Access into Memory: Differences in Judgments and Priming for Semantic and Associative Memory

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Abstract

Two experiments measuring the response times (RTs) of semantic and associative information processing are presented here. Experiment 1 tested the speed of judgments of associative and semantic word pairs (Maki, 2007a), and participants were able to judge associative relationships faster than semantic relationships. Interestingly, word relationship scores from database norms also predicted the RT for both semantic and associative judgments. Experiment 2 tested associative and semantic priming in a traditional lexical decision task, which also showed that associative word relationships were judged faster than semantic relationships. These findings are discussed as to how associative and semantic information is processed in memory.

The science of memory has come a long way since Tulving and Bower (1974, pg. 273) claimed that "it has not yet been made clear by anyone how the task of explaining memory phenomena is materially aided by the hypothesized existence of different memory stores and systems." They were, of course, talking about the distinction between semantic and episodic memory systems. One glance at a current journal shows that this debate still continues today. Semantic memory is generally described as a mental dictionary or the set of facts and world knowledge we have obtained through life experiences (Tulving, 1993). However, there is yet another field of memory research that is beginning to show clarity in the distinction between types of memory. Associative memory is said to be the relationship of words that occur together frequently in text and speech, such as COMPUTER and MOUSE (Nelson, McEvoy, & Schreiber, 2004).

These links are stored in an associative memory network, which is constantly changing due to experience. Associative memory tends to be more episodically based, although words with strong semantic relationships may also have strong associative relationships. For example, OLD and NEW show both a strong semantic link (old is the opposite of new) and a strong associative link (when asked, participants will say new or young in response to old). Even though these types of relationships can overlap, a separation is still needed because there are word pairings that are obviously not semantically formed. For instance, the pairing BASIC-INSTINCT and ROCK-ROLL would probably not exist if not due to popular culture.

Associative memory has a history of being intertwined, ignored, or simply misunderstood in past memory research. Semantic memory has traditionally been studied with the use of priming tasks, such as a lexical decision task, naming, and masking (see Neely, 1991 for a review). Over the years, experimenters in semantic memory have consistently relied upon several factors to select "related" stimuli for their experiments. More often than not, related word pairings were originally normed by a set of college freshman and used for many experiments (and even transferred to other researchers). Other word pairings were simply selected for their obvious relatedness. The inherent problem with this selection method was that there was no way to define the actual relationship between word pairs.

In the last five years, many databases of both associative and semantic memory have been published that solve this problem. Nelson et al. (2004) have presented a list of 72,000 word pairings created through a free association task, which is where participants are asked to name the first word that comes to mind given a target word. After averaging over many participants, this database contains the probability of words being present or thought of together. There also have been several semantic databases created in a slightly different way. Maki, McKinley, and Thompson (2004) used the online dictionary WordNET to create a measure of semantic overlap between words. They used WordNET's hierarchical structure to calculate the semantic distance between words in the dictionary, where words close to each other have a great deal in common. These databases provide a wealth of information and a very convenient

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way to dissociate semantic and associative relationships. Hutchison (2003) compiled a list of claimed semantic and associative priming studies to analyze if semantic priming was semantic, associative, or both (a similar review is presented in Lucas, 2000). The associative boost is a phenomenon where semantic priming is given a "boost" when words are both semantically and associatively related (Moss, Ostrin, Tyler, & Marslen-Wilson, 1995). Therefore, it is possible that many semantic priming studies were actually a combination of both semantic and associative priming. Firstly, Hutchison found that most studies were a mix of semantic and associative word pairs, even when they claimed to be strictly one type or another. Secondly, it appeared that semantic and associative priming could both be found independently and also when presented together. One type of relationship is not necessary to find priming, even as previously thought (Thompson-Schill, Kurtz, & Gabrieli, 1998).

Though, where exactly do all of these studies leave us when trying to understand how *associative* information is processed? First, it cannot be assumed that associations are stored exactly as semantic information is stored. In a traditional connectionist network, words are linked to their meanings, so that CAT is linked to features such as TAIL, FUR, and MEOWS. Semantic priming occurs when a second related concept is activated, which speeds identification of that second word because its features are already being processed (see Stolz & Besner, 1996 for a possible model). These indirect relationships through features do not quite explain how people understand the direct relation between words based on context. Overlap in activation from the semantic features would simply show strength in meaning relatedness and not necessarily more subtle relationships.

