THE MERE EXPOSURE EFFECT AND EMOTION:

A PSYCHOPHYSIOLOGICAL INVESTIGATION

by

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ABSTRACT

An experiment was conducted to test the hypothesis that in addition to familiar stimuli being rated more positively than unfamiliar stimuli, they would also evoke more positive and/or less negative affect. The effect of individual difference variables on these predicted effects was also examined. In the experiment, which used methods known to produce robust mere exposure effects, women were repeatedly exposed to photographs of 10 different women. The participants then viewed these same women again (familiar) and 10 novel women (unfamiliar) while zygomatic (cheek) and corrugator (brow) muscle region activity and frontal and parietal electroencephlographic (EEG) activity was recorded. After viewing each photograph, participants rated how much they liked the woman in the photograph. In addition to familiar stimuli being rated more positively than unfamiliar stimuli, they evoked more zygomatic muscle region activity. Anterior asymmetries in alpha activity at baseline related to ratings of familiar versus unfamiliar stimuli, with relatively less left anterior activation (inverse of alpha) related to more of a preference for the familiar over the unfamiliar. In addition, persons who scored high in social anxiety tended to react with less corrugator activity to the familiar than to the unfamiliar. Persons with less self-reported positive affect and persons with more negative affect reacted with more zygomatic activity to the familiar than to the unfamiliar. These results are discussed in terms of their relevance to the idea that familiar stimuli are preferred to unfamiliar stimuli because of their emotion-inducing effects.

I. INTRODUCTION

The idea that repeated exposure to a stimulus is sufficient to enhance attitudes toward the stimulus is an old idea, proposed by several psychologists (Fechner, 1876; James, 1890; Maslow, 1937; Meyer, 1903; Pepper, 1919). In one of the first experiments designed to test the idea, Maslow (1937) presented participants a set of paintings once each evening for four consecutive evenings. Two days later, participants rated the beauty of and how much they liked these paintings and new paintings. Results indicated that participants rated the familiar paintings more positively than the unfamiliar ones. Maslow (1937) replicated the effect with foreign names, but did not replicate it with other objects that were previously highly familiar to participants (paper clips, rubber bands).

Later research supported the hypothesis that repeated exposure to stimuli enhances attitudes toward them by revealing a significant relationship between word frequency and evaluative meaning of words, such that words connoting good, desirable, and preferred aspects of life are more frequently used (Howes and Solomon, 1950; Johnson, Thompson, & Frincke, 1960; Postman, 1953). The correlational nature of these results render it difficult to determine cause and effect, and whether the relation was due to the influence of unknown third variables. Johnson, et al. (1960), however, remedied this interpretive problem when they exposed nonsense words one, two, five, or ten times to participants, and found a significant positive relationship between frequency of exposure and liking. Like Maslow, however, they confounded stimuli and familiarity (same words always appeared in same frequencies), and consequently the data are subject to alternative explanations. Before 1968, the research conducted on the relation between familiarity and liking suffered from one of two problems: it was correlational, or it confounded stimuli and familiarity.

Zajonc (1968) remedied these problems by conducting four experiments in which stimuli and familiarity were counterbalanced and thus not confounded. In his first experiment, college students from the United States were presented "Turkish" words one, two, five, ten, or twenty five times, and asked to pronounce them after the experimenter did. Zajonc found a positive relationship between familiarity and liking. However, because participants were required to pronounce the nonsense words during the exposure phase, they may have been able to process the words with decreased difficulty, and this decrease in difficulty may have accounted for the increased liking (Wilson & Becknell, 1961). To assist in eliminating this alternative explanation, and provide evidence of the effects of <u>mere</u> exposure ("a condition which just makes the given stimulus accessible to the individual's perception" (p. 1)), Zajonc (1968) conducted a second experiment in which meaningless Chinese characters were substituted for the nonsense words, thus preventing participants from vocally or subvocally pronouncing the stimuli. As in the previous experiment, characters and exposures were counterbalanced, and participants rated the characters on a good-bad scale. Replicating the results of the previous experiment, a strong positive relationship resulted between exposure and positivity of ratings. In a third experiment, Zajonc (1968) replicated the mere exposure effect using photographs of the faces of men taken from a college yearbook.

Zajonc (1968) considered the psychological mechanisms that mediated the mere exposure effect. He postulated that there might be biological significance to the effect, so that a stimulus presented for the first time evokes "an instinctive fear reaction" (p. 19). Support for his idea comes from several sources. For example, Lorenz (1956) observed that young ravens reacted with escape responses to new objects, and later approached the objects after staring at them for hours. Bühler, Hetzer, and Mabel (1928) observed that human infants reacted to strange sounds with cries of fear, but that with repeated exposures of the sounds, the infants did not react with displeasure, but looked in the direction of the sounds with interest. Hunt (1965) observed that infants preferred familiar mobiles to novel ones, and Cairns (1966) argued that affiliative behavior among animals is solely determined by exposure to others. As Zajonc (1968) noted, "The survival value of an avoidance reflex to a novel stimulus is obvious." (p. 19). Thus, Zajonc (1968) hypothesized that exposure to novel stimuli elicits fear reactions, which decrease with repeated exposure in the absence of negative consequences. To test this hypothesis, Zajonc (1968) conducted a fourth experiment in which participants were presented nonsense words one, two, five, ten, and twenty-five times. He also measured their galvanic skin response (GSR) to the words, assuming that the GSR reflects fear. Results indicated less arousal (as measured by GSR) occurred in response to words that were repeatedly exposed. Whether this decreased arousal to the familiar reflects cognitive (e.g., orienting to the novel) or affective responses is unclear. Wilson (1979) was unable to replicate this finding.

Research has continued to demonstrate that familiar stimuli are preferred to unfamiliar stimuli. That is, presenting stimuli repeatedly without any reinforcement produces a significant enhancement in attitudes toward those stimuli. This effect has been termed the mere exposure effect (Zajonc, 1968). It has been found robustly in humans (for a review, see Bornstein, 1989), with stimuli that are presented so briefly that they are not consciously perceived (for a review, see Bornstein, 1992), with abstract, nonrepresentational stimuli and meaningful, social stimuli (Saegert, Swap, & Zajonc, 1973; Stang & O'Connell, 1974), with stimuli that are initially liked (Swap, 1977) and disliked (Litvak, 1969), in positive and negative contexts (Saegert, et al., 1973), in laboratory and field settings (Moreland & Zajonc, 1976; Zajonc & Rajecki, 1969), and in nonhuman animals (for a review, see Hill, 1978).

Individual Differences in the Mere Exposure Effect

The mere exposure has been demonstrated in over 200 experiments, but the influence of individual differences in susceptibility to it has been tested only eight times. An experiment by Schick, McGlynn, and Woolam (1972) tested the influence of individual differences in anxiety on the mere exposure effect. They found that persons who scored high on the Taylor Manifest Anxiety Scale rated familiar cartoons (known "Peanuts" characters) more positively than did persons who scored low in anxiety, but found that high and low anxious persons did not differ in their ratings of unfamiliar cartoons ("Peanuts" cartoons with the known characters (e.g., Charlie Brown, Linus) replaced by unknown characters).

Crandall (1968) examined the effects of individual differences in social desirability (Crowne & Marlowe, 1964) and Tolerance-Intolerance of Ambiguity (Budner, 1962) on preferences for familiar stimuli. Participants viewed several presentations of consonant-vowel-consonant syllable pairs, and then rated each syllable on a goodness-of-meaning scale. Persons scoring high in social desirability evidenced increased preferences for syllables (only those appearing first in the pair) that were repeatedly exposed, whereas persons scoring low in social desirability did not. Using the same methodology, Crandall (1968) found in two experiments that participants intolerant of ambiguity rated these syllables more positively with increased familiarity, whereas participants tolerant of ambiguity evidenced the opposite trend.

Pheterson and Horai (1976) assessed the effects of sensation seeking (Zuckerman, Kolin, Price, & Zoob, 1964) on the relationship between familiarity and liking. After being exposed to unattractive and attractive photographs of persons, participants rated these photographs. Participants preferred the attractive persons to the unattractive persons, and preferred the familiar to the unfamiliar, regardless of initial attractiveness level. Sensation seeking did not interact with familiarity.

