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Alexithymia in Men:

How and When Do Emotional Processing Deficiencies Occur?”

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Abstract

The present study extended existing research on alexithymia in men, investigating whether the deficit in processing emotions occurs early in the process, as a result of dissociation or repression, or later, as a result of suppression. We also examined the assumption in Levant's (2011) normative male alexithymia hypothesis that men with alexithymia would show the greatest deficits in identifying words for emotions discouraged by masculine norms that expressed vulnerability and attachment. Study 1, with 258 college men, showed that scores on measures of alexithymia and normative male alexithymia were more strongly and uniquely predicted by suppression than repression and dissociation, while controlling for positive and negative affect and depression. Study 2 used semantic priming with 85 college men, and revealed that men with alexithymia showed more errors in lexical decision performance using target emotion words discouraged by masculine norms as compared to men without alexithymia. In addition, men with and without alexithymia did not differ in their accuracy using target emotion words that are encouraged by masculine norms. We also found that the disruption in emotional processing among men with alexithymia occurred at 500 ms stimulus onset asynchrony, which is slow enough for conscious processing, supporting an explanation of suppression as the mechanism for the inhibition.

Keywords: Normative Male Alexithymia, Semantic Priming, Repression, Suppression, Inhibition

Alexithymia in Men: How and When Does the Deficit in the Processing of Emotions Occur?

Literally, alexithymia means "without words for emotions." Alexithymia is a personality construct that encompasses several deficits in the cognitive and affective processing of emotions. These deficits were initially observed among psychosomatic patients, and later among patients suffering from posttraumatic stress, substance use, and eating disorders (Taylor, 2004). The deficits were defined as: Difficulty identifying and describing feelings, difficulty making the distinction between feelings and bodily sensations, a paucity of fantasies, and externally-oriented thinking (Nemiah, Freyberger, & Sifneos, 1976). Three of these deficits (all but paucity of fantasies) are assessed by the Toronto Alexithymia Scale-20 (TAS-20; Bagby, Parker, & Taylor, 1994; Bagby, Taylor, & Parker, 1994), the most widely used measure of alexithymia (Taylor, 2000).

Normative Male Alexithymia Hypothesis

In addition to the occurrence of alexithymia in clinical populations noted above, Levant (1995) observed that alexithymia occurred in milder forms in non-clinical participants in the Boston University Fatherhood Project. Levant proposed the "normative male alexithymia" hypothesis to account for what he theorized was a socialized pattern of restrictive emotionality influenced by traditional masculinity ideology. He posited that those men had been discouraged as boys from expressing their emotions by parents, peers, teachers, or coaches, and some were punished (some very severely) for doing so. In particular, these men showed the greatest deficits in identifying and expressing emotions that reflected a sense of vulnerability (like hurt, sadness or fear), or that expressed attachment (like fondness, caring, or needing someone). On the other hand, these men had been encouraged to express aggressive and lustful emotions, and thus did not show any deficits in these emotional domains.

The first author extends this hypothesis, based on decades of clinical experience in counseling men, by proposing that there is a continuum in the severity of normative male alexithymia, corresponding to the degree of severity of the gender role socialization process. The latter ranges from mild, in which boys were simply instructed that the expression of vulnerable and attachment emotions was not appropriate (either in general, or in certain social contexts), to more severe, in which boys were punished for expressing these emotions, to traumatic, in which boys were severely and/or repeatedly punished to the point that they suffered trauma for expressing these emotions. It is further proposed that different psychological defense mechanisms operate at each of these points on this continuum, from suppression for mild socialization, to repression for severe socialization, to dissociation for traumatic socialization.

External Validity for the Alexithymia Construct

In order to assess the external validity for the alexithymia construct, researchers have moved beyond the use of self-report measures to focus on whether individuals with high scores on the TAS-20 would also show difficulty processing emotion-related content in performance tasks, and have found evidence that they do. Parker, Taylor, and Bagby (1993a) found that individuals who scored high on the TAS-20 were significantly worse at identifying faces' emotional content than were those who scored low, with total scores across 8 emotions averaging 14 % worse than for those who scored low. Parker, Taylor, and Bagby (1993b) also found that men and women who scored high on the TAS-20 had a significantly longer total response time in a Stroop task to color-name five emotionally arousing words (107 seconds) as compared to those who scored low (95 seconds).

Researchers have also utilized semantic priming to investigate whether persons with alexithymia would show deficits in their performance in response to stimuli designed to evoke emotional arousal. Semantic priming occurs when meaning-based context either facilitates or interferes with word recognition. In a lexical-decision task, Neely (1977) found that exposure to a word (the prime) primes semantically related words, so that one can identify a related word (the target) faster, showing *positive* priming. However, *negative* priming can also occur. For example, Allen, Goldstein, Madden, and Mitchell (1997) observed that primed semantic exemplars from “non-living” categories (e.g., “rock”) showed slower naming latencies than when “living” categories (e.g., “tree”) were used. This study was done with older adults, whose negative priming may have been due to a greater sensitivity to non-living items as exemplars of death.

An implication of Allen et al. (1997) is that when both prime and target are emotion words, then individuals with alexithymia would likely experience interference in response to the prime, resulting in either showing the absence of a positive priming effect, or having a slower reaction time and/or making more errors– that is, showing a *negative* priming effect. This was demonstrated in study by Suslow and Junghanns (2002), using emotion situation priming (short sentences designed to evoke a specific emotion) with a lexical decision-making task, which found positive priming for those scoring low on the TAS-20 and negative priming for those scoring high on the TAS-20 . Mean priming effects were 42.3 ms for the low alexithymia group, and – 52.7 ms for the high group. The interstimulus interval (ISI; the time interval between the end of the prime and the appearance of the target) was 500 milliseconds, which is thought to be slow enough to allow for conscious processing of the stimuli. This study thus also suggests that individuals scoring higher on the TAS-20 experienced the deficit later in the process (at 500 ms), which is consistent with suppression as the mechanism involved. However, because short ISIs were not used, an earlier deficit might also have occurred (e.g., due to either dissociation or repression).

The Present Study

The literature on alexithymia in men has relied principally on self-report measures and correlational studies. We wanted to extend that psychometric literature using a large self-report sample in Study 1 to determine whether such evidence implies a dissociation, repression, or suppression mechanism in alexithymia in men. Thus as a first aim, we assessed the extent to which scores on measures of alexithymia and normative male alexithymia can be differentially and uniquely predicted by scores on measures of dissociation, repression, and suppression, in order to more precisely examine by what mechanism the deficit in emotional processing occurs. However, as is usually the case in psychology, there is probably no "one size fits all" answer to this question, due to individual differences in personality. Given the non-clinical nature of the participants (college men), we hypothesized that alexithymia will be more strongly predicted by a measure of suppression than by measures of repression and dissociation, since research on gender role conflict suggests that normally-functioning men would likely have had milder experiences of masculine socialization than men suffering from psychiatric disorders (O'Neil, 2008).