A simple solution in explaining associative information processing would be to add links based on experience between words at the lexical level (Williams, 1996). Association links explain how associative priming occurs without the use of semantic information. The semantic feature overlap would not be relevant with associative word relationships and could be ignored. Obviously, there would be a great deal of overlap between semantic and associative information if these links were included. These links could explain the associative boost phenomenon, since there would be even more activation when a second related word is presented in a priming task. The feedback from the semantic features would now be added to direct associative activation and increase priming effects.

An issue with understanding memory is how to account for research in judgments of memory. Maki (2007a, 2007b) had groups of participants rate pairs of words based on their associative relatedness, which tested how people could predict free association scores. In the judgments of memory task, participants were first shown a description of associative memory and then asked to rate word pairs on "how many college students would give the second word if they were shown the first word." Judgments were made on a Likert-type scale ranging from zero (no responses) to nine (90 to 100 responses). Participants' judgments were compared to the word-pair database score, and it was found that database scores would predict ratings of word pairs (known as the JAM function). Judgments of semantic memory have been tested in a comparable way. Maki, Krimsky, and Munoz (2006) studied how participants are able to rate the amount of feature overlap (semantic similarity) instead of their associative relatedness. They found that participants are able to judge how much meaning presented word pairs had in common. Interestingly, both semantic database scores and associative database scores predicted the ratings on the semantic judgment task.

Separating associative and semantic memory in a connectionist model can quite easily explain these results. As word pairs are processed, the associative links are analyzed in either the associative judgment or semantic judgment condition. Since semantic information is not needed during an associative judgment task, it can simply be ignored. During a semantic judgment task, both types of information are activated because associative information is automatically processed before semantic information, especially because it is one direct link between words. Presently, experiments were created to test if associations are processed differently than semantic information. If associations are stored in a single link between words, then they should be processed quicker than semantics because semantic information would take extra time to compare many overlapping activations. Also, Anderson, and Reder's (1999) fan effect would explain why semantic processing should take longer. The fan effect occurs when processing slows down after extra links in memory are added. Semantic judgments would be slower because they require analysis of more activated links, while associative judgments require analysis of only one link.

To test this theory, participants were asked to judge both associative and semantic relationships while their RTs were recorded (Experiment 1). Given parallel processing and how fast automatic spreading activation is supposed to occur, it may simply be that RTs are a factor of their associative and/or semantic relatedness (Collins & Loftus, 1975). Therefore, associative and semantic database scores were used to predict RTs to see if they mirrored judgments of memory findings. In Experiment 2, a lexical decision task was examined to show that RT findings were comparable from the judgments of memory task to a more traditional priming paradigm.

Experiment 1
Method

Participants.

One hundred thirty-six psychology undergraduates from the University of Mississippi participated in exchange for course credit. Participants were all native English speakers. Seven participants were excluded from the analyses due to poor performance in the experiment, defined as completing an experimental block in less than 30 seconds or having a majority of trials in an experimental block be less than one second.

Apparatus.

The experiment was programmed using PsyScope Build 53 (Cohen, MacWhinney, Flatt, & Provost, 1993), which afforded recording of RTs with millisecond precision. Stimuli were presented using a MacBook Pro running OS 10.5.5 on a 2.4 GHZ Intel Core Duo processer with 2GB of SDRAM.

Materials.

Two hundred thirty-two word pairs were created for this experiment using the Nelson et al. (2004) free association norms and the Maki et al. (2004) semantic word pair norms. Word pairs were randomly selected from the databases with the requirement that each word pair have values on both the associative measure and semantic measure. Table 1 contains word pair averages on both the associative forward strength (FSG) and semantic relationship (JCN). Fifteen of the word pairs were used as practice for each block of the experiment and were not analyzed (30 pairs total). The remaining 202 pairs were split into half creating two blocks of 101 pairs each. The word pairs were judged equally in each block across participants, and each block was counterbalanced for position.

Procedure.

Participants were randomly assigned to condition where they either received associative or semantic instructions first. Word pairs were randomly presented in both the practice and experimental blocks.

Associative instructions. First, associative memory was defined through several examples. For instance, the concept of DOG was related to CAT by explaining that CAT and DOG are seen together in text like "it's raining cats and dogs." Then, the nature of a free association task was described as "the first word that pops into your mind when given another word." However, instead of being given one word at a time, participants were given two words to judge. Participants were told that they would be judging how many people out of a 100 would be have given the second target word if they received the first cue word. For example, given ASHTRAY-SMOKE, participants should have rated the pair at around 20 people per 100.