Martindale (1972) assessed the effects of individual differences in creativity, as measured by the Remote Associates Test (Mednick, 1963), on ratings of words that varied according to their natural frequency of use (fruits, flowers, trees, cities, and countries). Highly creative individuals did not differ from less creative individuals in their ratings of these stimuli. Martindale then had depressed, acutely schizophrenic, chronic schizophrenic, and normal individuals rate these same stimuli, and found no differences between groups in ratings of these stimuli.

Burgess and Sales (1971) presented participants with a heterogeneous series of consonant-vowel-consonant-vowel-consonant nonsense words 1 to 16 times. Participants then rated the nonsense words on a goodness-of-meaning scale. After the experiment, participants expressed their attitudes toward several issues. Analyses of the items of this scale revealed a reactions-to-life-in-general cluster, composed of three questions assessing attitudes toward oneself, life in general, and one's experience at the university. No relation was found between attitudes on this scale and liking for the familiar.

Bornstein, Kale, and Cornell (1990) found a relationship between boredom proneness and preference for the familiar. Participants who reported being easily bored on day to day activities, as measured by the Boredom Proneness Scale (Farmer & Sundberg, 1986), did not evidence a mere exposure effect, whereas participants who were not easily bored did. In the same experiment, Bornstein et al., (1990) found no relation between the mere exposure effect and scores on the Crowne-Marlowe (1964) Social Desirability Scale, and between the mere exposure effect and scores on Rotter's (1966) Locus of Control Scale. The absence of a relationship between the mere exposure effect and social desirability is inconsistent with the findings of Crandall (1968).

Of the individual difference variables examined, only anxiety, boredom proneness, and tolerance-intolerance of ambiguity have been found to relate to the mere exposure effect. Persons with high anxiety, low boredom proness, and intolerance of ambiguity tend to prefer the familiar to the unfamiliar more than do their counterparts on these individual difference variables. These effects suggest that emotional and motivational processes may be involved in the mere exposure effect.

While some individual difference variables have been found to relate to the mere exposure effect, other have not. Whether the failure of these individual difference variables to relate to the mere exposure effect is indeed the result of no relation, or merely a failure of the experimental manipulations of exposure is unclear. A variety of methods have been used in these experiments, rendering it difficult to assess their merit.

Explanations of the Mere Exposure Effect

Bornstein (1989) conducted a review and meta-analysis of mere exposure research that assessed the effectiveness of different methodologies in eliciting the mere exposure effect. He found that the effects are most robust when brief exposure durations are used, the stimuli are presented subliminally rather than supraliminally, the stimuli are presented in a heterogeneous rather than homogeneous exposure sequence, exposures are fewer than

10, a period of delay occurs between stimulus exposures and ratings, adults rather than young children are examined, and complex rather than simple stimuli are used.

In addition to informing us on the efficacy of different methodologies, this information assists in determining which of the explanations for the mere exposure effect best fits the data. According to the opponent-process model of exposure effects (Harrison, 1977), when a stimulus produces an emotional response, removal of that stimulus causes a rebound effect so that the opponent (opposite) emotional response results. Repeated exposures of stimuli strengthen the opponent response while weakening the initial emotional response. Initially unfamiliar stimuli evoke negative emotional responses (fear or unpleasant arousal), and repeated exposure of the stimulus causes a weakening of the initial negative response and a strengthening of the positive affect associated with the opponent process.

According to Bornstein (1989), the opponent-process model falls short in accounting for the extant research, because it does not predict the finding that homogeneous stimulus presentations produce no increase in attitudes with repetition, does not predict stronger effects for subliminally presented stimuli, does not account for the developmental changes in the exposure effect, and does not account for the finding that real words (which are initially somewhat familiar and thus less unpleasant) produce stronger exposure effects than nonwords.

Arousal models of the exposure effect (Berlyne, 1966, 1971; J. E. Crandall, 1970) posit that organisms seek and prefer a moderate level of arousal (Harrison, 1977; Hill, 1978). Deviations from this moderate level of arousal produce unpleasantness. Stimuli associated with moderate levels of arousal should elicit more favorable reactions than stimuli associated with high or low levels of arousal. Thus, as stimuli associated with high arousal potential become associated with less arousal potential, they are liked more, until they become associated with low arousal potential. Repeated exposure to a stimulus reduces the arousal potential from a high to a moderate level, and causes increased liking for the stimulus.

Consistent with the arousal models is the finding that complex stimuli produce stronger exposure effects than simple stimuli, and that stimuli presented in a heterogeneous sequence produce stronger effects than stimuli presented homogeneously. Inconsistent with the arousal models is the finding of an inverse relationship between exposure duration and preference, and the finding that delay between exposures and ratings produces increased exposure effects. The arousal model is also inconsistent with the finding that subliminally exposed stimuli produce exposure effects, for the arousal models require stimulus recognition (Berlyne, 1970). The arousal model also fails to predict the developmental changes that occur in the exposure effect, and, in contrast, predicts that adults and children should not differ in the exposure effect.

The two-factor model of exposure effects (Berlyne, 1970; Stang, 1973, 1974) posits that exposure effects result from the combined effects of stimulus habituation, which should cause increased preference as the stimulus becomes familiar and thus non-threatening, and of boredom, which causes decreases in preferences with too much exposure. These effects combine to produce an inverted-U relationship between frequency of exposure and preference. The apex of the inverted-U is said to be at the point at which curiosity about the stimulus begins to wane but boredom has not yet occurred.

The two-factor model is consistent with many findings: stronger exposure effects are found with shorter rather than longer exposure durations, with heterogeneous rather than homogeneous exposure sequences, with complex rather than simple stimuli, and with stimuli that have been presented fewer than 10 times. The two-factor model, however, is inconsistent with the finding that subliminal exposures produce enhanced preferences, because the model predicts preference to relate positively with subjective familiarity and stimulus recognition (Harrison, 1977). The model also does not predict that adults show more preference for the familiar than do children.

Of the explanations of the mere exposure effect, the two-factor model is most consistent with the research findings. As Bornstein (1989) pointed out, however, none of the models has satisfactorily addressed <u>why</u> the effect occurs. He proposed a model that integrated the two-factor model with principles derived from evolutionary theory. For adults, it may adaptive to prefer the familiar over the novel. Because novel objects could present a potential threat, organisms that had a fear of the strange and unfamiliar were likely to survive longer, reproduce, and pass on genetic material and inherited traits to subsequent generations than organisms that were more risk-taking. Preferring the familiar may be an adaptive trait that has evolved in humans and nonhumans over many generations (Bowlby, 1958; Bronson, 1968; Hill, 1978).

The two-factor/evolutionary model is consistent with the available research evidence. According to the model, a period of delay between exposure and ratings causes an increase in preference, because representations of the stimulus in short-term memory provide little information concerning whether the stimulus is safe to approach, but with repeated exposures that are not associated with negative reinforcement, one can conclude that the stimulus is not dangerous. Representations of the stimulus in long-term memory provide a more reliable index of the dangerousness associated with the stimulus than do representations in short-term memory.

The model is also consistent with evidence showing that when stimuli are overexposed, the familiar but overexposed stimuli are not preferred to the novel. Growing bored with stimuli that have been repeatedly exposed and never associated with positive reinforcement could be adaptive because the stimuli have shown themselves to be neither dangerous nor rewarding.

According to the two-factor/evolutionary model, unfamiliar as compared to familiar stimuli may evoke more negative affect and/or less positive affect because of the unfamiliar stimuli's association with potential danger. However, this interesting possibility has never been directly tested (see Zajonc et al. (1974) for evidence that familiar stimuli are rated as less harmful than unfamiliar stimuli).