The second aim, in Study 2, was to use an experimental approach (semantic priming), to investigate two assumptions of Levant's (1995, 1998, 2011) normative male alexithymia hypothesis: that men with alexithymia (as compared to those without it) would show the greatest deficits in identifying and expressing emotions discouraged by traditional masculine norms (those that express vulnerability or attachment, which we designated as experimental emotion words; e.g., lonely, tender); and that men with and without alexithymia would not differ in their ability to identify emotions that are encouraged by masculine norms (those that express aggression or lust, which we designated as control emotion words; e.g., angry, lewd). We also sought to extend existing research and the first aim by using a lexical decision-making task with different stimulus onset asynchronies (SOAs), so that we could more precisely ascertain the timing of the deficit.

First, we hypothesized that men with alexithymia (as compared to men without it) will show slower reaction times and/or more errors in the lexical decision-making task using experimental emotion words. Second, we hypothesized that men with and without alexithymia will not differ in their performance (either reaction times and/or accuracy) using control emotion words. Third, by using different SOAs of 100, 300, and 500 ms, we explored when alexithymia occurs. Specifically, we predicted that no appreciable priming should occur at the 100 ms SOA because primes would be offset immediately before targets would be onset (i.e., an interstimulus interval, ISI, of 0). We predicted that the 300 ms SOA conditions (200 ms ISI) would correspond to very early automatic preconscious priming , which is consistent with repression or dissociation as the mechanism, and that the 500 ms SOA would result in later conscious priming, which is consistent with suppression as the mechanism.

This rationale for the assertion that shorter SOAs measure automatic processes and longer SOAs measure conscious, cognitive processes is based on behavioral, psychophysiological (event-related potential, or ERP, summed brain waves that are a response to a specific experimental condition), and magnetoencephalography (MEG) scanning (a neuro-imaging technique that allows researchers to isolate areas of brain activation while maintaining temporal resolution) results. The behavioral evidence is that stimuli presented for 200 ms or less, and followed immediately by a backwards mask (when a pattern, e.g., "XXXXX", is presented immediately following target presentation) are not consciously experienced, but that stimuli presented for over 200 ms and then masked are experienced consciously (e.g., Averbach & Coriell, 1961).

Conscious processing in behavioral research is cognitive in nature (Pollock, Khoja, Kaut, Lien, & Allen, 2012; Shaw, Lien, Ruthruff, & Allen, 2011). Shaw et al. (2011) and Pollock et al. (2012) used a psychological refractory period (PRP) paradigm (a divided attention task that can assess whether automatic processing has occurred) in which the stimulus onset asynchrony (SOA) between Task 1 and Task 2 was varied from 50 ms to 1,000 ms. ERPs time-locked to Task 2 stimulus onset were measured. These studies found that the N2pc effect (the negative ERP deflection measured in the contralateral parietal cortex reflecting spatial attention; Shaw et al., 2011) and P1 (the positive ERP deflection measured in the occipital cortex reflecting early visual processing; Pollock et al., 2012) elicited by Task-2 angry faces were similar in magnitude at very short SOAs (50-100 ms) as the longest SOA (900-1000 ms). These results suggested that emotional faces, especially expressing negative emotions, could be processed automatically without central attention.

Finally, Cornwell et al. (2008) conducted a MEG-scanning study using the same emotionally-valenced faces as used by Shaw et al. (2011) and Pollock et al. (2012). They observed that the amygdala showed peak activation to emotional faces in less than 200 ms – converging evidence that early emotional responses to visual stimuli are preconscious and automatic. Consequently, there is evidence that priming in our 100 ms and 300 ms SOA conditions (because the ISI for these two conditions is 0 and 200 ms, respectively) should be automatic (preconscious), and that repression and dissociation are the most common inhibitory processes associated with this early stage. Furthermore, the 500 ms SOA would result in a 400 ms ISI – resulting in conscious, cognitive processing often associated with inhibitory suppression.

Study 1

Method

Participants. A total of 258 men from a large, public, Midwestern research university participated in the study. Ages ranged from 18 to 59 years, with a mean of 22.13 (SD = 5.88). The median age was 20, and the modal age was 19. Most participants identified as European American (79.8%), yet 10.5% identified as African-American. Fewer (3.1 % or less) identified as Latino/Hispanic, Asian or Asian/American, Middle Eastern, Bi/Multi-Racial, American Indian, or Other. Most participants (96.5 %) identified as heterosexual, with 2.3 % or less identifying as Gay or Bisexual. Most of the participants indicated that they were either single and dating one person exclusively (33.3 %) or single and not dating anyone (36.4 %), although 17.1 % identified as single and engaged in casual non-exclusive dating, and 14.4 % were married, partnered or engaged. The median self-identified socioeconomic status was middle class. Finally, in terms of religion, most participants (62.4 %) identified as Christian, but 21.3 % identified as Agnostic or Atheist, and 11.2 % as other. Fewer (1.2 % or less) identified as Jewish, Muslim, Hindu, Buddhist, or Pagan.

Procedure. The study was approved by the university IRB. Undergraduate men 18 years and older were solicited from psychology, computer science, and physics courses (the latter two because more men enroll in these courses than in psychology courses) and offered extra credit for their participation in the study. A web-based survey method with a commercially-available survey utility was used to collect the psychometric data. The first page of the site reviewed the informed consent information, and participants who agreed to participate clicked “yes,” and were taken the survey, which consisted of 9 different questionnaires with 189 questions total.

Instruments were presented in the order listed below. After participants completed the questionnaires, they received information on how to obtain the results of the study and course credit for their participation.

Measures.

Demographic Questionnaire. This questionnaire inquired about sex/gender, race/ethnicity, age, relationship status, sexual orientation, family/household income, SES, and religion.

Normative Male Alexithymia Scale (NMAS). The NMAS (Levant et al., 2006) is a 20-item inventory designed to assess normative male alexithymia (e.g., "I am often confused about what emotion I am feeling"). Participants answered questions about their own experience of emotions using a Likert-type format (1 = *strongly disagree*; 7 = *strongly agree*), with higher scores indicating higher levels of alexithymia. Exploratory and confirmatory factor analyses indicated that the NMAS consisted of a single 20-item factor. Scores on the NMAS displayed evidence of internal consistency (coefficient α = .92) and test-retest reliability (*r* =.91) over a 1 to 2 month period (Levant et al., 2006). In this study, coefficient α = .92.