Semantic Instructions. The semantic instructions explained how two concepts are related

Table 1. Stimuli variables for word pairs in Experiment 1 and Experiment 2.

	Mean	SD	Range
Experiment 1			
FSG	0.215	0.243	0.010-0.780
JCN	10.66	7.956	0.000-24.950
Experiment 2			
Associative Pairs			
FSG	0.58	0.105	0.450-0.880
JCN	20.658	1.753	18.290-25.200
Word Length	5.600	2.044	3.000-10.000
Lexical Decision RT	647.100	85.695	523.760-917.270
Naming RT	623.825	58.175	528.640-819.080
Neighborhood	8.663	1.905	4.040-12.660
Frequency	50.449	78.283	0.000-313.000
Semantic Pairs			
FSG	0.024	0.01	0.010-0.050
JCN	0.216	0.314	0.000-0.950
Word Length	5.833	2.141	3.000-11.000
Lexical Decision RT	633.119	66.815	522.780-806.130
Naming RT	615.256	41.891	524.890-758.670
Neighborhood	9.526	1.478	6.340-13.670
Frequency	66.778	76.641	2.000-323.000
Unrelated Pairs			
Word Length	6.192	1.911	2.000-13.000
Lexical Decision RT	664.778	70.297	534.370-838.460
Naming RT	639.439	53.316	516.320-798.330
Neighborhood	8.481	1.385	4.440-11.960
Frequency	26.351	35.681	0.000-204.000
Non-Word Pairs			
Word Length	6.250	2.433	1.000-12.000
Lexical Decision RT	690.076	80.689	533.700-867.320
Naming RT	654.373	66.123	533.960-876.110
Neighborhood	7.954	1.974	4.440-16.180
Frequency	204.836	1346.353	0.000-359.000

Note. Forward strength (FSG) is scaled from 0.00 (no associative strength) to 1.00 (high associative strength), while semantic relatedness (JCN) is scaled from 0.00 (complete semantic overlap) to 32.000 (no semantic overlap). Word length is the number of characters in each individual word in a pair. Lexical decision and naming RTs are average response times to individual words from Balota et al. (2007)'s English Lexicon Project. Neighborhood was taken from Burgess and Lund's (1997) hyperspace analogue to language (HAL), and Kucera and Francis' (1967) frequency norms were used to calculate average frequency.

through meaning. TORTOISES and TURTLES are described by their features, such as shells, and being reptiles. Several more examples are given to explain how two concepts can overlap in many features, some features (TORTOISE-SNAIL), or almost no features (TORTOISE-BANNER). Participants were asked to estimate in percentages how many of the features of both concepts presented overlapped.

Following both sets of instructions, a Likert-type scale was shown to explain how to enter their judgment ratings. The scale ranged from one to nine, which corresponded to "about 10 people or 10 percent overlap" to "90-100 people or 90-100 percent overlap" depending on the instructions. After each set of instructions was presented, participants were shown a set of 15 word pair practice trials. Each word pair was presented in 24 point Arial Bold font. The two words split the middle of the screen. Participants were allowed to move the computer to a comfortable viewing distance. Word pairs would remain on the screen until a judgment number was entered. Judgments were entered by pressing a number key on the top row of the keyboard.

After the judgment was entered, a 1000 ms blank inter-trial interval was shown. Then the next word pair would appear on the screen. At the end of the practice trials, participants were reminded of the scoring rubric and asked if they had any questions. The following block was an experimental block, which consisted of 101 word pairs. The experimental block was exactly the same as the practice block. Pairs were presented one at a time, followed by a 1000 ms inter-trial interval. After the first block, participants were allowed to take a short break. The next block switched to other instructional set, and participants repeated the procedures for the second type of judgment. RTs were recorded from the onset of the experimental word-pair. Following the second experimental block, participants were debriefed.

Results and Discussion

Judgments.

