An Embodied Approach to Emotion: Facial Responses to Subliminally Presented Stimuli

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Abstract

Traditionally, language has been viewed as an amodal system. However, recent experimenters have proposed an embodied approach suggesting that neural systems involved in perception and action are necessary for language comprehension. Previous experiments have tested this hypothesis by presenting participants with supraliminal emotion words. However, it is still unknown if embodiment would occur if emotional words were presented subliminally. Finding that subliminally presented words automatically produce bodily changes would provide evidence for Zajonc's proposal that affect, rather than cognitive appraisal, is primary in emotional experience. To test this hypothesis, corrugator and zygomaticus muscle activity was measured while words were presented to forty-one participants for 16ms. An ANOVA was used to analyze the difference in corrugator activity during the word type presentations (positive, negative, and neutral). No significant differences in corrugator activity were found across word types. An ANOVA was also used to analyze differences in zygomaticus activity among the word types. No significant differences in zygomaticus activity were found across word types. The present research suggests that subliminal words do not initiate facial responses as expected.

Keywords: facial electromyography, embodiment, emotion

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An embodied approach to emotion and language comprehension has begun to emerge in opposition to the traditional amodal symbolic system of language (Fodor, 1983). Prior to the idea of embodied cognition, information was considered to be in the form of arbitrary symbols. A person's body and physical experiences were not seen as having any involvement in the meaning-making process of these abstract symbols leaving it theoretically possible for a person who did not have a body (i.e., was only a brain in a vat as in Hilary Putnam's thought experiments) to be able to comprehend the emotionally charged world around them. It was not until the 1960's that researchers began to develop the idea of embodiment and propose the idea that individuals make meaning of their surroundings due to the body's ability to simulate features of the external world (Lakoff, 2012). Currently, theories of embodiment propose that cognition is a function of neural systems and, most importantly, physical bodily states (Niedenthal, Barsalou, Winkielman, Krauth-Gruber & Ric, 2005).

Evidence from multiple studies has shown that neural systems involved in perception and action influence language comprehension. Johnsrude and Pulvermuller (2004) discovered that motor and premotor cortexes became activated in a somatotopic fashion while participants read action verbs such as kick, pick, and lick. For example, when a person reads the word kick, the neurons that become activated when the person actually kicks their foot are activated. This neural simulation of the feeling of doing an action occurs in response to a written or verbal statement of the word itself in order to promote understanding of this word (Havas, Glenberg, & Rinck, 2007). The same neurons that become activated when an individual is performing the actual activity become activated when the person reads the word associated with that activity, enabling the individual to comprehend what the word means.

Willems, Hagoort, and Casasanto (2010) used functional magnetic resonance imaging to compare the neural simulation of right-handed participants compared to left-handed participants. Willems et al. (2010) found that, in fact, right-handers activated the left premotor cortex when completing a lexical decision task compared to left-handers who activated the right premotor areas. This shows that neural simulation depends on that individual's own body and is an actual simulation of the neural processes that occur when that particular person performs an action. This activation reminds the individual how it felt when they actually did the activity.

The Relationship between Embodiment and Emotion

Importantly, this process of simulation has also been related to emotion processing and comprehension. It is widely known that corresponding facial muscles become activated in response to facial expressions presented as stimuli (Dimberg, Thunberg, & Elmehed, 2000). For example, when a person sees a picture of a smiling face, their own muscles involved in smiling are activated, even just slightly. Halberstadt, Winkielman, Niedenthal, and Dalle (2009) found that participants who viewed a neutral face that had been paired with the word "happy" smiled more when presented with that face at a later time. Participants also frowned more when shown a neutral face that had previously been paired with the word "angry". Participants did not show facial responses when presented neutral faces that had not been associated with an emotion concept as well as Chinese ideographs which could be considered neutral pictures to the particular participants. This study provided further evidence for the role of embodiment in comprehending emotions (Halberstadt et al., 2009).