Bornstein and D'Agostino (1992) recently proposed another explanation of the mere exposure effect, and termed it the perceptual fluency/ attributional model. This model is based on the work of Jacoby and colleagues (Jacoby & Dallas, 1981; Jacoby & Kelley, 1987; Jacoby & Whitehouse, 1989), Mandler, Nakamura, and Van Zandt (1987), and Seamon, Brody, and Kauff (1983a, 1983b). Jacoby and colleagues have found that repeated exposure to a stimulus facilitates the perceptual encoding of that stimulus (Jacoby, Toth, & Debner, 1992). Familiar stimuli are easier to perceive, encode, and process than unfamiliar stimuli. Jacoby and colleagues refer to this as an increase in perceptual fluency (Jacoby & Kelley, 1987). Perceptual fluency effects represent a type of implicit memory for the previously exposed stimuli (Jacoby, et al. 1992; Kihlstrom, Barnhardt, & Tataryn, 1992). Bornstein and D'Agostino (1992) proposed that enhanced perceptual fluency may underlie the mere exposure effect. Given that the familiar stimuli have increased perceptual fluency, and given the contextual cues provided by the experimenter, persons will attribute these fluency effects to liking or to any stimulus property that the person is asked to rate. In typical exposure experiments, when participants rate stimuli, they are aware that they were previously shown the stimuli. They infer that the previous exposures will affect their reactions to the stimuli, and they engage in a correction process, revising their initial impressions of the stimuli, from highly positive to less positive (but still more positive than the unfamiliar). This model has been used to explain the finding that subliminally exposed stimuli are rated more positively than supraliminally exposed stimuli, and that supraliminal exposure effects are more likely to occur with delay between exposure and rating phases of the experiment, and when persons are not aware of the connection between exposed stimuli and rated stimuli (Bornstein & D'Agostino, 1994).

In support of the perceptual fluency model, Mandler et al. (1987) suggested the mere exposure effect was not the result of "special affective processing" but a "nonspecific consequence of the activation of the representation of meaningless shapes, which is not restricted to affective judgments" (p. 646). Mandler et al. (1987) proposed that "prior exposure generates and activates the stimulus representations, and that such activation may then be related to any judgment about the stimulus that is stimulus relevant" (p. 647). In a subliminal mere exposure experiment, Mandler et al. (1987) found that participants judged familiar irregular octagons (selected from Vanderplas & Garvin, 1959) as more likable, dark, or light than unfamiliar irregular octagons, depending on the question asked of them. Mandler et al. (1987), in a separate test, asked participants how much they disliked familiar and unfamiliar octagons. If nonspecific activation occurs, then participants should judge familiar octagons as more dislikable than novel octagons. Results did not support this prediction, nor did they support the prediction that the familiar would be disliked less than the unfamiliar. Essentially, a null effect emerged. Mandler et al. (1987) suggested that their nonspecific activation hypothesis was not supported because disliking is a complex judgment (the absence of liking). They concluded that "[t]he preference judgment is therefore understandable within the context of current information processing theory, which stresses the activation of and subsequent access to underlying representations, and no special affective processes need to be invoked." (p. 648).

The perceptual fluency model has generated intriguing research, and provides a reasonable explanation of the mere exposure effect. However, the data on dislike judgments obtained by Mandler et al., (1987) suggest that while mere exposure may have nonspecific effects on cognitive judgments that have little to do with affective judgments, it may not have such effects on affective judgments that disagree with the positive affect that mere exposure putatively produces. In other words, mere exposure may enhance both perceptual fluency and positive affect about the stimuli, and when they run counter to each other, as when persons are asked to make dislike judgments, no mere exposure effect results. Thus, the hypothesis that repeated exposure to a stimulus reduces the negative affect and/or enhances the positive affect toward the stimulus remains a tenable hypothesis.

Psychophysiological Assessment of Emotional States

In the present experiment, I tested this idea by assessing emotional reactions, as measured by psychophysiological responses, to familiar and unfamiliar stimuli. Much research has been conducted attempting to identify psychophysiological responses associated with emotions. A recent review of this research (Cacioppo, Klein, Berntson, & Hatfield, 1993) concluded that facial electromyography (EMG) and anterior electroencephalographic (EEG) asymmetries vary reliably as a function of the valence of emotion (positive versus negative, approach-related versus withdrawal-related).

Research assessing facial EMG has found that activity over the corrugator supercilii region is greater during negative emotional states, and activity over the zygomaticus major region is greater during positive emotional states (for a recent review, see Cacioppo, Tassinary, & Fridlund, 1990). Dimberg (1982, 1988, 1990) and colleagues (Dimberg & Thell, 1988) have conducted a series of experiments examining the role of facial EMG in emotion. For example, in one experiment, Dimberg and Thell (1988) exposed participants to six trials of one slide of a snake or six trials of one slide of a flower, and recorded facial EMG from the corrugator and zygomatic muscle regions. As expected, participants evidenced more corrugator activity when viewing the snake and more zygomatic activity when viewing the flower. Greenwald, Cook, and Lang (1989) also found that participants demonstrated increased zygomatic muscle region activity while viewing pleasant slides (e.g., happy baby) and increased corrugator muscle region activity while viewing negative slides (e.g., mutilation).

Research assessing EEG activity has found that increased relative right hemisphere activation in the anterior region of the cerebral hemisphere is associated with heightened negative affect, decreased positive affect, or both; and that increased relative left activation of the anterior region is associated with heightened positive affect, decreased negative affect, or both (e. g., Ahern & Schwartz, 1985; Allen, Iacono, Depue, & Arbisi, 1993; Davidson, 1984; Davidson, 1993; Davidson, Schwartz, Saron, Bennett, & Goleman, 1979; Davidson & Tomarken, 1989).

In an experiment demonstrating these effects, Davidson, Ekman, Saron, Senulis, and Friesen (1990) exposed participants to film clips designed to evoke positive or negative emotions. Results indicated that across the entire film period, positive and negative film clips did not evoke significant differences in anterior asymmetry. However, when EEG activity during facial signs of happiness and disgust were compared, differences in anterior activation emerged, with disgust being associated with more activation (less alpha power) in the right frontal region, and disgust eliciting more right than left activation. In the anterior regions, no significant effects occurred in the happiness condition. However, in the anterior temporal region, disgust was again associated with more right activation than was happiness, and happiness was associated with more left activation than was disgust. Within happiness, more left than right activation occurred, but in the disgust condition, activation did not differ between conditions. These effects support the idea that the right anterior region is involved in negative, withdrawal-related emotion, and that the left anterior region is involved in positive, approach-related emotion.

Illustrating the effectiveness of EMG and EEG as assessments of emotional states, Wexler, Warrenburg, Schwartz, and Janer (1992) auditorially presented to participants pairs of words so that the temporal and spectral overlap between the words of each pair was so great that only one of the words was consciously perceived. Three types of word pairs were presented auditorially: positive-neutral, neutral-neutral, or negative-neutral. Wexler, et al (1992) examined frontal EEG asymmetries in alpha activity and corrugator and zygomatic muscle region activity in response to presentation of the word pairs. They found greater left than right frontal EEG activation when positive words were presented but not perceived, and the opposite trend for negative words. They also found greater corrugator EMG activity to negative than to positive words, regardless of whether or not the words were consciously perceived. No differences between words emerged for zygomatic activity.

Research has also shown that individual differences in resting asymmetries in the anterior region predict affective responses. Davidson and Fox (1989) found that 10-month-old infants with relative right anterior activation during a baseline period were more likely to cry when separated from their mothers, whereas infants with relative left anterior activation were not. These two groups of infants did not differ on measures of emotional expressivity that were collected during baseline, suggesting that the asymmetry may be an indication of a person's disposition to respond affectively. Tomarken, Davidson, and Henriques (1990) found similar effects in an experiment in which anterior asymmetry in women predicted self-reported global negative affect and the difference between global negative and positive affect in response to emotion-evoking film clips. These effects occurred independently of participants' affect ratings collected during the baseline period, suggesting again that the asymmetry may reflect a persons' chronic disposition to respond affectively.