Toronto Alexithymia Scale (TAS-20). The TAS-20 (Bagby, Parker, & Taylor, 1994) is the most widely used measure of alexithymia, a construct referring to a cluster of characteristics including difficulty identifying and describing feelings, and externally oriented thinking. Sample items include, "I am often puzzled by sensations in my body," and "I don't know what's going on inside me." Participants rated their agreement with 20 statements ranging from 1 (*strongly disagree*) to 5 (*strongly agree*), with higher scores indicating greater alexithymia. In the present study, the total scale had a coefficient α of .84. Convergent validity has been demonstrated by negative associations with closely related constructs such as psychological mindedness, need-forcognition, affective orientation, and emotional intelligence (see Taylor, 2004, for a summary).

The NIMH Center for Epidemiologic Studies Depression Scale (CESD). The CESD (Radloff, 1977) was designed for use in studies of the epidemiology of depression. It consisted of 20 items in which participants were asked to indicate how often they felt or acted in the way depicted over the past week, using a 4-point Likert-type scale ranging from 0 = *rarely or none of the time (less than 1 day)* to 3 = *most or all of the time (5-7 days).* A representative item is: "I was bothered by things that usually don't bother me." Higher total scores suggest greater symptoms of depression compared to lower scores. The coefficient α for this study was .79.

The Positive Affect Negative Affect Schedule (PANAS). The PANAS (Watson & Clark, 1994***)*** is a 20-item scale designed to measure two general factors of self-rated affect – Positive Affect (PA) and Negative Affect (NA). Participants were asked to rate to what extent they have experienced a particular emotional state "on the average," using a 5-point Likert-type scale, where 1 = *very slightly or not at all* to 5 = *extremely*. Representative items are "Excited" for positive affect and "Distressed" for negative affect. In the present study coefficient α's were .87 for the PA scale and .86 for NA scale.

Manifest Anxiety Scale (MAS). Bendig (1956) selected the 20 most consistently valid items from the 50-item Taylor Manifest Anxiety Scale (Taylor, 1953) to create the MAS, a measure of trait anxiety. Participants responded to statements about physiological and subjective symptoms of anxiety in a true–false format (e.g., "I feel anxiety about something or someone almost all the time"). Scores range from 0 to 20, with higher scores indicating greater trait anxiety. Bendig (1956) reported coefficient α of .76. In the present study, coefficient α was .89.

Marlow–Crowne Social Desirability Scale (SDS). The 33-item SDS (Crowne & Marlowe, 1960) measures the tendency to respond in socially desirable ways. Participants assessed statements describing socially desirable or undesirable behaviors in a true – false format, for example, “I never hesitate to go out of my way to help someone in trouble.” Scores range from 0 to 33, with higher scores indicating greater defensiveness and more socially desirable responding. Crowne and Marlowe (1960) reported a test–retest reliability of .89 and coefficient α of .88. The coefficient α for the present study was .69.

Index of Self-Regulation of Emotion (ISE). The ISE (Mendolia, 2002; Myers & Derakshan, 2004) is based on the MAS and SDS and was used to measure repression. In this study, we followed the procedure of Wong, Pituch, and Rochlen (2006), and calculated participants’ ISE scores using the following formula: ISE = 20 – (MAS score – [SDS score × 20/33]). SDS scores were multiplied by 20/33 to equate the total possible score of the SDS with that of the MAS, because the SDS has a higher total possible score than the MAS (a score of 33 compared with 20). Scores range from 0 to 40, with higher scores representing higher levels of repression (low levels of self-reported anxiety and high levels of defensiveness). Construct validity has been demonstrated through many studies demonstrating that repressors tend to employ an avoidant style of information processing, repress negative cognitions, dissociate their somatic reactions from their perceptions of distress, and are hypersensitive to anxiety-provoking information (Furnham, Petrides, Sisterson, & Baluch, 2003; Myers & Derakshan, 2004).

Attitudes Towards Emotional Expression Scale (ATEES). The ATEES (Joseph et al., 1994) is a 20-item measure of beliefs and tendencies regarding emotional expression. Participants rated their agreement with statements on a 5-point scale ranging from 1 (*disagree very much*) to 5 (*agree very much*). Scores range from 20-80, with higher scores indicating more negative attitudes toward emotional expression. A representative item is: “I think getting emotional is a sign of weakness.” Joseph et al. (1994) reported a coefficient α of .90 for the total scale. In the present study, the total scale had a coefficient α of .97. Evidence for convergent validity was provided through reports of associations between the ATEES overall scale and higher levels of depression, a lack of seeking social support (Joseph et al., 1994), and greater ambivalence toward emotional expression (Laghai & Joseph, 2000).

Dissociative Experiences Scale (DES). The DES (Bernstein & Putnam, 1986) is a 28-item measure of dissociation. Participants were asked to rate how frequently they experience specific dissociative symptoms, using an 11-point scale from 0 (*never experiencing*) to 10 (*constantly experiencing*). A representative item is: "Some people have the experience of driving or riding in a car or bus or subway and suddenly realizing that they don't remember what has happened during all or part of the trip." A meta-analysis (Van Ijzendoorn & Schuengel, 1996) found evidence of convergent validity with other measures of dissociation (d =1.82, N = 5916), and of predictive validity with dissociative disorders (d =1.05, N =1705), PTSD (d =.75, N =1099) and abuse (d =.52, N =2108). However, discriminant validity was less well established. In the present study, the coefficient α was .94

Results

Data Screening and Descriptive Statistics. All participants who began the survey completed it, for a completion rate of 100 %. The data were thoroughly screened before conducting statistical analyses to ensure the accuracy of the data file. There were missing data as some participants did not respond to every item. No evident patterns of non-response were found by visually inspecting the missing data, which suggested that they were missing at random; hence we replaced missing values using SPSS-17's Linear Trend at Point method. This is a regression-based single imputation method, in which the existing series is regressed on an index variable scaled 1 to n, and missing values are replaced with their predicted values. Descriptive statistics and bivariate correlations of study variables are presented in Table 1.

Regression Analyses. We used hierarchical multiple regression analyses to assess the extent to which scores on measures of alexithymia (TAS-20) and normative male alexithymia (NMAS) can be differentially predicted by scores on measures of dissociation (the Dissociative Experiences Scale, DES), repression (the Index of Self-Regulation of Emotion, ISE), and suppression (the Attitudes Toward Emotional Expression Scale, ATEES), in order to investigate by what mechanism the deficits in emotional processing occur. We hypothesized that suppression, a later cognitive regulation effect, will more strongly and uniquely predict alexithymia scores than the earlier effects of either dissociation or repression.

Alexithymia is associated with anhedonia, including both a tendency to experience negative emotions and a diminished capacity to experience positive emotions (Prince & Berenbaum, 1993). Alexithymia is also related to depression (Bagby, Taylor, & Parker, 1994). Hence we also included measures of these variables, using the Positive Affect Negative Affect Schedule (PANAS, which has two subscales, a measure of negative emotions, or affect, NA, and a measure of positive emotions, or affect, PA), and the Center for Epidemiologic Studies Depression Scale (CESD, a measure of depression) as predictors.

