
tanque-solo
mina-elecciones
soplo-sexto
batería-llevar
apuntar-mitad
mángo-libro
bote-espinilla
pasaje-papa
reparo-curva
rollo-tela
salero-luz
sierra-brillo

S.R.
gota-enfermedad
pendiente-asignatura
trompa-borrachera
portero-fútbol
frente-guerra
botín-zapato
virgen-mujer
especular-hablar
ante-delante
cola-rabo
término-fin
segundo-minuto
metro-tren
piquete-sangre

S.U.
presente-animal
gemelos-médico
solitario-agua
voto-lápiz
quinto-corazón
acarrear-cocina
medio-señalar
apéndice-fruta
grano-barco
mama-libro
parábola-arreglo
raso-lío
farol-gracia
mate-cortar

Appendix VIII

Letter length (LL) and subjective printed usage frequency (SPUF) for the primes in word-word trials (W-W) and in word-pseudoword trials (W-P).

W-W Primes	LL	SPUF	W-P Primes	LL	SPUF
apéndice	8	3.13	verde	5	3.58
especular	9	3.26	trepar	6	2.99
grano	5	2.93	trampa	6	3.23
tocar	5	3.71	titular	7	3.34
ante	4	3.11	timbre	6	3.02
mango	5	2.63	tenor	5	2.87
mama	4	3.29	tenedor	7	3.03
bote	4	3.18	tapa	4	3.14
cardenal	8	3.03	tajo	4	2.95
cola	4	3.30	sonar	5	3.39
importar	8	3.60	sobre	5	3.27
parábola	8	2.73	siniestro	9	3.15
pasaje	6	2.88	segregar	8	3.16
término	7	3.55	sangría	7	2.90
reparo	6	3.06	sal	3	3.15
régimen	7	3.39	saeta	5	2.51
raso	4	3.03	remitir	7	2.98
rollo	5	3.29	ramo	4	3.15
segundo	7	3.59	radio	5	3.45
abonar	6	3.22	quebrar	7	3.32
farol	5	3.08	primo	5	3.16
metro	5	3.43	prensa	5	3.51
objetivo	8	3.78	precipitado	11	3.44
mate	4	2.85	porte	5	2.58
piquete	7	2.93	pipa	4	2.80
sierra	6	3.14	película	8	3.44
salero	6	2.99	pegar	5	3.39
real	4	3.62	pasador	7	2.65
Mean	**5.90**	**3.21**		**5.89**	**3.13**
presente	8	3.66	partido	7	3.37
llama	5	3.42	pabellón	8	3.23
gota	4	3.15	obtuso	6	2.61
ganado	6	3.30	normal	6	3.92
gemelos	7	2.91	moral	6	3.92
parte	5	3.50	mona	4	2.73
pendiente	9	3.54	luna	4	3.41
pila	4	3.19	llave	5	3.46
solitario	9	3.21	lecho	5	3.26
tanque	6	3.15	jabalina	8	2.68
trompa	6	2.86	intimar	7	2.94
tienda	6	3.54	infiel	6	3.12
voto	4	3.50	guarnición	10	2.88
mina	4	3.28	golfo	5	3.10
portero	7	3.33	fuente	6	3.30
quinto	6	3.44	fresco	6	3.24
sirena	6	2.66	falda	5	3.16
soplo	5	2.72	escuadra	8	2.90
frente	6	3.51	encaje	6	2.57
yema	4	2.94	empollar	8	2.84
acarrear	8	3.35	embotellar	10	2.74
batería	7	3.16	doble	5	3.57
botín	5	3.04	diana	5	2.74
curiosidad	10	3.35	dado	4	3.27
medio	5	3.77	curso	5	3.55
apuntar	7	3.37	cuerda	6	3.16
virgen	6	3.33	costear	7	3.13
asta	4	2.68	contraer	8	3.33
Mean	**5.96**	**3.23**		**6.07**	**3.13**
Total Mean	**5.93**	**3.22**		**5.98**	**3.13**

Appendix IX

The prime and its target in the word-pseudoword trials.

Prime-Target
verde-traper
trepar-pamtra
trampa-tutilar
titular-tembri
timbre-ronte
tenor-tenoder
tenedor-apat
tapa-ojat
tajo-sanor
sonar-sebro
sobre-siniostre
siniestro-segrager
segregar-gríasan
sangría-sel
sal-tasae
saeta-rimetir
remitir-moar
ramo-rodia
radio-brarque
quebrar-promi
primo-pranse
prensa-precipitoda
precipitado-perto
porte-paip
pipa-pelícalu
película-pager
pegar-pasodar
pasador-partodi
partido-pabollón
pabellón-obtosu
obtuso-narmol
normal-marol
moral-namo
mona-lanu
luna-llavo
llave-loche
lecho-jabilana
jabalina-intamir
intimar-infeil
infiel-guirnación
guarnición-fogol
golfo-tefuen
fuente-frosce
fresco-dafal
falda-ascuedra
escuadra-anceje
encaje-empallor
empollar-embatellor
embotellar-deblo
doble-daina
diana-doda
dado-corsucurso-cuarde
cuerda-casteor
costear-cantreor
contraer-verdo