The Present Research

The present research was designed to test the hypothesis that the mere exposure effect occurs because familiar stimuli, as compared to unfamiliar stimuli, are associated with increased positive affect and/or decreased negative affect. This hypothesis follows from Zajonc's original paper, the opponent-process model, the two-factor model, and the two-factor/evolutionary model, but it has never been directly tested. The perceptual fluency model, however, does not predict effects on emotions, as it assumes that the increased liking observed as a result of mere exposure occurs because the familiar stimuli have increased perceptual fluency (easier to perceive, encode, and process), and that this causes increased judgments along any relevant dimension. Indeed, mere exposure may cause both increased perceptual fluency and increased positive affect.

Based on the hypothesis that the mere exposure has effects on emotion, it is predicted that familiar stimuli will be rated more positively, evoke more zygomatic activity, evoke less corrugator activity, and be associated with relatively more left anterior activation than unfamiliar stimuli.

In addition to testing this primary hypothesis, several secondary hypotheses will be tested. One hypothesis involves individual differences in anxiety. If enhanced preference for the familiar occurs as the initially unfamiliar stimulus becomes familiar and less threatening and anxiety-provoking, then persons with higher anxiety may show a greater preference for the familiar. Consistent with this reasoning, Sheldon (1969) found that rats placed in strange environments showed increased preference for the familiar, and Schick, et al., (1972) found that persons with high levels of trait anxiety displayed more of a mere exposure effect than persons with low levels of trait anxiety. Thus, persons with high levels of trait anxiety, relative to persons with low levels, are predicted to evaluate the familiar more positively than the unfamiliar, evidence more zygomatic and less corrugator to the familiar than to the unfamiliar stimuli, and show more left frontal anterior activation to the familiar than to the unfamiliar stimuli. While persons with high and persons with low anxiety are predicted to evidence the above effects, persons with high anxiety are predicted to evidence stronger effects.

Relatedly, the relation between self-reported state affect and the mere exposure effect will also be examined. Persons low in positive affect and persons high in negative affect may be more susceptible to the mere exposure effect and its effects on emotion.

Another secondary hypothesis involves the need for closure and its relation to the mere exposure effect. According to Kruglanski (1989, 1990), the need for closure is the motivated tendency to desire an answer on a topic instead of confusion and ambiguity. The need for closure is presumed to occur when predictability, stability, or action is needed. Thus, under situations thought to evoke the need for closure (e.g., time pressure), persons are more likely to use early cues and pre-existing knowledge structures (stereotypes) to reach judgments than to more completely examine the stimulus information (e.g., Freund, Kruglanski, & Schpitzajzen, 1985; Heaton & Kruglanski, 1991; Kruglanski & Freund, 1983). Similarly, the need for closure may relate to preference for the familiar. Preferring the familiar to the unfamiliar may reflect a motivated desire to maintain predictability and stability. The unfamiliar may be associated with unpredictability and unstability, whereas the familiar is more predictable and stable. If so, when persons are in situations that evoke the need for closure or when they are dispositionally high in the need for closure, they may be more likely to prefer the familiar to the unfamiliar. Crandall's (1968) finding of persons who were intolerant of ambiguity evidencing more preference for the familiar is consistent with this hypothesis, because intolerance of ambiguity has been found to relate to the need for closure (Webster &

Kruglanski, 1994). Webster and Kruglanski (1994) recently developed an individual difference measure of the need for closure. In the present research, the relation between individual differences in the need for closure and susceptibility to the mere exposure effect will be examined. Persons who score high in the need for closure may be more susceptible to the mere exposure effect and the emotion effects predicted to correspond with it than persons low in the need for closure.

Another secondary hypothesis involves the relation of somatosensory amplification to the mere exposure effect. Barsky, Wyshak, and Klerman (1991) refer to somatosensory amplification as the "tendency to experience somatic and visceral sensation as unusually intense, noxious, and disturbing." (p. 323). As such, individuals with a tendency to engage in somatosensory amplification may evaluate unfamiliar stimuli more negatively if the unfamiliar stimuli evoke sensations of negative affect. With familiar stimuli, individuals who tend to engage in somatosensory amplification may evaluate them as even more positive, if the stimuli induce positive affect and if these individuals experience positive affect as more positive. Thus, in the present experiment, the relation between individual differences in somatosensory amplification and susceptibility to the mere exposure effect will be examined. Persons who score high in somatosensory amplification may be more susceptible to the mere exposure effect and its predicted effects on emotion than persons who score low in somatosensory amplification.

A final hypothesis concerns individual differences in resting anterior asymmetry. Davidson (1984; Davidson & Tomarken, 1989) has hypothesized that the anterior regions of the brain mediate approach and withdrawal motivation, with heightened approach motivation being reflected in relative left anterior activation and heightened withdrawal motivation being reflected in relative right anterior activation. Research has found that asymmetries in anterior activation have high test-retest stability (Tomarken, Davidson, Wheeler, & Kinny, 1992), so it seems likely that the asymmetry reflects a chronic disposition. Thus, persons with relative right anterior activation or less relative left anterior activation, and thus high in withdrawal tendencies or low in approach tendencies, may be especially likely to respond favorably to mere exposure, if the familiar reduces withdrawal tendencies (negative affect) or increases approach tendencies (positive affect).

II. METHOD

Overview of the Present Experiment

Women scoring high or low on a social anxiety scale were repeatedly exposed to pictures of women, and then asked to view these pictures again, along with pictures of unfamiliar women. Participants' EEG and EMG were assessed while they viewed these pictures. I hypothesize that familiar pictures will be rated more positively and will evoke less negative affect and/or more positive affect (as assessed by frontal asymmetries in EEG activity and facial EMG) than unfamiliar pictures. These effects are predicted to be most pronounced for women high in social anxiety. The effects of individual differences in the need for closure, somatosensory amplification, and resting anterior asymmetries will also be examined.

Pre-Screening of Participants

At a pre-screening session, 152 women from introductory psychology classes completed the Social Avoidance and Distress Scale (SAD; Watson & Friend, 1969), a 28-item scale that assesses social anxiety. The scale's internal consistency is high (Cronbach's alpha = .90; Leary, 1991), as is the test-retest reliability (.68 over 4 weeks). These women had also completed a handedeness scale (Chapman & Chapman, 1987), which has good internal consistency (Cronbach's alpha = .96), test-retest validity (.96 over 6 weeks), and construct validity. Only those women who were strongly right-handed (score between 35 and 39) and scored in the upper or lower third of the distribution of social anxiety scores were invited to the experiment. The experimenters were blind to the participant's anxiety level. Only right-handed women were invited to participate because the EEG asymmetry has been found to be stronger in women and only in right-handed persons (e.g., Tomarken, et al., 1992). Thirty-seven women participated in the experiment in exchange for credit towards their psychology grade.

Procedure

The experimenter informed the participant that the session would consist of two experiments, one that assesses the relation between brain waves and personality characteristics, and one that assesses brain waves while persons process visual information. After the participant read and signed a consent form, electrodes were affixed to her face and scalp to assess facial EMG and EEG, respectively. The participant was then seated in a dimly-lit sound-attenuated room, and given the Positive and Negative Affect Schedule--State Version (Watson, Clark, & Tellegen, 1988), the SAD (Watson & Friend, 1969), and the Behavioral Inhibition/Behavioral Activation Scales (BIS/BAS; Carver & White, 1994) to complete. The BIS/BAS was administered to test hypotheses not relevant to the present experiment (i.e., the relationship between resting EMG, EEG, and scores on this questionnaire). The SAD was administered to confirm the participants' anxiety levels (participants whose level fell out of the upper or lower third of the distribution were not included in the analyses of social anxiety). Once the participant had completed the questionnaires, resting EEG was recorded for four minutes, two with eyes open and two with eyes closed in one of two randomly assigned counterbalanced orders (O, C, O, C or C, O, C, O).

Following the methods of Bornstein and D'Agostino (1992), the experimenter then explained:

> During the next few minutes you will see a series of pictures. All you need to do is look at the pictures as they are presented. The pictures will go by quickly. There will be about 50 pictures. Between pictures, you should focus on the dot in the center of the screen. That's where the pictures will appear.