The results are shown in Table 2. We conducted two analyses, one with alexithymia (TAS-20) as the criterion variable and one with normative male alexithymia (NMAS) as the criterion variable. In Model 1, Step 1 we tested whether depression (CESD), positive affect (PA), negative affect (NA), repression (ISE) and dissociation (DES) would predict TAS-20 scores. While the model was significant ($F = 3.95$, $p < .003$), none of the beta coefficients were significant. In Step 2, we simply added suppression (ATEES) as the final predictor. The model was significant ($F = 6.16$, $p < .0001$), and the increment in R-squared was .113 ($F = 14.02$, $p <$

.0001). Furthermore, the only significant predictor was suppression, and its squared semi-partial correlation, reflecting the unique variance was .113. Thus, even when suppression was forced to be entered last, it still was the only significant predictor. This suggests that suppression predicted TAS-20 scores independently of all the other variables.

In Model 2, Step 1, we tested whether depression (CESD), positive affect (PA), negative affect (NA), repression (ISE) and dissociation (DES) predicted normative male alexithymia (NMAS). As in Model 1, Step 1 was significant ($F = 3.58$, $p < .005$), but none of the beta coefficients were significant. In Step 2, we added suppression (ATEES) to the other five predictors. The second step was significant ($F = 15.59$, $p < .0001$), and the increment in R-squared was .349 ($F = 62.98$, $p < .0001$). Both negative affect and suppression were significant predictors. Their squared semi-partial correlations, reflecting unique variance, were .047 and .349, respectively. The results from Model 2 suggested that suppression predicted NMAS scores independently of most of the other variables, with the exception of negative affect, although it accounted for almost three times as much unique variance as negative affect.

Discussion

Although we theorized that normative male alexithymia could be associated with dissociation, repression or suppression, given the non-clinical nature of the participants (college men), we hypothesized that it would be more strongly predicted by a measure of suppression than by measures of repression and dissociation, since normally-functioning men would likely have had milder experiences of masculine socialization. The results support the hypothesis that suppression was a significant predictor in both of the analyses, and accounted for the most unique variance. Although negative affect was also a significant predictor for normative male alexithymia, it accounted for much less unique variance. Consequently, in the present psychometric study conducted on a large sample of men, we observed that suppression was the strongest predictor of alexithymia and normative male alexithymia.

There are limitations with regard to the surveys used in Study 1. First, there may have been an order-effect (as all surveys were presented in the same order for Study 1) and participant fatigue (given the number of questions). Second, the item similarity between the alexithmia (TAS-20), normative male alexithymia (NMAS), and suppression (ATEES) measures (all three focused on emotions), as contrasted with the lack of similarity between the TAS-20, NMAS and the measures of repression and dissociation, may have been, in part, responsible for the results. Third, the alpha for one of the measures (Marlow-Crowne Social Desirability Scale) was marginal (.69). Fourth, the self-report nature of the surveys introduces the possibility of bias due to socially-desirable responding. A future study employing a multi-method design (including the interviewing method) would strengthen evidence for these relationships. Further, given the correlational nature of the data in Study 1, we cannot make inferences about causal relationships.

Study 2

Method

Participants. The semantic priming data from 85 participants were analyzed for the lexical decision-making task for Study 2. We divided this sample into two levels based on scores on the Toronto Alexithymia Scale-20 (TAS-20). Although many investigators use a cut score of ≥ 61 for alexithymia, Bagby et al. (1994) had marked this threshold value as "preliminary." Franz et al. (2008) noted that a cut score of ≥ 61 corresponded to the 90^{th} percentile and recommended instead using the 66^{th} percentile, which for men is 53.Thus the groups were created as follows: alexithymia (TAS-20 score ≥ 53), non-alexithymia (TAS-20 score ≤ 52). For the alexithymia group, $N = 19$, ages ranged from 18 to 58 years, with a mean of

23.95 (*SD* = 8.91), and the mean and SD alexithymia scores were 57.69 and 3.92. For the non-alexithymia group, *N* = 66, ages ranged from 18 to 59 years, with a mean of 23.61 (*SD* = 7.78), and the mean and SD alexithymia scores were 40.26 and 6.96.

Apparatus, Stimuli, and Procedure. Participants were tested individually on microcomputers equipped with 20-inch monitors, with a viewing distance of about 60 cm. Stimuli were presented and data were collected using the E-prime software (Schneider, Eschman, & Zuccolotto, 2002). All stimuli were presented in white against a black background. As is shown in Supplemental Online Figure 1, each trial started with a fixation display for 1,200 ms, followed by the prime display for 100 ms. The target display then appeared after one of the SOAs (100, 300, or 500 ms) and was on the screen until participants made a response. Auditory feedback (a tone) was presented 100 ms after incorrect responses and silence lasted for 100 ms after correct responses. Immediately after the feedback, the next trial began with the fixation display for 1,200 ms.

The fixation display consisted of a centrally located plus sign (0.76° width × 0.86° height). Both the prime display and the target display contained top and bottom rows of characters, which were centered 0.86° apart. The prime display consisted of either two rows of 8 X's or one row of X's and a prime word in a different row. The target display consisted of one row of 8 X's and the target, either a word or a pronounceable non-word, in a different row. Both the prime and the target were printed in lowercase. Each of the letters and X's subtended a visual angle of approximately 0.76° width × 0.86° height. The location of the target word was fixed throughout the whole experiment (the top row for half of the participants and the bottom row for the other half). Participants were encouraged to consciously allocate their attention to that target location. The prime word always appeared in the opposite location as the target.

Words used in the prime and the target were in two categories: Experimental Emotion adjectives (words for emotions discouraged by masculine norms that express vulnerability and attachment, such as “anguished”, “love”) and Control Emotional adjectives (words for emotions encouraged by masculine norms that express aggression and lust, such as “brutal”, “lustful”). The non-words for the target were formed by changing one of the letters for each word (e.g., the word “love” vs. the non-word “luve”). Participants were to press the key “Z” with the left index finger for words and the key “M” with the right index finger for non-words. Reaction time (RT; in ms) and errors were measured.

Participants completed 1 practice block of 24 trials and 4 regular blocks of 60 trials each (a total of 240 experimental trials, see the Supplemental Online Appendix for the target stimuli) consisting of 24 conditions resulting from 3 prime conditions (experimental emotion word, control emotion word, X’s) × 3 target conditions (experimental emotion word, control emotion word, pronounceable non-word) × 3 SOAs (100, 300, and 500 ms). However, this was a nested design because we did not vary prime-type and target-type (e.g., experimental prime words never appeared before control target words – this was done to unambiguously determine the locus of priming effects). This resulted in 24 instead of 27 cell conditions (see Table 3). Participants received a summary of their mean RT and errors at the end of each block.