Facial mimicking has been shown to facilitate the understanding of emotions and may even affect the intensity of an individual's emotion. Havas et al. (2007) asked participants to hold a pen with either their teeth or their lips. Holding the pen with the teeth creates an open

lipped expression in which the same muscles are contracted that would be activated if the person was smiling naturally. Holding the pen with the lips activates the muscles that would be used to frown and simulates a negative expression. Participants who held the pen with their teeth (simulating a smile) reported feeling a greater intensity of humor in response to cartoons compared to participants who held a pen with their lips, which simulated a frown. The activation of corresponding facial muscles actually increased the strength of the participants' feelings of humor. Havas et al. (2007) also found that when the valence of a sentence matched the emotion their facial expression was simulating, processing of that sentence was faster. For example, if the person was holding the pen in their teeth, and therefore smiling, they processed sentences with a happy connotation faster than sentences with a negative connotation. Therefore, activation of corresponding facial muscles appears to facilitate the processing and understanding of the emotion the individual is exposed to. Similarly, Neumann, Hess, Schulz, and Alpers (2005) found that when participants were asked to respond to positive and negative stimuli with either a frown or a smile, participants responded faster when the stimulus and the facial response they were asked to make corresponded with one another. For example, if the participant was asked to smile when they saw the stimulus, they reacted quicker when the word was positive. It appears that facial mirroring facilitates the rate of processing stimuli as well as the understanding of what the stimuli is or means.

The embodiment of emotion goes beyond facial mimicking in response to emotionally expressive faces. Even more abstract stimuli such as emotion words can prompt similar bodily responses. Foroni and Semin (2009) found that written action verbs referring to emotional expressions (e.g., smile and frown) elicited activation of facial muscles in the observer in the same way as posed faces. Although, these researchers used words such as smile and frown,

which were relatively concrete in suggesting what facial response should occur, others found that

even more "abstract" emotional words such as joyful, foul, and irritable elicited corresponding

facial reactions (i.e. participants smiled when exposed to words like joyful and frowned more

when exposed to words like irritable; Niedenthal, Winkielman, Mondillon, & Vermeulen, 2009).

These results suggest that words with an emotional connection have at least some degree of

embodiment.

Using Embodied Emotion to Understand Whether Affect or Cognition is Primary in

Emotion

A debate persists regarding what is "primary" in the experience of emotion: affect or

cognition and research on the embodiment of emotion may help to answer this question. Two

researchers have come to the forefront regarding this primacy question: Zajonc and Lazarus (see

e.g., Lazarus, 1982; Lazarus, 1984; Lazarus, 1991; Zajonc, 1980). Zajonc proposes that affect,

the raw feeling that something is good or bad, is the predecessor to an emotional experience and

that cognition is not required (Zajonc, 1980). In other words, affect comes first and cognition is

not necessary to experience feelings. In fact, Zajonc suggests that an individual may never

become cognitively aware of a stimulus, but is still affected by the stimulus. For example, even

when participants could not remember the stimulus, they preferred the stimulus they had been

previously exposed to when compared to a novel stimulus showing that even unconscious

exposure to emotionally connoted stimuli can affect an individual's preferences (Zajonc, 1980).

In contrast, Lazarus proposes that cognitive appraisal is a necessary precursor to affect and

emotion because a person must first evaluate how a stimulus may impact his or her wellbeing.

Only after this cognitive appraisal has occurred can a stimulus be experienced as affectively

good or bad. Therefore, according to Lazarus, cognitive appraisal must always precede affect and emotional experience (Lazarus, 1983).