Results from previous studies were replicated (Maki, 2007a; Maki et al., 2006). Participants' associative judgments were predicted by the associative database score (FSG), but not the semantic database score (JCN). Semantic judgments were predicted by both the semantic database norms and the associative database norms. Scores were first averaged over participants for each word pair by judgment type. Two multiple linear regressions were used to predict participant judgments from database scores. First, FSG associative strength and JCN semantic strength were used to predict participants' associative judgment scores. As shown in the left panel of Figure 1, associative database scores significantly predicted associative judgments ($t(201) = 5.577$, $p < .001$), while semantic database scores did not significantly predict associative scores ($t(201) = 1.063$, $p = .289$). The second multiple linear regression used associations and semantics to predict semantic judgment scores, which showed that both FSG associations ($t(201) = 3.310$, $p<.001$) and JCN semantics ($t(201) = -2.174$, $p = .031$).

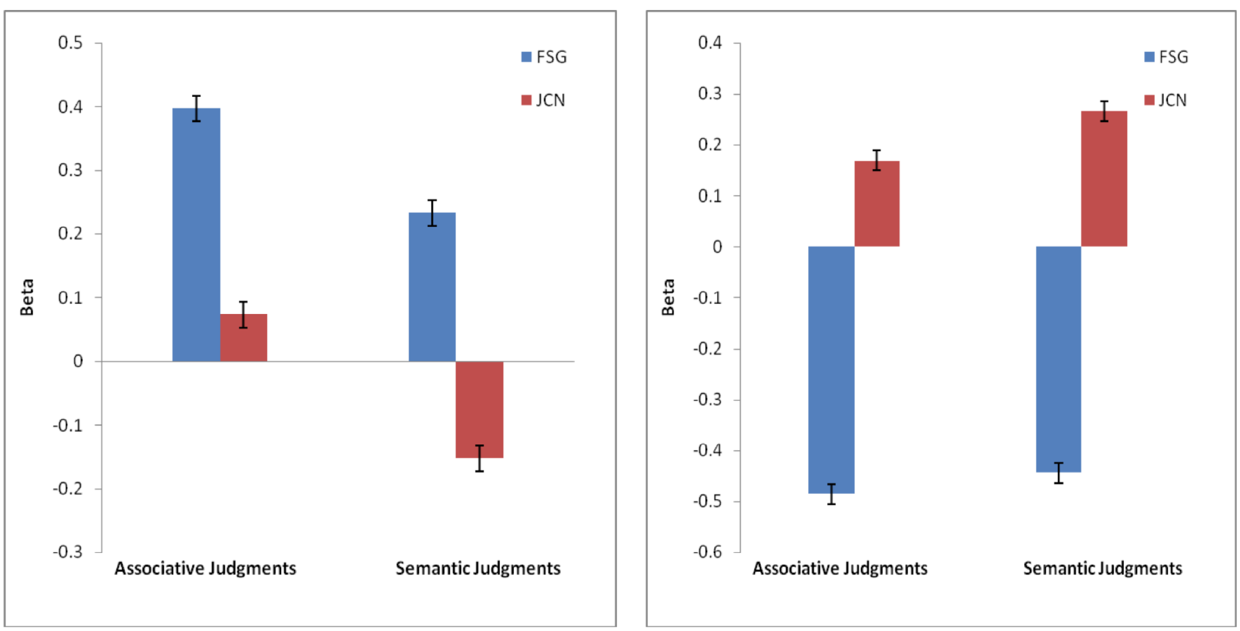

Figure 1. In the left panel, betas for forward strength (FSG) and semantic relatedness (JCN) as they predicted participant judgment scores in Experiment 1. In the right panel, betas for FSG and JCN as they predicted RTs for judgments. Error bars are standard error.

Response Times.

Similar to judgments, RTs were averaged over word pairs by associative or semantic condition. From here, the Van Selst and Jolicoeur (1994) standard deviation trimming procedure was used. This procedure finds the RTs' average and standard deviation and eliminates RTs that are three standard deviations away from the average. The process is recursive, so extreme scores are eliminated in each round until no extreme scores are left. This procedure eliminated approximately two percent of the overall data and each word pair lost no more than two RTs in either condition. Most scores eliminated were over 10 seconds.

East list of 202 words was then averaged to create an associative and semantic judgment RT score. As predicted, associative judgments (M = 2553.55, SE = 50.10) were significantly faster than semantic judgments (M = 2662.16, SE = 58.21) as shown by a paired samples t-test ($t(201) = -3.041$, $p = .002$).

Predicting Response Times.