We did not analyze the data involving non-words because they are not processed lexically, and hence there would be no priming effect. These data were used to determine if participants were doing the lexical decision-making task correctly. Note also that our semantic priming task differed from earlier priming tasks that presented primes and targets in the same spatial location and varied the SOA between the two. Our procedure allows more precise control over the temporal interval between the prime and the target. Critically, it allows the target to be presented before the prime is offset from the screen.

Results

We analyzed a nested design using repeated measures ANOVA to test 2 levels of Prime-Type (word [either an experimental or control emotion word, depending on the Target-Type] or a row of X's), 2 levels of Target-Type (either experimental or control emotion word as the target), 3 levels of SOA (100, 300, and 500 ms), and 2 levels of TAS group based on scores on the Toronto Alexithymia Scale-20 (TAS-20), as described above. We analyzed the data separately for the two dependent variables, RT and errors, expecting that effects could appear either in RT, or in errors, or in both.

For RT, there were significant main effects for Target-Type, $F(1,83) = 32.22$, $p < .0001$, $\eta^2 = .280$, and SOA, $F(2,82) = 6.88$, $p = .0017$, $\eta^2 = .080$, and one significant 3-way interaction, of Prime-Type × SOA × TAS Group, $F(2,82) = 4.81$, $p = .0106$, $\eta^2 = .040$. Mean RT's, SD's and priming effects are shown in Table 4. The three-way interaction implied that there was a different pattern of priming effects across TAS group and SOA. To better interpret this interaction, we ran simple effect analyses separately for each SOA. For the 100 ms SOA, there was no Prime-Type × TAS Group interaction ($p = .818$), as expected. For the 300 ms SOA, the Prime-Type × TAS Group interaction approached significance, $F(1,83) = 3.17$, $p = .079$ (the non-alexithymia group showed a trend toward negative priming: -19 ms; whereas the alexithymia group showed a trend toward positive priming: 38 ms). For the 500 ms SOA, the Prime-Type × TAS Group interaction also approached significance, $F(1,83) = 3.39$, $p = .069$ (both groups showed trends toward negative priming: -8 ms for the non-alexithymia group and -61 ms for the alexithymia group).

Finally, because the results from Study 1 suggested suppression as the mechanism for the emotional processing deficit, priming should occur for the alexithymia group at the 500 ms SOA, but not in any other of the TAS Group × SOA conditions. Therefore, we ran simple effects separately by SOA and TAS Group to determine when, and if, statistically significant priming occurred for the RT data. Just the 500 ms SOA for the alexithymia group showed significant priming, $F(1,83) = 6.80$, $p = .018$ (- 61 ms, negative priming), $\eta^2 = .274$. The 300 ms SOA for the alexithymia group showed a trend toward positive priming, $F(1,83) = 2.30$, $p = .147$, but the other four analyses did not approach statistical significance (alexithymia group, 100 ms: p = .459; non-alexithymia group: 100 ms: p = .259; 300 ms: p = .228; 500 ms: p = .572). Thus, the pattern of priming for RT did vary across TAS group, SOA and Prime-Type, but only the 500 ms SOA for the alexithymia group showed a statistically significant negative priming effect. A very curious possibility, though, is that the alexithymic group actually showed a trend toward positive priming (38 ms) for the 300 ms SOA.

For errors there were significant main effects for TAS-group, $F(1,83) = 4.14$, $p = .0450$, $\eta^2 = .047$ (mean percent error: alexithymia group = 14.8 %, non-alexithymia group = 10.7 %), and Target-Type, $F(1,83) = 55.38$, $p < .0001$, $\eta^2 = .399$ (experimental emotion targets = 10.5 %, control emotion targets = 15.0 %), and one significant 3-way interaction for Prime-Type × Target-Type × TAS-group, $F(1,83) = 5.70$, $p = .0193$, $\eta^2 = .064$ (see Table 5 for means). From the three-way interaction, it appeared that there was a different pattern of Target-Type effects for the non-alexithymia group as compared to the alexithymia group across prime type. For the non-alexithymia group, the Prime-Type effect (control emotion target – experimental emotion target = 12.53 – 8.47) = 4.06, and the Prime-X's effect (14.07 – 7.80) = 6.27. For the alexithymia group, the Prime-Type effect (17.80 – 12.27) = 5.53, and the Prime-X's effect (15.67 – 13.47) = 2.20. This pattern was further elucidated by additional simple effect analyses by Prime-Type.

There was a TAS Group × Target-Type interaction, $F(1,83) = 5.66$, $p < .02$, $\eta^2 = .062$, for row of X's primes, but not for word primes, $F(1,83) = .79$, $p = .38$. Thus, there were no TAS Group differences in errors across experimental and control targets for words as Prime-Type, but with a row of X's as the Prime-Type there was an advantage of experimental targets relative to control targets for the non-alexithymia group compared to the alexithymia group. The large difference in error rates for experimental targets versus control targets for the non-alexithymia group (7.8 % vs. 14.1 %) dwarfed that of the same comparison for the alexithymia group (13.5 % vs. 15.7 %). Consequently, even though, overall, individuals performed lexical decision-making more accurately for experimental emotion words than for control emotion words, the alexithymia group did not show a significant improvement in lexical decision performance for the experimental emotion target words, whereas the non-alexithymia group did show the effect.

We had specified two a-priori hypotheses, tested via planned comparisons, which we report next.

Hypothesis 1. Hypothesis 1 stated that the alexithymia group will show slower RTs and/or more errors in the lexical decision-making task using experimental emotion words as compared to the non-alexithymia group. We did not find a significant Prime-Type × Target-Type × TAS Group interaction for RT, but we did for errors. Hence, to test Hypothesis 1, we examined the simple effects for one of the Target-Types, experimental emotion words, and found a significant effect for TAS group, $F(1,83) = 6.98$, $p = .0099$, $\eta^2 = .078$. Averaged across the three SOA's, the alexithymia group had poorer accuracy (errors: 12.9 %) than did the non-alexithymia group (8.1 %) with experimental emotion words, supporting Hypothesis 1.

Hypothesis 2. Hypothesis 2 stated that the alexithymia and non-alexithymia groups would not differ in their performance (RTs and/or accuracy) on a lexical decision-making task using control emotion words. Since there was no Prime-Type × Target-Type × TAS Group interaction for RT, but there was for accuracy, we examined the simple effects for only one of the target types, control emotion words to test this hypothesis. The effect for TAS group was not significant, $F(1,83) = 2.11$, p = n.s., supporting Hypothesis 2.