There are interesting data to support Zajonc's view. The mere exposure effect, which is the ability to heighten a person's preference for a relatively neutral stimulus by repeatedly exposing a person to the stimulus for very brief amounts of time, provides evidence that the experience of affect can occur prior to cognition (Zajonc, 1980). Importantly, it was found that the mere exposure effect is not simply due to the recognition of previously seen stimuli and actually has a proven robust effect that has remained stable across cultures, species, and different stimuli (Zajonc, 2001). A study by Matlin (1971) found that the increase in preference after exposure to a stimulus is a function of both subjective and objective familiarity. If the individual believes they have seen the stimulus before, they will rate the stimulus as more preferable. However, more importantly, objective familiarity influences preferences just as much as subjective familiarity. When individuals had been previously exposed to the stimulus their preference for that stimulus still increased whether they remembered seeing the stimulus or not (Zajonc, 1980). Additionally, Kunst-Wilson and Zajonc (1980) found that even when recognition of the stimuli was at chance level, distinct preferences for previously recurring stimuli still occurred in comparison to novel stimuli. In fact, in order to reduce the level of recognition to that of chance, stimuli in the exposure phase were displayed subliminally. However, even after being exposed to these subliminal stimuli, 60% of participants still reported that they "liked" the old stimuli more than the novel stimuli (Kunst-Wilson & Zajonc, 1980). The findings that individuals were influenced by a stimulus even when they did not remember their previous exposure to that stimulus, provides evidence for the idea that individuals can be influenced by subliminal stimuli that do not reach conscious awareness.

Although Zajonc has discovered that subliminal stimuli can affect participants' preferences for those stimuli, it is still unclear how preferences for external objects can translate to internally experienced emotions. The current research proposes that the embodiment of emotion may be the missing link between preferences for what is in the external world and internal emotional experiences. In order for a person's preferences to be affected, they must understand the subliminal stimulus to at least some degree. When exposed to an emotional subliminal stimulus embodiment could allow an individual to have an affective response to the stimulus without having a cognitive experience.

As previously discussed, people's faces respond to emotional stimuli. Facial mimicking has been linked to the facilitation of comprehension of emotional information and the initiation of emotional experience without conscious awareness or memory of the actual stimulus (Dimberg, Thunberg, & Elmehed, 2000; Havas, Glenberg, & Rinck, 2007; Foroni & Semin, 2009). Zajonc's theory, the vascular theory of emotional efference (VTEE), posits that facial expressions may affect emotion by changing the temperature of the brain, most importantly the hypothalamus. Zajonc theorizes that emotional stimuli cause vascular displacement and imbalance associated with an emotional response which then activates facial efference in attempt to restore balance. Activation of facial muscles can then change the flow of air into the nasal cavity as well as the venous flow of blood into the cavernous sinus. These changes then lead to fluctuations in the temperature of the blood entering the brain and the hypothalamic temperature. This difference in temperature can in turn affect the blocking or releasing of neurotransmitters leading to changes in affect. For example, the contraction of certain facial muscles may change the hypothalamic temperature so that norepinephrine is either blocked or released leading to either calming or excitation. The activation of facial muscles and sequential changes in venous

blood flow to the brain in conjunction with neurological simulation and autonomic arousal provide sensory feedback that provide enough information to influence one's affective state without conscious awareness or cognitive appraisal (Zajonc, Murphy, & Inglehart, 1989) .

If the proposal above is accurate, it may provide a solution to the Zajonc-Lazarus debate. Embodiment is certainly not a cognitive representation as Lazarus thought of it, but it may be the mechanism by which affective responses are generated. Therefore, "embodied cognition" may be a way to reconcile the affect-cognition primacy dispute. In addition, if facial reactions do occur in response to subliminal stimuli, this would suggest that the embodiment of emotion is a preattentive process that occurs automatically therefore providing a way of comprehending stimuli without conscious awareness. Currently, all prior research exploring simulation has presented participants with supraliminal stimuli. The goal of the present study is to determine if emotional words presented subliminally will initiate the same facial reactions as words presented supraliminally.

There are some clues in the literature to suggest that words may produce bodily reactions, even when presented subliminally. As previously discussed, Zajonc's mere exposure effect provides robust evidence for the ability of subliminal stimuli to have an effect on an individual. In addition, Neumann (2005) found that when participants were exposed to positive and negative words, their cheek and brow muscles significantly changed in approximately 300-500ms. These data suggest that embodiment of emotions happens so quickly that consciousness may not be necessary. Neumann (2005) also found that even when participants were not asked to consciously evaluate the stimuli, congruent muscle activity still occurred. This serves as more evidence showing that even if subliminal information does not reach conscious awareness, facial

simulation can still occur which would suggest that embodiment of emotion can occur without cognition as Zajonc argues.