The experimenter then left the room, and the instructions were reiterated on the computer monitor. The computer monitor then presented ten stimuli (photographs of women's faces taken from a high school year book) five times in a heterogeneous presentation sequence such that before a picture was repeated, all other pictures had been shown once. The pictures were 7 cm high, and 5 cm wide. Exposure duration was 98 ms, and inter-trial interval was 2000 msec. Two sets (A and B) of 10 pictures of women that had been rated as equally likable were used. For half of the participants, set A was familiar and set B was unfamiliar; for the other half, this was reversed. These methods replicate those used previously (e.g., Bornstein, Kale, & Cornell, 1990).

Five minutes after the participant viewed these photos, the experimenter entered the room, and explained to the participant that the computer would display more photos, for 6 sec each. The experimenter asked the participant to view the photo the entire time it was displayed, and to then make her rating of the photo on the provided questionnaire. After the experimenter left the room, these instructions were reiterated on the computer monitor.

The computer presented these 10 photos again (familiar) and 10 new photos (unfamiliar) for 6 sec each in a random order. Four random orders were presented so that order and familiarity would not be confounded. Following the presentation of each photo, the computer presented a question that asked how much the person displayed in the photo was liked. The participant rated on a sheet of paper the degree of liking (1 = not at all; 9 = very much). After making each rating, the participant pressed the space bar of the computer keyboard to view the next photo. Once the participant finished making the ratings, the experimenter entered the room and asked the participant to complete two questionnaires, the Need for Closure Scale (Webster & Kruglanski, 1994) and the Somatosensory Amplification Scale (Barsky, et al., 1991). After the participant completed these questionnaires, she was thoroughly questioned and debriefed. The first half of the participants did not complete the Need for Closure Scale and the Somatosensory Amplification Scale in the experimental session, because these questionnaires were added to the procedure after the experiment had been started. These participants were contacted by telephone, asked to complete the questionnaires, and then mailed the questionnaires, which they returned. All except one participant returned both questionnaires. One participant who only needed to complete the amplification scale did not return it.

Assessment of EMG and EEG

To assess facial EMG, miniature Ag/Ag-Cl electrodes (made by SensorMedics) filled with Redux Paste were attached bilaterally in pairs over the corrugator supercilii (brow) and zygomaticus major (cheek) muscle regions, after the inter-electrode impedances were reduced to less than 10 Kohms (Cacioppo, et al., 1990) by rubbing Redux paste and alcohol in the areas. EMG signals were amplified by a factor of 20,0000 with AC differential amplifiers (bandpass 0.1 and 1,000 Hz), and digitized continuously at 2048 Hz. Signals were recorded in a bipolar fashion, with two adjacent electrodes over the same muscle region referenced to one another.

To assess anterior asymmetries in EEG activity, tin electrodes in a stretch-lycra cap (Electrocap) were placed on the participant's head. Scalp placements included F3, F4, P3, P4, and Cz of the International 10-20 (Jasper, 1958). Inter-electrode impedances for EEG electrodes were reduced to less than 5 Kohms. All sites were referenced to Cz, amplified by a factor of 20,000 with AC differential amplifiers (bandpass 0.1 and 100 Hz), and digitized continuously at 2048 Hz. To monitor eye blinks (EOG), tin electrodes were affixed to the outer canthus and superior orbit (amplification = 5 K, bandpass = 0.1 to 100 Hz).

Data Analyses

Because the primary hypothesis was that familiar stimuli would evoke more positive ratings and more positive affect and/or less negative affect than unfamiliar stimuli, analyses were first conducted without inclusion of any individual differences factors. Following these analyses, the individual difference factors were included in the analyses, to assess whether these effects were moderated by social anxiety, need for closure, somatosensory amplification, and/or baseline anterior asymmetries in cortical activation.

An examination of the raw data revealed that the first second of picture viewing contained much eye-movement and muscle artifact (similar problems occurred in Greenwald, et al., 1989). Thus, analyses were performed on the EMG and EEG activity that occurred in seconds two through six of picture viewing. Because no meaningful effects involving time block occurred, the data were averaged across seconds two through six, and time block was not used as a factor in the reported analyses. Composites summing over seconds yield more reliable data than activity in only one second. Analyses using seconds one through six as factors in analyses of variance (ANOVAs) are included in the Appendix.

EMG analysis. EMG was screened for movement artifacts, and then high-pass filtered (1/2 amplitude frequency = 10 Hz), rectified off-line. The average of rectified activity in each of 6 one-second windows was derived.

EEG analysis. EEG was first screened for movement and muscle artifacts. Ocular artifact was then reduced by using a linear regression approach (Semlitsch, Anderer, Schuster, & Presslich, 1986), which calculates the extent to which ocular movements propagate to each EEG site. Regression weights were computed after averaging the EOG and EEG with respect to blink onset. These weights were then applied to the raw (unaveraged) data to correct the EEG data for contributions from the EOG channel. Data was then epoched into seven two-sec epochs, overlapping by 75% beginning at stimulus onset and resetting every 500 msec, with the last two-sec epoch terminating after the stimulus had been presented for 5 sec. The power spectra were derived via the fast fourier transform [FFT] method using a Hamming window with tapering 10% of the distance from each end of the epoch for each two-second epoch following stimulus onset, and then averaged across each presentation type (familiar, unfamiliar) for each participant to produce the total power in four frequency bands: delta (1-4 Hz), theta (4-8 Hz), alpha (8-13 Hz), and beta (13-20 Hz).

For consistency with previous research, the alpha band was used to quantify differences in hemispheric activation. Decreases in alpha band activity are associated with increases in cortical activation (see Davidson, 1988; Lindsley & Wicke, 1974). Activity in the delta, theta, and beta bands were also analyzed for exploratory purposes. As in previous research (Tomarken, et al., 1990), the power density values were log transformed to normalize the distributions.

Individual differences in resting frontal alpha asymmetries. To assess the effects of baseline anterior asymmetries in cortical activation on susceptibility to the mere exposure effect, participants were divided into groups based on their anterior asymmetries in alpha activity during the baseline eyes-open period, as in Davidson and Fox (1989) and

Tomarken et al., (1990). An anterior asymmetry index (log right minus log left alpha power) was computed as in previous work (e.g., Tomarken, et al., 1990). Because alpha power is inversely related to activation, higher scores on the index indicate greater left hemisphere activation.

Statistical issues. Preliminary analyses revealed no significant laterality effects involving the right-left factor of facial EMG, so data were collapsed across left and right sides and this factor was not included in the reported analyses. Analyses also indicated that the number of eye blinks did not differ as a function of familiarity, and no significant effects involving level of need for closure occurred. Thus, analyses on these variables are not reported. Follow-up tests were conducted only for effects involving familiarity, the primary variable of interest. Four participants were excluded from the analyses: two because the computer acquiring the physiological data malfunctioned; one because she did not follow instructions in rating the pictures; and one because she did not view the pictures the entire time they were displayed on the monitor. Additional data were lost, creating differences in degrees of freedom in various analyses. These reflect loss of psychophysiological data due to high impedances (two due to high impedances at EMG sites, and three due to high impedances at EEG sites), due to level of social anxiety changing from pretest to experimental session (two participants), or due to failure to obtain individual difference questionnaires from participants (two participants did not return somatosensory amplification questionnaire, and one did not return the need for closure questionnaire).

III. RESULTS

Ratings of the Stimuli

I predicted that familiar stimuli would be rated more positively than unfamiliar stimuli, and that this effect would be greater for high than low socially anxious persons, for high than low need for closure persons, for high than low somatosensory amplification persons, for persons with relatively less left anterior activation, for persons with high rather than low negative affect, and for persons with low rather than high positive affect.