Discussion

Both hypotheses were supported through the planned comparisons. The alexithymia group showed more errors in lexical decision performance using experimental emotion words as compared to the non-alexithymia group, but the alexithymia and non-alexithymia groups did not differ in their errors using control emotion words. These lexical decision results need to be tempered by the fact that they occurred only for row of X's as primes, and not for word primes, a finding which we attribute to spatial location issues for our specialized priming task. That is (as shown in Supplemental Online Figure 1) we used different spatial presentation locations for prime and target so that we would have more precision in the SOA manipulations. This likely resulted in less priming because more attentional resources had to be allocated to holding two stimuli in working memory at different spatial locations than one would observe in a traditional priming task in which the prime and target are presented in the same location. Nonetheless, the alexithymia group performed less accurately than the non-alexithymia group with experimental emotion words as targets, but both groups performed the same with control emotion words as target.

With regard to the exploratory question, we predicted that no appreciable priming should occur at the 100 ms SOA because primes would be offset immediately before targets would be onset; that the 300 ms SOA conditions (200 ms ISI) would correspond to very early automatic priming (which in turn corresponds to repression or dissociation); and that the 500 ms SOA would result in conscious, cognitive priming (suppression). There was a significant 3-way interaction, of Prime-Type × SOA × TAS-group, for RT, but there was no significant interaction involving SOA for accuracy. As noted earlier, the only statistically significant simple effect for priming was negative priming for alexithymic men at the 500 ms SOA (-61 ms). This is evidence for a later inhibitory priming effect on all emotional words for alexithymic men that appears to be consistent with a suppression interpretation.

General Discussion

Summary of Results

The results from Study 1 showed that suppression was a better predictor of alexithymia than were either dissociation or repression, while controlling for positive and negative affect and depression, although both suppression and negative affect predicted normative male alexithymia. However, the squared semi-partial correlations (reflecting unique variance) were substantially larger for suppression than for the other predictors for both alexithymia and normative male alexithymia. Consequently, these regression results from Study 1 provide evidence that suppression is the best predictor of alexithymia and normative male alexithymia in a sample of college men. This is consistent with prior survey research on "restrictive emotionality," a form of men's gender role conflict that is similar to normative male alexithymia (O'Neil, 2008). Wong et al. (2006) found, using regression analyses that suppression, as measured by the ATEES, was found to be most closely associated of a set of emotion-related variables with restrictive emotionality.

There were three important findings observed in Study 2. First, both hypotheses were supported through the planned comparisons with the error data. In regard to the first hypothesis, the alexithymia group showed more errors in lexical decision performance using experimental emotion words as compared to the non-alexithymia group; in regard to the second hypothesis, the two groups did not differ in their errors using control emotion words. As previously noted, these results need to be tempered by the finding that neither group showed evidence of any priming with regard to errors, which we attributed to spatial location issues which likely attenuated priming effects. The Prime Type × Target Type × TAS Group interaction for errors occurred because the alexithymia group did not show a significant improvement in lexical-decision performance for the experimental emotion target words relative to control target words, whereas the non-alexithymia group did show this effect. Thus, even though participants overall showed better lexical decision performances for experimental emotion words than for control emotion words (which, as we will shortly discuss, may be due to the higher frequencies of the experimental emotion words as compared to the control emotion words), the alexithymia group did not show this effect. This provides additional support for Levant's (1995, 1998, 2011) normative male hypothesis, particularly the postulate that men with normative alexithymia would show the greatest deficits in identifying and expressing emotions that reflect vulnerability or attachment.

Second, the RT data showed a significant negative priming effect for the alexithymia group at the 500 ms SOA, but none of the other TAS Group × SOA conditions showed significant simple effects. These results suggest that the alexithymia group inhibited both experimental and control emotional words for primes at a 400 ms ISI (500 ms SOA because the prime stimulus was presented for 100 ms) – and this is consistent with the suppression mechanism observed in the regression analyses for Study 1, as well as with Suslow and Junghanns (2002) who also found a negative priming effect for emotional situations at a 500 ms ISI for an alexithymia group.

Thus, converging lines of evidence, arising from survey data analyzed by regression techniques (as in the present study and Wong et al., 2006), to experimental data using semantic priming (as in the present study and Suslow and Junghanns, 2002), implicate suppression as the mechanism for alexithymia and normative male alexithymia. One important implication for theory development is that Gender Role Strain Paradigm theorists (Levant, 2011; Pleck, 1981, 1995; Pollack, 1998), who have characterized the emotional socialization process that occurs during boyhood as "trauma strain," may have overestimated the damaging effects of the male emotional socialization process for most men. Suppression is considered a higher level, less reality-distorting defense mechanism than either repression or dissociation. However, as was previously noted, there is probably no "one size fits all" answer to the question of where the disruption in emotion processing occurs. It is conceivable that repression and dissociation might play stronger roles in community, or, more likely, clinical samples.

Limitations and Suggestions for Future Research

We wish to acknowledge some limitations of the current study which at present may also place some boundaries around the generalizations of results. First, the majority of college men who participated in the investigation were young, European American, heterosexual, and Christian, raising concerns about the generalizability of our findings. Future research should attempt to replicate the present findings with a more diverse population in terms of age, race/ethnicity, sexual orientation, and religion. Moreover, in terms of addressing the question of when the deficit in emotion processing occurs, and further investigating the role of repression, dissociation, it would be important to include clinical samples in future research.

Second, as noted above, there are limitations with regard to Study 1, which include a potential order-effect in the presentation of the scales, participant fatigue, item similarity between the alexithmia, normative male alexithymia, and suppression measures, low alpha for one scale, the possibility of bias due to socially-desirable responding, and the correlational nature of the data. Future research should address these issues.

Third, there are also limitations with regard to Study 2. As mentioned, the present approach of presenting primes and targets at separate spatial locations to allow more precision in manipulating the SOA between these two variables may have resulted in an attentional resource limitation making it more difficult to observe priming, which should be addressed in future research. In addition, the present experimental emotion words exhibited significantly higher frequencies (mean HAL frequency = 8,549, see Balota et al., 2007) than did the control emotion words (mean HAL frequency = 5,295) (see Supplemental Online Appendix). This probably resulted in a considerable under-estimation of the present level of suppression for experimental emotion words, which should be addressed in future research. However, the fact that we still observed suppression for these words in spite of their greater saliency suggests that the effect is strong.

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Table 1.