The Present Research

The current experiment will use facial electromyography to measure participants' responses to subliminal, emotion words. The activation of the corrugator supercilli muscle, furrowing of the brow, has been correlated with negative affect and the activation of the zygomaticus major muscle, smiling, has been correlated with positive affect (Larsen, Norris, & Cacioppo, 2003). It is hypothesized that participants' corrugator supercilli muscles will become activated when viewing subliminal, negative words and that corrugator activity will be significantly larger in response to the negative word trials when compared to the positive and neutral word trials. Secondly, we hypothesize that zygomaticus activity will be significantly larger in response to positive word trials when compared to negative and neutral word trials.

Methods

Participants

Forty undergraduate students and one graduate student from California State University, Chico participated in the study for extra credit. The sample consisted of 10 men and 31 women. Fifty-one percent of participants identified themselves as Caucasian, 30% Latino or Hispanic, 10% multi-racial, 5% Asian, 2% African American or Black and 2% Native American. The average age of participants was 23 and ages ranged from 19 to 52 years old. Participants received extra credit for their participation in the study. The Institutional Review Board approved this study.

Materials and Apparatus

Facial electromyography data acquisition. Facial electromyography data was recorded throughout the duration of the E-Prime word presentation experiment. The zygomaticus major muscle was used to measure positive affect and the corrugator supercilii muscle was used to measure negative affect (Dimberg, 1990). Two Ag-AgCl 4mm bipolar, shielded electrodes filled with Biogel were placed one centimeter apart on the left corrugator muscle and one centimeter apart on the left zygomaticus muscle. A 4mm monopolar electrode served as a ground and was placed behind the left ear on the mastoid process (Fridlund & Cacioppo, 1986). No data were collected with impedance readings greater than 20kΩ**.**

A Biopac MP150 data acquisition system with two EMG100C amplifiers (Biopac Systems, Inc., Santa Barbara, CA) was used to record EMG signals at a sample rate of 2500 samples/second with a gain of 5,000 Hz. Signals were low and high pass hardware filtered at 500 Hz and 10 Hz. The EMG signals were processed further using AcqKnowledge software. Data were rectified and smoothed at an interval of 100ms.

Baselines were collected for each individual stimulus presentation trial for each participant by taking the average rectified mean of 1,000ms before stimulus onset. A difference score was calculated (in µV) by subtracting the baseline from the average rectified mean of 2,000ms after the stimulus onset.

E-Prime. The Biopac MP150 data acquisition system was connected to an STP100C module to interface with E-Prime (Psychology Software Tools, Inc., Sharpsburg, PA). E-Prime was used to present stimuli to participants and synchronize those stimuli with EMG recordings. E-Prime was installed on an Intel computer equipped with a Radeon HD 3450 graphics card and 4.00GB of RAM and stimuli were presented on a Dell 120 Hz capable CRT monitor.

Stimulus words

The stimulus words were more ambiguous as opposed to direct emotion words. Words were positive (i.e. heart and hope), negative (i.e. sin and stress) and neutral (i.e. chair and stool). For a full list of words please see *Appendix A*.

Procedure

Data were collected from each participant individually. Participants were first given an informed consent form followed by a demographics questionnaire. They were then told to sit in a chair in the psychophysiology laboratory. Participants were then given a very brief verbal description of what was going to happen during the study. Individuals were told that electrodes would be placed on to their face above their left eyebrow, on their left cheek, and behind their left ear and assured that the electrodes would not shock or harm them and were only there to measure their muscle movements. If the participant was wearing any makeup, an alcohol pad was used to clean the skin in the areas the electrodes would be placed.

Once electrodes were securely attached to the participant's face, they were asked to move their chair to face the computer monitor. The individuals were told to read all directions that came on to the screen and were informed that the computer portion of the study would take approximately twenty minutes. Once the individual was ready to start the experiment, the experimenter left the room.