As expected, familiar stimuli (M=6.18) were rated more positively than unfamiliar stimuli (M=5.98), $t(32) = 2.20$, $p < .04$. A 2 (anterior asymmetry group: upper 25% vs. lower 25%) between-subjects X 2 (familiar) within-subjects ANOVA on ratings of the pictures revealed a main effect for familiar, $F(1,14)=7.62$, $p < .02$, qualified by a marginally significant interaction, $F(1,14)=3.89$, $p<.07$. The interaction indicated that whereas persons with relatively less left-sided activation preferred the familiar (M=6.40) to the unfamiliar (M=5.80), $t(14)=3.35$, $p<.01$, persons with relatively more left-sided activation did not (Ms=5.90 and 5.80). When using all participants (not just those in the extreme quartiles), the correlation between resting asymmetry and ratings of familiar minus ratings of unfamiliar approached significance, $r(30) = -.26$, $p < .10$, one-tailed. No other individual difference variables interacted with familiarity.

Table 1

Liking for Familiar and Unfamiliar Stimuli as a Function of Individual Differences

	Familiar	Unfamiliar
Low social anxiety	6.45 (1.02)	6.21 (1.38)
High social anxiety	5.85 (0.97)	5.70 (1.00)
Low left-frontal activation	6.40 (1.35)	5.80 (1.17)
High left-frontal activation	5.90 (1.66)	5.80 (1.00)
Low positive affect	6.24 (0.88)	5.90 (1.08)
High positive affect	5.70 (1.23)	5.60 (1.46)
Low negative affect	6.10 (1.28)	5.93 (1.81)
High negative affect	6.69 (0.63)	6.44 (0.54)

Note. Means and standard deviations (in parentheses). Liking ratings could range from 1 (not at all) to 9 (extremely).

EMG Analyses

I predicted that greater activity would occur in the zygomatic muscle region for familiar than for unfamiliar stimuli, and that this effect would be greater for high than low socially anxious persons, for high than low need for closure persons, for high than low somatosensory amplification persons, for persons with relatively less left anterior activation, for persons with high rather than low negative affect, and for persons with low rather than high positive affect. Greater activity over the corrugator muscle region was predicted for unfamiliar than familiar stimuli, and this effect should be greater for high than low socially anxious persons, for high than low need for closure persons, for high than low somatosensory amplification persons, for persons with relatively less left anterior activation, for persons with high rather than low negative affect, and for persons with low rather than high positive affect.

A 2 (familiarity) X 2 (muscle region: zygomatic vs. corrugator) repeated measures ANOVA revealed a main effect for region, $F(1,30) = 114.11$, $p < .0001$, and a marginally significant region X familiarity interaction, $F(1,30) = 2.29$, $p = .07$, one-tailed. The interaction indicated that more EMG activity occurred in the zygomatic muscle region during viewing of the familiar pictures ($M = 2.34$ microvolts) than during the viewing of the unfamiliar pictures ($M = 2.16$), $t(30) = 2.07$, $p < .05$. No significant differences emerged for corrugator muscle region activity. Thus, these results confirm the hypothesis that zygomatic muscle region activity would be greater for familiar than for unfamiliar stimuli. These results, however, do not support the hypothesis that corrugator muscle region activity would be less for familiar than for unfamiliar stimuli.

To test for the effects of individual differences, 2 (level of individual difference factor) between-participants X 2 (familiarity) X 2 (muscle region) within-participants ANOVAs were conducted. When level of social anxiety was included, the 2 X 2 X 2 ANOVA revealed a marginally significant three-way interaction, $F(1,26) = 1.72$, $p = .10$. Follow-up analyses indicated that the interaction was the result of a marginally significant interaction between level of social anxiety and corrugator activity in response to familiar versus unfamiliar stimuli, $F(1,28) = 2.80$, $p = .11$. This interaction indicated that persons high in social anxiety responded with more corrugator muscle region activity to the unfamiliar (M=10.70) than to the familiar (M=10.50), $t(28) = 1.45$, $p = .10$, one-tailed, whereas persons low in social anxiety tended to respond with more corrugator muscle region activity to the familiar (M=8.33) than to the unfamiliar (M=8.20). While this effect was only marginally significant, it does support the hypothesis that persons high in social anxiety would evidence less negative affect to the familiar than to the unfamiliar.

The effects of self-reported state positive and negative affect on zygomatic activity to the familiar as compared to the unfamiliar were consistent with predictions. A 2 (positive affect group: upper 25% vs. lower 25%) between-subjects X 2 (familiar) within-subjects ANOVA revealed a main effect for familiar, $F(1,16)=5.02$, $p < .04$, qualified by a marginally significant interaction, $F(1,16)=2.34$, $p<.07$, one-tailed. The interaction indicated that whereas persons with relatively low positive affect reacted with more zygomatic activity to the familiar (M=2.45) than to the unfamiliar (M=1.94), $t(16)=2.53$, $p=.02$, persons with relatively high positive affect did not (Ms=2.22 and 2.12). When using all participants (not just those in the extreme quartiles), the correlation between postive affect and zygomatic activity to familiar minus zygomatic activity to unfamiliar was significant, $r(29) = -.43$, $p = .02$.

A 2 (negative affect group: upper 25% vs. lower 25%) between-subjects X 2 (familiar) within-subjects ANOVA revealed a main effect for familiar, $F(1,11)=5.16$, $p < .05$, qualified by a significant interaction, $F(1,11)=7.33$, $p<.02$. The interaction indicated that whereas persons with relatively high negative affect reacted with more zygomatic activity to the familiar (M=2.85) than to the unfamiliar (M=2.27), $t(11)=3.39$, $p=.01$, persons with relatively low negative affect did not (Ms=3.34 and 3.39). When using all participants (not just those in the extreme quartiles), the correlation between negative affect and zygomatic activity to familiar minus zygomatic activity to unfamiliar was significant, $r(29) = .42$, $p < .05$. No other individual difference variables interacted with familiarity.

Table 2

Facial EMG to Familiar and Unfamiliar Stimuli as a Function of Individual Differences

	Zygomatic		Corrugator	
	Familiar	Unfamiliar	Familiar	Unfamiliar
Low social anxiety	2.72 (1.42)	2.57 (1.56)	8.72 (2.21)	8.57 (2.35)
High social anxiety	2.06 (0.97)	1.87 (0.73)	9.80 (4.44)	9.93 (4.27)
Low left-frontal activation	2.57 (1.13)	2.23 (0.94)	8.29 (2.28)	8.54 (2.59)
High left-frontal activation	3.00 (1.65)	2.82 (1.80)	8.84 (2.06)	8.82 (2.04)
Low positive affect	2.46 (1.01)	1.94 (0.70)	7.48 (2.47)	7.62 (2.79)
High positive affect	2.22 (1.41)	2.12 (1.48)	9.11 (2.98)	9.08 (2.89)
Low negative affect	3.34 (1.76)	3.39 (1.83)	9.63 (3.00)	9.30 (2.98)
High negative affect	2.85 (0.97)	2.27 (0.59)	8.02 (2.75)	7.82 (2.53)

Note. Means and standard deviations (in parentheses).

EEG Analyses

I predicted that relatively greater left than right anterior activity (the inverse of alpha activity) would occur in response to familiar than unfamiliar stimuli, and that this effect will be greater for high than low socially anxious persons, for high than low need for closure persons, for high than low somatosensory amplification persons, and for persons with relatively less left frontal activation.

As with EMG activity, 2 (familiarity) X 2 (region: frontal vs. parietal) X 2 (hemisphere: left vs. right) repeated measures ANOVAs were first conducted using each frequency band as the dependent variable. Then, 2 (level of individual difference variable) between-participants X 2 (familiarity) X 2 (region) X 2 (hemisphere) within-participants ANOVAs were conducted.

For delta activity, the analyses revealed a main effect of region, $F(1,29) = 167.35$, $p < .0001$, and a main effect of hemisphere, $F(1,29) = 28.54$, $p < .0001$.

For theta activity, the analyses revealed a main effect of region, $F(1,29) = 123.98$, $p < .0001$, a main effect of hemisphere, $F(1,29) = 10.36$, $p < .004$, a hemisphere X region interaction, $F(1,29) = 47.57$, $p < .0001$, and a region X familiarity interaction, $F(1,29) = 4.25$, $p < .05$. The region X familiarity interaction indicated that in the frontal region, more theta activity occurred in response to the unfamiliar (M=.53) than to the familiar (M = .51), $t(29) = 3.07$, $p < .01$. No differences between unfamiliar and familiar emerged in the parietal region. In addition, for theta activity, individual differences in somatosensory amplification interacted with familiarity, $F(1,26) = 4.89$, $p < .04$, indicating that for persons low in amplification, more theta occurred to the unfamiliar ($M = .31$) than to the familiar ($M = .28$), $t(26) = 2.04$, $p < .05$. No differences emerged for persons high in amplification.