Descriptive Statistics and Correlation Coefficients for All Survey Variables

Scale	1	2	3	4	5	6	7	8	9	10
1.TAS-20	.70**	.34**	-.28**	.42**	.22**	-.11	-.24**	.26**	.61**	
2.NMAS		.32**	-.30**	.37**	.20**	-.14*	-.23**	.14*	.72**	
3.Depression			-.42**	.61**	.48**	-.25**	-.51**	.32**	.34**	
4.Pos Affect				-.29**	-.27**	.24**	.33**	-.06	-.25**	
5.Neg Affect					-.45**	-.24**	-.48**	.30**	.41**	
6.Anxiety						-.13*	-.90**	.23**	.25**	
7.Soc Desire							.54**	.12	-.20**	
8.Repression								-.24**	-.30**	
9.Dissociation									.29**	
10.Suppression										
Mean	44.05	3.44	13.29	36.86	18.73	10.70	16.68	19.73	22.59	54.17
SD	10.10	1.03	6.64	6.67	6.34	4.03	3.31	4.76	12.80	11.80
Alpha	.84	.92	.79	.87	.86	.89	.69	--	.94	.87
Score Range	1-100	1-7	0-60	10-50	10-50	0-20	0-33	0-40	0-280	20-80

Note: N = 258 men. TAS-20: Toronto Alexithymia Scale-20; NMAS: Normative Male Alexithymia Scale; Depression: Center for Epidemiologic Studies Depression Scale; Pos A and Neg Affect: Positive and Negative Affect subscales (respectively) of the Positive Affect Negative Affect Schedule; Anxiety, Manifest Anxiety Scale; Soc Desire: Marlowe–Crowne Social Desirability Scale; Repression: Index of Self-Regulation of Emotion; Dissociation: the Dissociative Experiences Scale. Suporession: Attitudes Towards Emotional Expression Scale.

* = $p < .05$; ** = $p < .01$.

Table 2.

A Summary of Heirarchical Multiple Regression Analyses on Alexithymia (TAS-20) and Normative Male Alexithymia (NMAS).

Model 1 (Criterion = TAS-20):

Predictor	Beta Coefficients (Standardized)	Significance	Squared Semi-Partial Correlations (Unique Variance)
Step 1			
Depression	.201	.177	.017
Positive Affect	-.088	.453	.005
Negative Affect	.208	.169	.018
Repression	.075	.608	.002
Dissociation	.150	.155	.019
Step 2			
Depression	.119	.398	.006
Positive Affect	-.067	.544	.003
Negative Affect	.235	.099	.022
Repression	.169	.223	.012
Dissociation	.093	.350	.007
Suppression	.380	.000	.113

Model 2 (Criterion = NMAS):

Predictor	Beta Coefficients (Standardized)	Significance	Squared Semi-Partial Correlations (Unique Variance)
Step 1			
Depression	.057	.705	.001
Positive Affect	-.113	.342	.009
Negative Affect	.293	.057	.035
Repression	-.028	.846	.0004
Dissociation	-.032	.759	.0009
Step 2			
Depression	-.088	.450	.003
Positive Affect	-.075	.408	.004
Negative Affect	.339	.005	.047
Repression	.137	.232	.008
Dissociation	-.133	.108	.015
Suppression	.668	.000	.349

Note: Depression: Center for Epidemiologic Studies Depression Scale (CESD); Positive and

Negative Affect: PA and NA subscales (respectively) of the Positive Affect Negative Affect Schedule (PANAS); Repression: Index of Self-Regulation of Emotion (ISE); Dissociation: the Dissociative Experiences Scale (DES); Supression: Attitudes Towards Emotional Expression Scale (ATEES).

Table 3.

Experimental Design for the Semantic Priming Study

100 ms SOA		300 ms SOA		500 ms SOA	
Experimental Condition					
Prime	Target	Prime	Target	Prime	Target
15 E words	15 E words	15 E words	15 E words	15 E words	15 E words
5 E words	5 non-words	5 E words	5 non-words	5 E words	5 non-words
15 XXX	15 E words	15 XXX	15 E words	15 XXX	15 E words
5 XXX	5 non-words	5 XXX	5 non-words	5 XXX	5 non-words
Control Condition					
15 C words	15 C words	15 C words	15 C words	15 C words	15 C words
5 C words	5 non-words	5 C words	5 non-words	5 C words	5 non-words
15 XXX	15 C words	15 XXX	15 C words	15 XXX	15 C words
5 XXX	5 non-words	5 XXX	5 non-words	5 XXX	5 non-words

Note: E words, Experimental Emotion adjectives (vulnerable and attachment words); C words, Control Emotional adjectives (anger and lust words); XXX, a row of X's; non-words, pronounceable letter strings that were not words. Both E and C words are shown in the Supplemental Online Appendix

Table 4.

Reaction Times and Priming Effects for Alexithymia and Non-alexithymia Groups over Three SOA's for Both Experimental and Control Emotion Words.

Condition	Alexithymia (*N* = 19) SOA's						Non-alexithymia (*N* = 66) SOA's					
	100 ms		300 ms		500 ms		100 ms		300 ms		500 ms	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
EE	921.44	238.24	868.53	260.17	929.54	290.06	892.90	229.70	864.53	234.46	836.41	217.12
CC	947.66	265.59	879.91	287.29	928.50	261.41	937.09	202.70	907.19	246.52	881.75	220.05
XE	895.36	250.49	852.20	237.87	848.27	262.72	878.26	215.80	840.83	219.62	826.67	193.04
XC	929.68	321.17	972.91	322.65	888.46	279.08	921.25	202.54	892.65	243.78	875.78	219.01
E+C/2	-22.03		38.34				-15.24					

Note: Reaction times in milliseconds; EE = experimental emotion words as both prime and target; CC = control emotion words as

-60.65 -19.00 -7.86

both prime and target; XE = Row of X's as prime, experimental emotion word as target; XC = Row of X's as prime, control emotion word as target; E = priming effect of experimental emotion word (XE mean – EE mean); C = priming effect of control emotion word (XC mean – CC mean); E+C/2 = average priming effect over experimental and control emotion words.

Table 5.

Accuracy (in Percentage) and Priming Effects for Alexithymia and Non-alexithymia Groups for Both Experimental and Control Emotion Words.

Condition	Alexithymia (N = 19)	Non-alexithymia (N = 66)
EE	12.27	8.47
CC	17.80	12.53
XE	13.47	7.80
XC	15.67	14.07
E	-1.20	0.67
C	2.13	-1.54

Note: Accuracy expressed as the mean percentage of words incorrectly identified; EE = experimental emotion words as both prime and target; CC = control emotion words as both prime and target; XE = Row of X's as prime, experimental emotion word as target; XC = Row of X's as prime, control emotion word as target; E = priming effect of experimental emotion word (EE - XE); C = priming effect of control emotion word (CC - XC).