The experiment began with four practice trials, which presented the prime words for decreasing amounts of time until they reached full speed. The first practice block displayed the words for 88ms, the second displayed the words for 64ms, the third presented the words for 48ms, and the fourth practice trial was at full speed (16ms). The practice blocks presented four words in random order with two positive (i.e. vacation, hug) and two negative words (i.e. destruct, murder). The true E-Prime experiment presented sixteen positive, sixteen negative, and

sixteen neutral words. (See Appendix A for a complete list of words.) The experiment consisted

of two blocks of trials in which each word was presented twice in each block. Each individual

participant therefore completed a total of 192 word presentation trials. Each prime word was

presented for 16ms. Words were presented in a randomized order for each participant.

The participants began by focusing on a fixation cross, located in the middle of the

screen. They would then press the spacebar on the keyboard in front of them to begin the trial.

The pressing of the spacebar would initiate the trial beginning with the fixation cross displayed

for 132ms followed by the prime word for 16ms, immediately followed by a mask presented for

49ms and ending with a fixation cross presented for 996ms. A blank slide would then appear for

2,000ms separating each trial, followed by another fixation cross signaling the trial was over and

the participant could press the spacebar again to begin the next trial. (See figure 1 for a visual of

the E-Prime experiment slides.) The duration of the final fixation cross and the blank space

separating trials allowed for a sufficient amount of time for facial reactions to the prime word to

occur. The participants continued with this process until they completed all 192 trials. In

between the two blocks of trials they were given the opportunity to alert their experimenter if

they had any questions or concerns before continuing on with the second half of the experiment.

After completion of the E-Prime experiment, the participant was given a funnel debrief

questionnaire to complete to ensure that they did not see any of the words, which were intended

to be subliminal. None of the participants reported the ability to see any of the experimental

words. Participants were given a sheet of paper with a debriefing paragraph, which contained a

brief description of the intent of the study, as well as their extra credit slip and thanked for their

time.

Results

An increase in zygomaticus activity in response to positive, subliminal words and an increase in corrugator activity in response to negative, subliminal words would show that even subliminally presented stimuli illicit facial simulation and would provide evidence that consciousness is not a necessary precursor for embodiment of emotion. Difference scores were calculated for each individual stimulus presentation trial for each participant. These difference scores were calculated by taking the average rectified mean from 2,000ms after the stimulus onset and subtracting the average rectified mean of 1,000ms before the stimulus onset. An average was then calculated for each word type, combining all positive, negative, and neutral difference scores so that each participant was left with six averages: zygomaticus activity during positive word trials, corrugator activity during positive word trials, zygomaticus activity during negative word trials, corrugator activity during negative word trials, zygomaticus activity during neutral word trials, and corrugator activity during neutral word trials.

We hypothesized that zygomaticus activity would be significantly larger in response to positive subliminally presented words compared to negative or neutral words. A repeated measures analysis of variance (ANOVA) was used to measure differences in zygomaticus activity across the three word types (positive, negative, and neutral). However, no significant differences in zygomaticus activity were found across word types, $F(1.62, 39) = .43$, $p = .614$.

In addition we hypothesized that corrugator activity would be significantly larger in response to subliminally presented negative words when compared to positive and neutral word type presentations. A repeated measures ANOVA was used to compare corrugator activity across the three word types. However, no significant differences in corrugator activity were found across word types $F(1.37, 39) = 1.05$, $p = .333$. For both analyses Mauchly's test indicated that the assumption of sphericity had been violated. Therefore, degrees of freedom

were corrected using Greenhouse-Geisser estimates of sphericity. Our non-significant results suggest that subliminal words do not initiate the embodiment of emotion.

In addition to our primary analysis, we compared the zygomaticus and corrugator muscle activity for the individual words "happy" and "angry" to test whether significance was not reached due to the ambiguity of the majority of the stimulus words. Happy and angry were selected because they were determined to be the most direct emotion words in our list. One facial electromyography response to the word "happy" and one response to the word "angry" were taken for forty of the original participants (one participant was removed from the sample due to an issue retrieving their E-Prime data file). A difference score was calculated by taking the average rectified mean from 2,000ms after the stimulus onset and subtracting the average rectified mean of 1,000ms before the stimulus onset.