For alpha activity, the analyses revealed a main effect of region, $F(1,29) = 110.71$, $p < .0001$, and a region X hemisphere interaction, $F(1,29) = 42.09$, $p < .0001$.

For beta activity, the analysis revealed a main effect of region, $F(1,29) = 128.09$, $p < .0001$, a main effect of hemisphere, $F(1,29) = 24.61$, $p < .0001$, and a region X hemisphere interaction, $F(1,29) = 16.03$, $p < .0005$.

Table 3

Alpha Activity to Familiar and Unfamiliar Stimuli as a Function of Individual Differences

	F3		F4	
	Familiar	Unfamiliar	Familiar	Unfamiliar
Low social anxiety	0.39 (0.29)	0.37 (0.32)	0.47 (0.28)	0.46 (0.30)
High social anxiety	0.41 (0.47)	0.37 (0.46)	0.47 (0.45)	0.45 (0.44)
Low left-frontal activation	0.74 (0.38)	0.76 (0.36)	0.78 (0.35)	0.80 (0.32)
High left-frontal activation	0.15 (0.15)	0.14 (0.14)	0.26 (0.16)	0.26 (0.14)
Low positive affect	0.47 (0.51)	0.46 (0.47)	0.56 (0.44)	0.55 (0.41)
High positive affect	0.17 (0.28)	0.12 (0.27)	0.24 (0.27)	0.21 (0.26)
Low negative affect	0.24 (0.15)	0.17 (0.20)	0.32 (0.15)	0.27 (0.19)
High negative affect	0.24 (0.41)	0.27 (0.44)	0.33 (0.40)	0.38 (0.42)

Note. Means and standard deviations (in parentheses).

Table 3 -- continued

Alpha Activity to Familiar and Unfamiliar Stimuli as a Function of Individual Differences

	P3		P4	
	Familiar	Unfamiliar	Familiar	Unfamiliar
Low social anxiety	0.15 (0.34)	0.13 (0.33)	0.06 (0.36)	0.09 (0.34)
High social anxiety	0.20 (0.44)	0.16 (0.42)	0.14 (0.49)	0.11 (0.46)
Low left-frontal activation	0.50 (0.40)	0.49 (0.35)	0.47 (0.38)	0.48 (0.28)
High left-frontal activation	-0.11 (0.14)	-0.11 (0.15)	-0.17 (0.19)	-0.15 (0.19)
Low positive affect	0.28 (0.47)	0.28 (0.44)	0.19 (0.49)	0.22 (0.44)
High positive affect	0.01 (0.28)	-0.12 (0.25)	-0.02 (0.28)	-0.10 (0.27)
Low negative affect	-0.05 (0.24)	-0.08 (0.26)	-0.16 (0.21)	-0.12 (0.31)
High negative affect	0.10 (0.32)	0.12 (0.32)	0.05 (0.40)	0.08 (0.37)

Note. Means and standard deviations (in parentheses).

IV. DISCUSSION

The results of the present experiment partially support the hypotheses tested. As hypothesized, participants preferred the familiar to the unfamiliar stimuli, and they evidenced more zygomatic muscle region activity while viewing familiar than while viewing unfamiliar stimuli. In addition, persons with relatively less left frontal activation at baseline preferred the familiar to the unfamiliar, whereas persons with relatively more left frontal activation did not. Persons with more self-reported negative affect at baseline and persons with less self-reported positive affect evidenced more zygomatic activity to the familiar than to the unfamiliar, whereas persons with less negative affect and persons with more positive affect did not. Also, persons with high levels of social anxiety tended to evidence more corrugator activity to the unfamiliar than to the familiar, whereas persons with low levels of social anxiety tended to evidence more corrugator activity to the familiar than to the unfamiliar. Taken together, these results suggest that familiar stimuli are preferred to unfamiliar stimuli because of their effects on affective responses.

Overall, participants did not evidence more corrugator muscle region activity or relatively more right than left anterior cortical activation to the unfamiliar than to the familiar stimuli, as hypothesized. Familiarity of the stimuli did interact with region on theta power, indicating that more theta power occurred to the unfamiliar than to the familiar in the frontal but not in the parietal region. The exact meaning of this effect is unclear, in part because the relationship between theta and psychological processes is not clear (Ray, 1990; Schacter, 1977).

That the familiar was not rated extremely more positively than the unfamiliar (the mean difference was only 0.20 on a 9-point scale) may help explain the failure to observe differences in corrugator muscle region and frontal EEG activity. Had the mere exposure effect been stronger, these other effects may have been significant.

Why was the mere exposure effect not particularly strong in the present experiment? The procedures used in the present experiment were chosen to optimize the chances of finding a mere exposure effect, but the effect was still not very strong. Perhaps the wearing of the facial EMG electrodes and EEG cap became uncomfortable, and prevented participants from experiencing more of the affect putatively associated with viewing the familiar versus unfamiliar stimuli. Future research should explore this possibility by using fewer electrodes, which might not be as uncomfortable to the participants. For instance, laterality effects were not observed with facial EMG; thus, in future research, electrodes could be placed on only one side of the face. The electrode cap could also be replaced with single electrodes, which may be more comfortable for participants.

In addition, the stimuli used were photographs of women taken from a high school yearbook. These photos were rated relatively positively even when they were unfamiliar to the participants. Use of stimuli that are initially evaluated more neutrally may produce larger differences between ratings of familiar and unfamiliar stimuli.

The asymmetries in anterior cortical activity and corrugator muscle region activity may not have occurred as predicted because the affect evoked by the familiar stimuli used in the present experiment may not have been of sufficient intensity to elicit these effects. Previous research finding effects on these measures has used emotion-eliciting stimuli that were more probably intense than the present stimuli. Perhaps the effects on these measures emerge only once affect of sufficient intensity has been evoked. Cuthbert, Bradley, and Lang (in press) recently found that modulation of the startle reflex during the viewing of positive versus negative stimuli (increased startle to negative stimuli and decreased startle to positive stimuli) occurs only when the stimuli are relatively strongly arousing, and does not occur with less arousing emotion-evoking stimuli. As Lang (1995) proposed, arousal or intensity may elicit these effects due to its potential to bring about action. Such an idea is plausible when one considers that emotions may serve as action dispositions or tendencies (e. g., Frijda, 1986; Lang, 1995), which prepare organisms for action. These speculations are consistent with the idea that activation in the frontal regions reflects approach-withdrawal tendencies (Davidson, 1984). If the familiar versus unfamiliar stimuli used in the present research evoked weak action tendencies, then these effects may not have been detected by patterns of anterior cortical activation or corrugator muscle region activity.

Individual Differences and the Mere Exposure Effect

The mere exposure effect was moderated by only one individual difference variable: persons with relatively less left anterior activation at baseline rated the familiar more positively than the unfamiliar, whereas persons with relatively more left anterior activation did not. These effects are consistent with the idea that the familiar is preferred to the unfamiliar because the familiar enhances positive affect for persons who may suffer deficits in approach motivation. This finding extends previous research by showing that not only do baseline anterior asymmetries in cortical activity predict emotional responses to stimuli, they also predict attitudes toward stimuli.

The effect of mere exposure on corrugator activity was also moderated (marginally) by only one individual difference variable--social anxiety. For persons with high levels of social anxiety, more corrugator activity occurred in response to the unfamiliar than to the familiar, whereas this trend was in the opposite direction for person with low levels of social anxiety. During the viewing of both familiar and unfamiliar stimuli, persons with high social anxiety also tended to have more corrugator activity than persons with low social anxiety, $F(1,28) = 2.51$, $p = .06$, one-tailed. These results suggest that persons with high social anxiety experienced less negative affect to the familiar than to the unfamiliar. This effect occurred even in the absence of a measurable difference in ratings between familiar and unfamiliar stimuli.

