Method

*Participants.*

Twenty undergraduate students were recruited from the University of Mississippi (13 women and 7 men) and volunteered to participate. All participants were English speakers. Volunteers received no incentive for participation. The experiment was carried out with the permission of the University of Mississippi Institutional Review Board, and all participants signed the corresponding consent forms. One participants’ data was corrupted and could not be used, leaving eighteen participants (13 women and 6 men).

*Apparatus.*

The system used was a 32 Channel EEG Cap connected to a NuAmps monopolar digital amplifier, which was connected to a computer running SCAN 4.5 software to record the data. This SCAN software is capable of handling the digital data captured by the NuAmps amplifier. STIM2 was used to match with the timing issues associated with Windows XP and EEG data on a separate computer. STIM2 also serves as the software base for programming and operating experiments of this nature. The sensors in the EEG cap are sponges injected with 130 ml of electrically conductive solution (non-toxic and non-irritating). Also, to protect the participants and equipment, a surge protector was used at all times during data acquisition. The sensors record electrical activity just below the scalp, displaying brain activation. This data was amplified by the NuAmps hardware, and processed and recorded by the SCAN software.

*Materials.*

This experiment consisted of 360 word pairs separated into pairs in which the target words were unrelated to the prime (60), semantically associated to the prime (60), associatively related to the prime (60), or were nonwords (60). Of the 360 pairs, 180 involved a lexical decision task, and 180 involved a letter search task. The ratio of yes/no correct answers for words and non-words was 2:1. This paper deals specifically with the lexical decision tasks, while the letter search portion will be analyzed for another piece.

The stimuli were selected from the Nelson et al. (2004) associative word norms, and Maki et al. (2004) semantic word norms. The associative word pairs were chosen using the criteria that they were highly associatively related, having an FSG score greater than .5; with little or no semantic similarities, determined by having a JCN score of greater than 20. The semantic word pairs were chosen using the criteria that they had a high semantic relatedness shown in a JCN of 3 or less; and were not associatively related, having an FSG of less than .01. The unrelated words were chosen so that they had no similarities between the paired words on any scale. For non-word pairs, the target word had a letter changed so that it was no longer a real word, but the structure was left intact to require that the participant process the word cognitively. These words were entered into a program written in the Gentask (Generalized Task Editor) function of the Stim2 software.

*Procedure.*

Testing occurred in one session consisting of six blocks of acquired data, broken up by brief rest periods. These recordings were later processed to extract the n400 waveform data.

A NuAmps monopolar digital amplifier headpiece was used to detect EEG patterns occurring just below the scalp. This device was hooked to a computer running both the STIM2 and SCAN software packages capable of interpreting and encoding EEG data, as well as being the software in which the lexical decision task was programmed and run. Each participant signed a consent form prior to the experiment. Before each participant was measured, the system was configured to the correct settings and the hardware prepared. This setup consisted of inserting sensor sponges into the appropriate slots of the EEG cap, and securing the cap to the participant’s head with a Velcro chinstrap. Next two ground sensors (baseline scalp electroconductivity without underlying brain activity) were placed on the right and left mastoid bones, or the slightly protruding bones just behind each ear. With the cap and sensors in place, a non-toxic, non-irritating electrically conductive solution was applied to the sensors with an automatic pipette. Once the participant was fully prepared, the impedance value of the signal received from their scalp was measured to ensure accurate readings. In the event of too much impedance (not enough electrical conductivity), manual measures were taken to remedy the problem: applying pressure to expand the sensor sponges, pressure to the scalp to complete the circuit, more solution added to increase conductivity, etc. Once proper operating conditions were reached, the participants were asked to blink their eyes rapidly a few times to establish a base for determining eye blink artifacts in the data. Once these baselines were acquired the lexical decision task began.

The lexical decision involved the participants observing a word onscreen and deciding whether or not it was a word or non-word (such as TORTOISE and WERM) using pre-determined button presses. The word would be presented onscreen, and would stay there until the participant pressed either “1” for yes (real word), or “2” for no (fake word). The experiment made use of 6 sets of 60 randomly assigned word pairs for a total of 360 trials, 180 of which were lexical decision tasks. These trials were presented in Arial 19 point font, and the inter-trial interval was set to five seconds to allow for complete recording of the N400 waveform.