Two paired samples t-tests were run. The first examined zygomaticus activity in response to "happy" compared to "angry". Although, no significant difference in zygomaticus activity was found between happy and angry, $t(39) = 1.53$, $p = .133$, the p values for the responses to these words were much closer to significance compared to the original analysis which compared all of the more ambiguous words together. This suggests that more direct emotion words, even presented subliminally, may have an effect on facial responses. For zygomaticus, although not significant, the small difference was in the hypothesized direction. There was slightly more zygomaticus activity in response to "happy" ($M = .12\mu V$, $SE = .15$) compared to "angry" ($M = .04\mu V$, $SE = .28$). We also used a second paired samples t-test to examine corrugator activity in response to the word "happy" compared to the word "angry". There was no significant difference in corrugator activity in response to the words happy and angry ($t(39) = 1.62$, $p = .113$). However, although the p values were still closer to significance

than the original analysis that included all of the stimulus words, the direction of this difference

was in the opposite direction than we predicted. Corrugator activity was actually greater in

response to "happy" ($M = .37\mu V$, $SE = .41$), compared to "angry" ($M = .19\mu V$, $SE = .81$). This

suggests that analyzing specific, more direct, emotion words compared to ambiguous emotion

words could lead to the production of facial responses, however, the methodology and analysis

techniques should be reviewed.

Discussion

Research has provided much evidence regarding the simulation of emotions and facial

mimicking of emotion to assist individuals' comprehension of the meaning of emotions and

processing of corresponding emotional stimuli. However, prior research has focused on the

presentation of supraliminal stimuli. If subliminal stimuli were to elicit the same simulation and

facial mimicking, it would suggest that conscious awareness does not necessarily have to come

before embodiment of emotion. Theoretically, this could suggest that conscious awareness is not

necessary to process emotional stimuli. The non-significant results found in this study for both

zygomaticus activity and corrugator activity across the negative, positive, and neutral word

types, however, suggests that subliminal stimuli do not initiate the embodiment of emotion and

that conscious awareness may in fact be a necessary precursor to fully process an emotional

stimulus. The additional analysis comparing the two most direct emotion words (happy and

angry) do suggest that more direct words could illicit facial responses, however, these results

remained insignificant meaning that subliminal emotion words may not lead to facial responses.

One main limitation of the study was the rather small sample size (41 participants).

Because we used a repeated measures design and each participant completed 192 total trials we

believed that a smaller overall sample size would not hinder our results. However, it may be

possible that a larger sample size could reveal greater differences in activity in response to positive, negative, and neutral subliminal stimuli. Because the muscles movements would most likely be extremely miniscule, it may be necessary to have a larger sample size.

Another limitation may have been the methodology. We discovered that corrugator activity was significantly larger across all word types when compared to zygomaticus activity across word types. Some physiology studies have found stronger effect sizes for corrugator compared to zygomaticus. Corrugator is less susceptible to effects of surrounding muscle activity in comparison to zygomaticus which is located on the cheek surrounded by many other overlapping muscles (Tassinary & Cacioppo, 2000). Larsen, Norris, and Cacioppo (2003) also found that the zygomaticus muscle had lower baseline recordings when compared to the corrugator muscle. It may be possible that the corrugator muscle naturally provides stronger electromyography readings with less overlap or confusion with surrounding muscles.

However, it is also possible that the task requirements for our participants stimulated corrugator activity throughout the entire experiment causing more natural facial responses to be inhibited. Our task required participants to focus their eyes on a small fixation cross and attempt to see the words that were being presented to them extremely quickly. The word trials were presented only two seconds apart and the participants were only required to take one short break halfway through the experiment. The entire experiment took approximately twenty minutes meaning that participants were focusing on the fixation cross for quite a while without ever seeing any words because they were meant to be subliminal. It is possible that in concentrating on the fixation cross and attempting to catch these word trials, participants were activating their corrugator much more than their zygomaticus throughout the entire experiment. It has been found that the activation of the corrugator can actually inhibit the activation of the zygomaticus

(Larsen et al., 2003). For example, if one is furrowing their brow whether through concentration or negative affect, it is more difficult and less likely for them to smile. I hypothesize that our methodology initiated too much corrugator activation throughout the task which inhibited zygomaticus activity that may have otherwise been stronger.