Another interesting finding from this study was the ability to predict RTs for judgments by both associations and semantics. Two multiple linear regressions were used to predict associative and semantic judgment RTs with associative and semantic database scores, which closely mirrors the findings for predicting participant ratings. See the right panel of Figure 2 for betas. Associative relationships (FSG) predicted associative judgment RTs ($t(201) = -7.915$, $p < .001$), and unlike participant judgments, semantics (JCN) also predicted associative judgment RTs ($t(201) = 2.756$, $p = .006$). Both databases also predicted participant semantic judgment scores (FSG: $t(201) = -7.352$, $p < .001$; JCN: $t(201) = 4.410$, $p < .001$). An examination of the betas for both semantics and associations explains this effect.

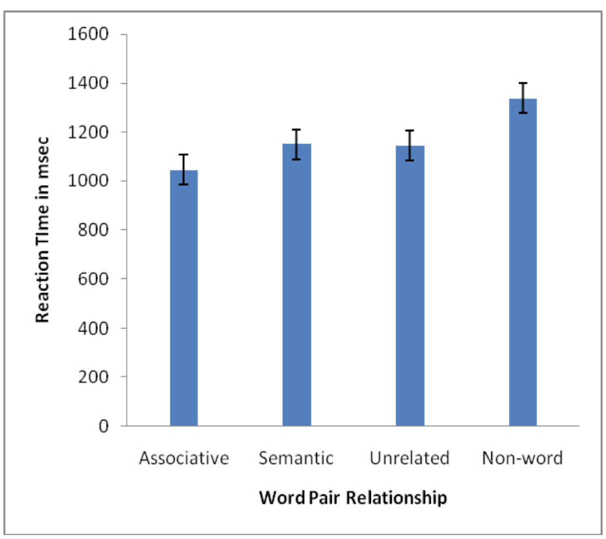

Figure 2. RTs for associative, semantic, unrelated, and non-word pairs in the lexical decision task for Experiment 2. Error bars are standard error.

The associative FSG beta values are negative, which indicates that as associative strength increased, RTs for judgments in both conditions decreased. However, the semantic JCN variable is reverse scored, so the positive beta indicates that as semantic relationship got stronger (going from 32 to zero) the RTs for both conditions also decreased.

A combination of the judgment and predicted RTs results found here support associative information stored in direct links between word pairs. For an associative judgment, only associative information was used to process the relationship between word pairs. With direct links, a quick judgment can be made by simply assessing the strength of activation between the word pairing. Semantic links between features would not be necessary for the associative judgment task, and therefore were ignored. Semantic information was required for a semantic judgment and was predictive of semantic judgments. Since associative information was only one link to be processed, it was activated and predicted semantic judgments.

The RTs' results presented an even stronger argument for the direct associative links. An extra 100 ms was required to process semantic judgments, which indicated that the comparison of feature overlap required an extra step (or in this case, extra layers of information). Associative links are suggested to be direct, which would make the judgment faster than semantic judgments that require a comparison of activations for many features. However, as shown by predicting RTs, it was obvious that associative and semantic relatedness play some part in determining judgment RT. Associative and semantic judgments RTs were influenced by both associations and semantic feature overlap, which could be explained through spreading activation.

Experiment 2

Experiment 1 illustrated that associative information and semantic information are processed differently during a judgments of memory task. Associative information predicted participants' ability to judge both associative and semantic word pair relationships, while both associations and semantics predicted the RTs of the word pair judgments. Associative judgment RTs were faster than semantic judgment RTs, which seems to support different activation weighting strategies during judgments. However, a judgment of memory task may activate information differently than a traditional semantic priming task. The length of time required to make a judgment may give participants time to filter out semantic information, even though it activated automatically. This experiment was designed to test separate priming and activation in memory between associative and semantic information by creating word pairs with orthogonal relationships. These word pairs were then tested in a lexical decision task to examine the nature of semantic and associative memory priming.

Method

Participants.

All participants were recruited from the psychology human subjects pool and received course credit for their participation. Participants were all native English speakers. One hundred fifteen participants were tested in the experiment; however, eight participants were excluded for low performance. Low performance was defined as scoring less than three standard deviations below the average percent correct for any condition. Basically, this amounted to scoring at or below chance for one of the conditions described in the procedure.

Apparatus.

The participants were tested individually using personal computers (Dell or HP clones) equipped with 15-in. color monitors. Displays were synchronized with the refresh rate of the monitors (75 Hz). This experiment was programmed with Millisecond's Inquisit, which measures millisecond RTs on Windows operating system computers.

Materials.