Supplemental Online Appendix

Target (Experimental and Control) Emotion Words

Experimental Words:

afraid	afflicted	Moody	unpopular
agitated	alarmed	mournful	unqualified
alone	belittled	nerveless	unsure
anguished	blameworthy	Nervous	useless
anxious	branded	ostracized	valueless
apprehensive	feeble	Burned	vulnerable
awkward	fidgety	censured	weak
bashful	flimsy	criticized	whipped
bewildered	forlorn	debilitated	worthless
blue	forsaken	defamed	worrying
broken	fragile	overwhelmed	wrecked
bummed	frail	Pained	deprecated
clumsy	frightened	Panicky	depreciated
confused	futile	paralyzed	destroyed
cowardly	gloomy	Pathetic	derided
crippled	glum	perplexed	disabled
crushed	grief	Pitiful	admired
debilitated	hated	powerless	adored
defeated	helpless	Rebuked	affectionate
defective	hesitant	regretful	attached
deficient	hopeless	rejected	brotherly
deflated	horrified	reprimanded	caring
degraded	humiliated	ridiculed	comforting
dejected	hurt	sad	cordial
demolished	ignored	Scared	dedicated
demoralized	impaired	Scorned	dependent
depressed	impotent	Shaken	devoted
desolate	inadequate	Shamed	empathetic
despairing	incapable	Shy	faithful
desperate	incompetent	sickened	fondly
despondent	ineffective	Sickly	kind
diminished	inept	slighted	kindly
discouraged	inferior	Small	loveable
discredited	insecure	stranded	love
disgraced	insufficient	swamped	loving
disliked	intimidated	Tearful	neighborly
disparaged	jealous	Tense	nice
disturbed	jumpy	terrified	obliging
dismal	jilted	Timid	receptive
downcast	jittery	tormented	reliant

downhearted	lame	Unable	respectful
dread	libeled	uncertain	sensitive
effeminate	loathed	uncomfortable	sweet
embarrassed	lonely	underrated	sympathetic
estranged	lonesome	Uneasy	tender
excluded	lost	Unfit	thoughtful
exhausted	low	unhappy	understanding
exposed	meek	unimportant	unselfish
fearful	miserable	Unloved	Warm

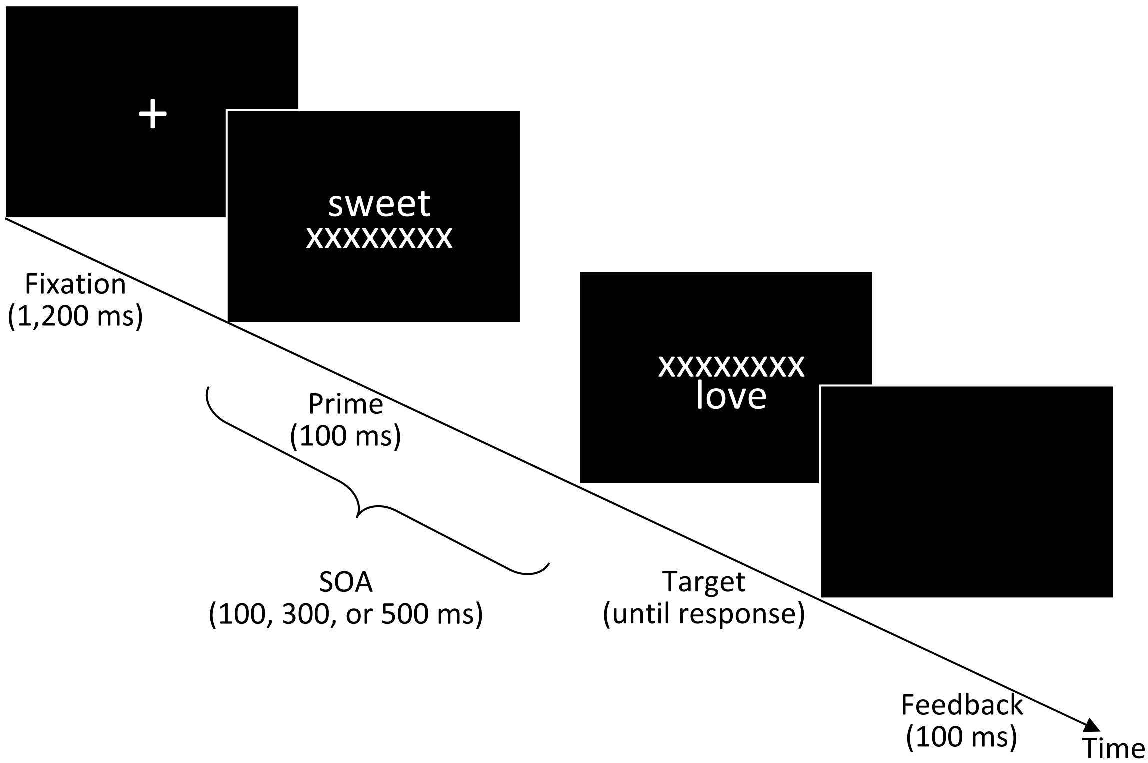
Control Words:

abuse	envious	Oppress	beautiful
aggravate	exasperated	Outrage	bodily
agitate	exploitative	perturbed	carnal
aggressive	ferocious	Peeved	craving
angry	fierce	Pissed	curvaceous
annihilate	forceful	Pitiless	cute
annoyed	frustrated	poisonous	delightful
antagonistic	furious	provoked	desirous
arrogant	gladiatorial	pugnacious	erotic
assertive	gory	Pushy	exciting
barbaric	gruesome	Quarrel	fetching
beastly	hard	Reckless	fleshy
belligerent	harass	relentless	flirtatious
biting	harsh	remorseless	gratifying
bloodthirsty	hateful	resentful	hedonistic
blunt	hawkish	revengeful	horny
brutal	heartless	Ridicule	hot
brutish	hellish	rough	intimate
bullying	hideous	rude	juicy
callous	hostile	ruthless	lascivious
combative	homicidal	sabotage	lecherous
cantankerous	humiliating	sadistic	lewd
coercive	hypercritical	savage	luscious
cold	impatient	scoff	libidinous
contrary	incensed	scorn	licentious
cranky	inconsiderate	seethe	lustful
critical	inhuman	severe	provocative
cross	insensitive	slam	physical
cruel	intolerant	spiteful	pleasurable
cutthroat	invading	threaten	pleasing
contentious	irritated	throttle	racy
corrosive	mad	unfeeling	randy
deadly	malicious	unmerciful	raunchy
derisive	maligned	unruly	risqué

despise	mean	uptight	rough
destructive	militant	vengeful	seductive
diminish	militaristic	vicious	sensual
disagreeable	mock	vindictive	sexy
disdain	monstrous	violent	spicy
dismay	murderous	wrathful	stimulating
disgrace	nasty	warlike	steamy
displeased	obstinate	stifle	suggestive
dominate	intolerable	stormy	tantalizing
disgust	neglect	unfriendly	teasing
dissatisfied	put-down	provoking	voluptuous
dogmatic	rebel	sybaritic	untamed
patronize	shame	appealing	wanton
bigoted	offend	arousing	wild
enraged	oppose	attractive	

Figure Captions

Supplemental Online Figure 1: An example event sequence for the semantic priming experiment. In this example, the target was presented in the bottom location. The prime and the target words were experimental emotional words. SOA: stimulus onset asynchrony.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Prime
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