Future research should break up the subliminal word trials in some way or require more breaks throughout the experiment to help reduce effects on the corrugator due to factors such as concentration on the task or even boredom or fatigue. More importantly however, future researchers should also add a check either throughout the experiment or at the end of the experiment to see if participants are processing any semantic meaning of the emotion words. This would begin to answer the question of whether facial and neural simulation does allow individuals to process and comprehend emotion or if the comprehension of emotion actually occurs prior to facial mimicking. It could be possible that participants were capturing the meaning of the words, but that their face was simply not reacting quickly enough. The addition of meaning related questions would help to answer our question much more thoroughly by having another measure instead of solely facial electromyography data. Further research is needed to provide additional evidence on whether subliminally presented words initiate facial mimicking and to answer the question of which comes first, conscious awareness or the experience and embodiment of emotion.

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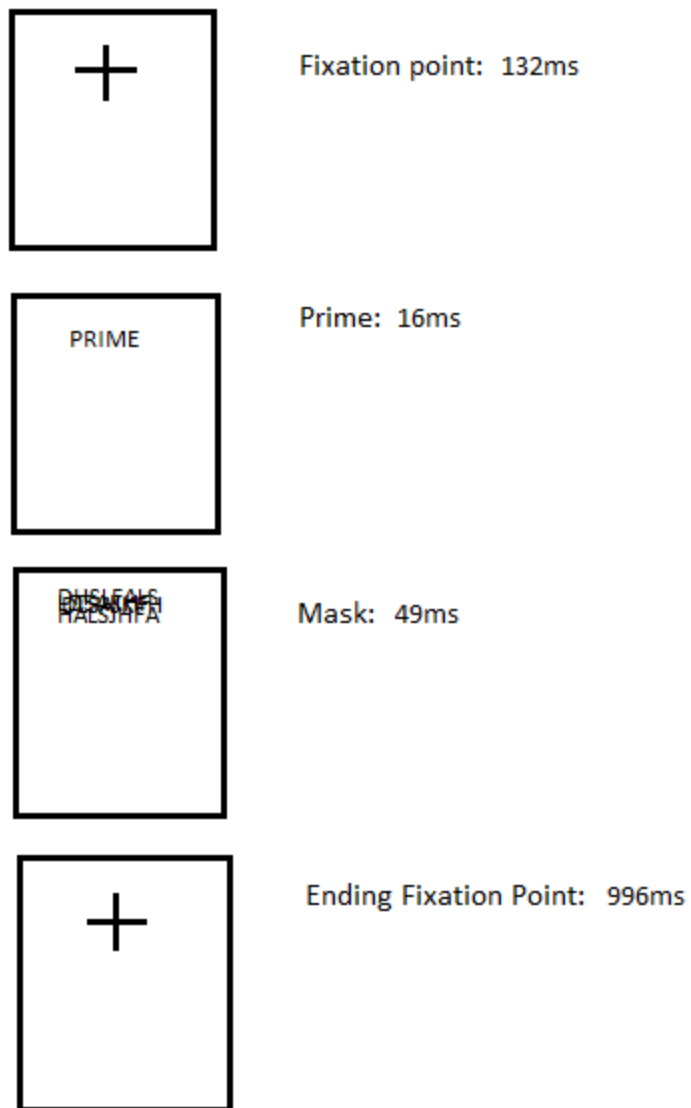
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Figure 1. Shows the order and is an example of the appearance of the E-Prime slides that participants saw as they went through each stimulus presentation trial.

Positive	Negative	Neutral
• Hope	• Bomb	• Cord
• Heart	• Hate	• Stool
• Proud	• Dead	• Metal
• Win	• Stress	• Seat
• Baby	• Failure	• Paper
• Humor	• Angry	• Board
• Fun	• Hell	• Pencil
• Joy	• Pain	• Bowl
• Honest	• Prison	• Phase
• Pleasure	• Lie	• News
• Soft	• Riot	• Square
• Wise	• Insult	• Month
• Free	• Rude	• Wagon
• Kind	• Thief	• Column
• Happy	• Sick	• Bench
• Pretty	• Sin	• Sphere

Appendix A. A complete list of the words used in this experiment.