Several types of stimuli were created for these experiments by using two of the databases described earlier. Forward strength (FSG) and backward strength (BSG) were used for associative relationships from the Nelson et al. (2004) database, and JCN from the WordNET database was used for semantic relationships (Maki et al., 2004). Table 1 contains the means, standard deviations, ranges for association, semantic feature overlap, word length, average lexical decision, naming RTs (Balota, Yap, Cortese, Hutchison, Kessler, Loftus, et al., 2007), neighborhood (Burgess & Lund, 1997), and frequency (Kucera &Francis, 1967). Word pairs were tested on these variables and were not significantly different across types of word features (mixed ANOVA, $F(15, 1310) = 1.217$, $p = .251$). Stimuli were presented in the center of the screen and subtended visual angles of 2^{o} horizontally and $.60^{o}$ vertically from a viewing distance of 45 cm.

Priming pairs. An associative set and semantic set of priming pairs were created. These sets were chosen from the Nelson et al. and Maki et al. databases so that one set of 30 word pairs only had associative relationships and the other set of 30 word pairs had only semantic relationships. To generate the associative list, word pairs were found with extremely high values on the associative FSG variable (above .5) and very low values on the semantic JCN variable (below 20). The procedure was reversed for the semantic list, where values on the semantic variable were very high (below 3) and FSG variable values were low (below .1). For example, DEVELOP-CREATE is high on the semantic factor and low on the associative factor; PEANUT-BUTTER is high on the associative factor and low on the semantic factor.

Unrelated pairs. Unrelated word pairs were created by repairing words in the two databases, which ensured that they had no relationship. For example, CAVE-AMOUNT are not paired in either database and therefore have no semantic or associative relationship. To keep relatedness proportion low (ratio is 1:2), 60 pairs were generated.

Nonword pairs. First, another 60 word pairs were selected in the same fashion as the unrelated word pairs described above. A set of non-words was created by changing a single letter of one of the original paired words in the stimulus set. For example, SUITCASE was changed to MUITCASE.

Procedure.

First, participants were informed on the nature of a lexical decision task. Instructions appeared on how to judge targets as either "words" or "nonwords" with examples. For example, participants would say yes to a word like COLD, but no to a fake word like WERM. Participants responded by pressing keys for yes and no on the keyboard (the "/" and "z" keys). Altogether, participants responded to 60 priming trials, 60 unrelated trials, and 60 non-word trials, which created an experimental response ratio of 2:1 for yes to no answers. Non-word pairs were used as no responses, so participants could not simply press the yes key until the experiment ended. These keys were counterbalanced across participants, where yes and no equally appeared on each key. They were given 15 practice trials to make sure they understood the instructions.

A 400 ms fixation cue was presented followed by the prime word in white for 200 ms in the center of the screen. For semantic, unrelated, and non-word trials, the prime word was randomly chosen. For associative word trials, the first word in the word pairing was used as the prime word because associative relationships vary in their forward and backward relationships (as discussed in the introduction, COMPUTER-MOUSE do not have the same relationship as MOUSE-COMPUTER). The target word followed the prime word after 200 ms offset (SOA 400ms) and stayed on the screen until a response was entered. The inter-trial interval was one second from response to the next fixation cue. Participants entered word/non-word judgments in two blocks of 90 trials with breaks between each block. They judged the 30 associative pairs, 30 semantic pairs, 60 unrelated pairs, and 60 non-word pairs in a random order.

Results and Discussion

This experiment mirrored results from the first experiment. Correct proportion rates were also examined as mentioned in the participants section. Participants were excluded if their proportion correct for any section was three standard deviations below the average rate. After these subjects were eliminated, correct proportion rates were as follows: associative word pairs ($M = .972$, SE = .004), semantic word pairs (M = .942, SE = .004), unrelated word pairs (M = .920, SE = .005), and non-word pairs (M = .914, SE = .008). These proportions were found to be significantly different from each other using a repeated measures ANOVA ($F(3,249) = 26.343$, $p<.001$). Further analysis using paired samples t-tests indicated that participants were most accurate in associative word pair conditions ($M_{semantic} = .031$, $t(83) = 5.788$, $p<.001$; $M_{unrelated} = .052$, $t(83) = 8.943$, $p<.001$; $M_{non\text{-}words} = .059$, $t(83) = 7.090$, $p<.001$), followed by the semantic word pair condition ($M_{unrelated} = .021$, $t(83) = 3.476$, $p=.001$; $M_{non\text{-}words} = .029$, $t(83) = 3.340$, $p=.001$), and finally unrelated word pairs had equal correct proportions to non-word pairs ($M_{non\text{-}words} = .006$, $t(83) = .764$, $p=.458$). Only correct trials were analyzed for RT differences. Next, the Van Selst and Jolicoeur RT trimming procedure was utilized to eliminate extremely long RTs. Less than one percent of the data was eliminated and only eliminated RTs well over five seconds.

