

Startle Modulation via Processing of Emotional Semantic Knowledge

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Abstract

Background: The amygdala plays a role in detecting danger and priming the subcortical startle circuitry. It has strong reciprocal projections to extensive cortical and neocortical areas that underlie the processing of emotional contextual information. We wanted to investigate whether emotional semantic knowledge derived from faces of famous individuals would modulate the intensity of the human startle response. **Hypothesis:** We predicted that the perception of famous people judged to be 'evil' would result in larger startle responses than those judged to be 'neutral' or 'good'.

Participants and Methods: Twenty-eight normal college students judged pictures of well-known individuals as good, evil, or neutral. A custom slideshow was created for each subject depending on their subjective responses, with equal representation of pictures from each moral category. White noise bursts induced startle eye blinks while subjects viewed these pictures.

Results: The data were analyzed using an Affect (Good, Neutral, Evil) x Gender (M, F) repeated-measures ANOVA. In accordance with our prediction, startle eye blinks were significantly larger ($p < 0.01$) when subjects viewed faces of people who represented evil versus neutrality or goodness, and responses were also significantly larger ($p < 0.01$) for faces judged to be neutral versus good.

Conclusions: These data indicate that emotional semantic knowledge derived from the human face modulated emotional reactivity in normal individuals. Faces of 'evil' people exerted more powerful priming effects on startle reactivity possibly because the perception of an evil person represents more direct threat than those judged to be neutral or altruistic, thus more effectively inducing a motivational propensity to withdraw or escape. These findings highlight the influence of semantic emotional stimulus processing on motivated behavior.

Background

The startle reflex is an automatic withdrawal response to a sudden, intense stimulus, such as a flash of light or a loud burst of noise. The most reliable component of this protective reflex is the eye blink, which when associated with the startle reflex are more intense during negative/aversive emotional states (e.g., fear, anxiety) versus more positive, appetitive states (e.g., happiness, sexual arousal). These potentiated responses presumably reflect the amygdala's roles in danger detection and priming of subcortical circuitry. The amygdala also has strong reciprocal projections to extensive cortical and neocortical areas that underlie the processing of emotion-related semantic knowledge during normal perception. We previously argued that emotional semantics is a broadly distributed network throughout the brain (Bowers et al., 1993).



Startle Response

Purpose of the Present Study

* We sought to investigate whether emotional semantic knowledge derived from faces of famous individuals, along the dimension of "good-evil", would modulate the intensity of the human startle response.

* We predicted that the perception of famous people judged to be 'evil' would result in larger startle responses than those judged to be 'neutral' or 'good'.

Participants

- **28 college students** (15 male) from the University of Florida
- **Exclusion criteria:** neurologic trauma, currently taking medication for mood, scores outside the normal range on clinical measures of depression (Beck Depression Inventory 2) or anxiety (State-Trait Anxiety Inventory).

Methods & Procedures

Task 1: Famous Face Recognition & Judgment

- **RATINGS:** Subjects rated photos of 100 famous people
 - **Recognition** (provision of the name of the individual)
 - **Confidence** (1-9)
 - **Valence** on a dimension of "good-evil" (1-9), if stimulus was recognized

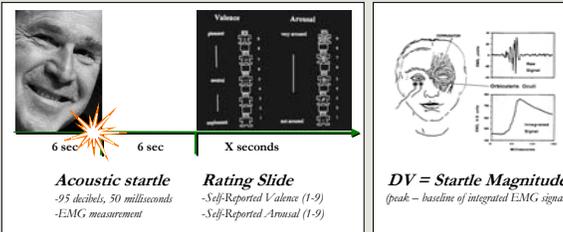


PARTICIPANT-SPECIFIC SLIDESHOW:

- Correctly recognized famous face stimuli were subdivided into three groups of stimuli based on the subject's *Valence* ratings. These three groups were categorized as "Evil" ($V=1$ to 3), "Neutral" ($V=4$ to 6), and "Good" ($V=7$ to 9). Equal numbers of stimuli from these groups were placed in randomized order to create customized slideshows for each participant. The total number of trials ranged from 24 to 30.

Task 2: Startle Eyeblink Measurement

For each trial presented within a participant's slideshow, a single image was presented for 6 seconds, during which time a 95 db acoustic startle probe was delivered. The magnitude of the startle response (EMG peak - baseline) was recorded for each eye via electrodes over the orbicularis oculi muscles; these signals were amplified (gain = 30,000) and integrated (200 ms time constant). After 6 additional seconds, the subject self-assessed *Valence* (positivity-negativity) and *Arousal* (excitement/interest) during viewing of the slide. All measures were obtained on a trial-by-trial basis.



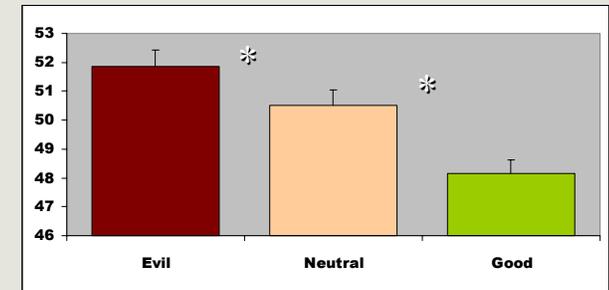
Results

Summary of Results

For each participant, the startle magnitude for each affective category (Good, Evil, Neutral) was converted to T score metric (mean = 50, standard deviation = 10) to minimize between-subject variability.

The data were analyzed using an Affect (Good, Neutral, Evil) x Gender (M, F) repeated-measures ANOVA. In accordance with our prediction, startle eye blinks were significantly larger ($p < 0.01$) when subjects viewed faces of people whom they believed to represent "evil" rather than "neutrality" or "goodness". The magnitude of the startle responses were also significantly larger ($p < 0.01$) while viewing faces of people judged by the subject to be "neutral" versus "good".

The main effect of Gender was not significant, and there was no significant Affect x Gender interaction.



$F[2,48] = 8.972, p < .001, \eta^2 = 0.27, Power = .965$

Conclusions

- These data indicate that emotional semantic knowledge derived from the human face modulated emotional reactivity in normal individuals.
- Faces of 'evil' people exerted more powerful priming effects on startle reactivity possibly because the perception of an evil person represents more direct threat than those judged to be neutral or altruistic, thus more effectively inducing a motivational propensity to withdraw or escape.
- These findings highlight the influence of semantic emotional stimulus processing on motivated behavior.