A repeated measures ANOVA was analyzed on average correct RTs for associative, semantic, unrelated, and nonword pairs. Figure 2 illustrates the RT for these different conditions, which were significantly different from each other ($F(3,318) = 44.621$, $p<.001$, $\eta^2 = .296$). First, non-words were compared to word pairs with paired samples t-tests to show that participants engaged in the task, which would require longer to process non-word pairs. Non-words were significantly slower than associations ($M_{difference} = -292.62$, $SE = 33.50$, $t(106) = -8.736$, $p<.001$), semantics ($M_{difference} = -188.62$, $SE = 33.18$, $t(106) = -5.687$, $p<.001$), and unrelated word pairs ($M_{difference} = -194.42$, $SE = 22.22$, $t(106) = -8.753$, $p<.001$).

Next, paired samples t-tests were used to test if orthogonal word pairs would prime for either associations or semantics and to observe if associative word pairs were processed quicker than semantic word pairs as with Experiment 1. Associative information was primed over unrelated word pairs ($M_{difference} = 98.19$, $SE = 22.18$, $t(106) = -4.428$, $p<.001$), while semantic information was not primed over unrelated word pairs ($M_{difference} = 5.77$, $SE = 25.22$, $t(106) = -.229$, $p=.820$). However, similar to Experiment 1, associative word pairs were over 100 ms faster than semantic word pairs ($M_{difference} = 103.96$, $SE = 13.39$, $t(106) = -7.763$, $p<.001$).

General Discussion

These set of experiments were used to investigate judgments and priming for associative and semantic memory. Experiment 1 was a speeded judgment task that measured RTs for both semantic and associative judgments. Associative judgments were processed faster than semantic judgments, but both types of memory played into those judgments. Participants' judgments showed an asymmetry in the use of information, which replicated previous findings (Maki, 2007a, 2007b). For judgments, associative judgments were always predicted by associative relationships, while semantic judgments were predicted by associative and semantic relationships generally. These results indicate that associative information and semantic information are separated on some level, where associations are always processed. Therefore, direct associative links would help explain the differences in semantic processing and associative processing. Links between word pairs that are automatically activated would be the simplest explanation for where associations are stored, which would explain why associative information cannot be blocked or suppressed due to task demands. A mechanism that might explain why semantic information does not predict associative judgments, suggested by Hutchison and Bosco (2007), is activation suppression. Activation suppression occurs when the activation of word links is suppressed due to task demands. This mechanism could conceivably work to dampen activation of semantic information (but not completely suppress it), which could explain why semantic information predicts RTs but not associative judgments.

Experiment 2 used normed databases to create separate word pairs to investigate associative and semantic priming. As mentioned earlier, Hutchison (2003) and Lucas (2000) have demonstrated that semantic priming was not always semantic in older studies of priming. This experiment supported that associative priming can occur without semantic feature links, and that semantic priming may need the extra boost from associative links to be processed faster than unrelated word pairs. Associative information was processed before all the feature links could be examined, which would predict that associative information will be processed faster than both unrelated word pairs and semantically related word pairs. These predictions were found using a lexical decision task: associative word pairs were around 100 ms faster than semantic word pairs and unrelated word pairs. Activation suppression could explain why no semantic priming was found. In a lexical decision task, only the word-level links are needed to make a word/non-word judgment. Activation from the semantic features might be ignored or dampened due to task demands and did not help semantically related word pairs be processed faster than unrelated word pairs.

Considered in conjunction, these results argue for a separation of semantic and associative memory into different types of memory, which are possibly activated in a specific order. Activation suppression has been suggested to explain why semantic information was not always predictive of judgments and not priming during the lexical decision task. Associative information is processed directly between word pairs and is very quick. Semantic information is compared across activated features, which requires extra time to process. A combination of both types of memory mechanisms is the most likely explanation for how information is processed. Now that the use of semantic and associative databases has become more prevalent, new studies of priming and judgments can help further elucidate the differences in these memories as well as their boundary conditions.

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