In addition, the effect of mere exposure on zygomatic activity was moderated by self-reported state affect. Persons with higher levels of negative affect reacted with more zygomatic activity to the familiar than to the unfamiliar, and persons with lower levels of positive affect reacted with more zygomatic activity to the familiar than to the unfamiliar. These effects, which occurred in the absence of a measurable difference in ratings between familiar and unfamiliar stimuli, suggest that persons most in need of the comfort offered by familiar stimuli react to it with increased positive affect.

Individual differences in somatosensory amplification interacted with familiarity of the stimuli on theta power. This effect was not predicted, and is difficult to interpret because the relationship between theta power and psychological processes is not fully understood (Ray, 1990; Schacter, 1977). Thus, while this effect suggests that level of familiarity played a role in cortical activation, it was not predicted and did not involve interpretable patterns of cortical activity.

Future research should examine the effects of different psychological and affective states on the mere exposure effect. As discussed in the introduction, the mere exposure effect may relate to individual differences. Manipulation of states similar to these individual differences in a controlled laboratory experiment may allow one to test whether these constructs (need for closure, anxiety, amplification) relate to the mere exposure effect. For example, manipulation of the need for closure by applying time pressure (e. g., Kruglanski & Freund, 1983) on participants would provide a test of the idea that the need for closure moderates the mere exposure effect.

Does Mere Exposure Enhance Positive Affect, Reduce Negative Affect, or Both?

Previous models presumed that the mere exposure effect resulted because unfamiliar stimuli evoked negative affect, and that this affect was reduced by repeatedly presenting the stimulus to the person. Is this the case? The data from the present experiment suggest that the familiar is preferred to the unfamiliar because the familiar is associated with increases in zygomatic muscle region activity, a response usually associated with increased positive affect, although some research has found decreased zygomatic activity to negative stimuli. To attempt to answer the question of whether mere exposure causes its effect due to its effect on positive or negative affect, I derived an assessment of baseline zygomatic muscle region activity by obtaining the mean activity over the eyes-open baseline period, and compared it to activity in familiar and unfamiliar picture viewing. Zygomatic activity increased in response to the familiar rather than decreased in response to the unfamiliar, as the baseline zygomatic activity did not differ between baseline (M=2.08) and unfamiliar stimuli viewing (M=2.16), but did differ between baseline and familiar stimuli viewing (M=2.34), $t(30)=1.66$, $p = .05$, one-tailed. In addition, participants with relatively low state positive affect evidenced more zygomatic to the familiar than to the unfamiliar, whereas participants high in state positive affect did not. Thus, these data suggest that the mere exposure exerts its effects on liking through its effects on positive affect.

However, other effects observed in the present experiment suggest that mere exposure reduces negative affect. Participants high in social anxiety evidenced less corrugator muscle region activity to the familiar than to the unfamiliar, and participants high in state negative affect evidenced more zygomatic activity to the familiar than to the unfamiliar. Thus, taken together, the effects obtained in the present experiment suggest that mere exposure increases positive affect and decreases negative affect. Further research is needed to ascertain whether mere exposure affects both negative and positive affect, or whether only positive or negative affect is altered (Cacioppo & Berntson, 1994). Such research would assist in fully understanding the precise mechanisms by which the mere exposure effect occurs.

Perceptual Fluency and Emotion in the Mere Exposure Effect

According to the perceptual fluency model, the mere exposure effect occurs because repeated exposure to stimuli make the stimuli easier to perceive, encode, and process. Persons then attribute these perceptual fluency effects to any stimulus property they are asked to rate. Research generated by the perceptual fluency model has shown that mere exposure to stimuli causes increases in non-specific judgments of stimuli. Although this model has generated interesting findings, it is doubtful that it would have generated the present research, or that it could be used to explain the present findings.

The present findings suggest that the mere exposure effect may result from the effect familiar versus unfamiliar stimuli have on affective responses. The present findings are consistent with most of the accumulated evidence, especially if one assumes that the mere exposure effect can have effects on purely cognitive judgments when they do not contradict the affect presumed to be involved in the mere exposure effect. In contrast, the perceptual fluency model may have difficulty explaining not only the results of the present experiment but the results of some of the previous research. For instance, in Zajonc's (1968) second experiment, participants were repeatedly exposed to Chinese characters, and then rated these characters and unfamiliar ones on a bipolar good-bad scale. The participants were told that the characters stood for adjectives, and that they were to guess the meaning of the characters on the good-bad scale. According to the perceptual fluency model, it is not clear why participants consistently rated the familiar stimuli as more good than the unfamiliar stimuli. That model predicts persons would attribute fluency effects to any stimulus property they are asked to judge. Thus, persons should be at least as likely to judge the familiar stimuli as more bad than the unfamiliar stimuli, but these effects do not emerge. Similar effects using bipolar scales have occurred in much research on the mere exposure effect (e. g., Zajonc, 1968; Zajonc, Crandall, & Kail, 1974; Zajonc, Markus, & Wilson, 1974; Zajonc, Shaver, Tavris, & Van Kreveld, 1972).

The perceptual fluency model might be able to explain the present results by positing that mere exposure enhanced perceptual fluency for the familiar stimuli, and this enhanced fluency made participants experience more positive affect. However, such an explanation would also have to be able to explain the moderating effects of the individual differences variables, social anxiety and resting anterior asymmetry. The present research predicted that these individual differences would moderate the mere exposure effect, whereas it is doubtful that the perceptual fluency model would have.

Conclusion

The results of the present research support the idea that the mere exposure effect occurs because of its effects on affective responses. Not only does this research assist in the understanding of the mere exposure effect and the process by which affect influences attitudes, it addresses a question central to many of the explanations of the mere exposure effect by showing that affect is indeed involved in the mere exposure effect.

V. APPENDIX A

DATA ANALYSES OF ALL SECONDS

Analyses Without Individual Differences Factors Included

EMG activity. For EMG, a 2 (familiarity) X 2 (muscle region: zygomatic, corrugator) X 6 (sec with respect to picture onset) ANOVA revealed only a main effect for region, $F(1, 30) = 112.90$, $p < .0001$.

Alpha activity. A 2 (familiarity) X 2 (region: frontal, parietal) X 2 (hemisphere: left, right) X 7 (time block) ANOVA on alpha activity revealed a main effect for region, $F(1, 29) = 113.99$, $p < .0001$, a region X hemisphere interaction, $F(1, 29) = 40.22$, $p < .0001$, and a main effect for time block, $F(6, 174) =$, 3.51, $p < .04$.

Delta activity. A 2 (familiarity) X 2 (region: frontal, parietal) X 2 (hemisphere: left, right) X 7 (time block) ANOVA on delta activity revealed a main effect of region, $F(1, 29) = 198.69$, $p < .0001$, a main effect of hemisphere, $F(1, 29) = 38.85$, $p < .0001$, a region X hemisphere interaction, $F(1, 29) = 52.16$, $p < .0001$, a main effect of time block, $F(6, 174) = 9.84$, $p < .0005$, and a region X time block interaction, $F(6, 172) = 6.23$, $p < .006$.

Theta activity. A 2 (familiarity) X 2 (region: frontal, parietal) X 2 (hemisphere: left, right) X 7 (time block) ANOVA on theta activity revealed a main effect of region, $F(1, 29) = 149.39$, $p < .0001$, a region X familiarity interaction, $F(1, 29) = 5.79$, $p < .03$, a main effect of hemisphere, $F(1, 29) = 11.46$, $p < .003$, and a region X hemisphere interaction, $F(1, 29) = 52.27$, $p < .0001$.

The region X familiarity interaction indicated that more theta activity occurred to the familiar (M=.50) than to the unfamiliar (M=.52) in the frontal regions, $t(30) = 2.09$, $p < .05$; no difference between familiar (M=.07) and unfamiliar (M=.06) occurred in the parietal regions, $p > .20$.

Beta activity. A 2 (familiarity) X 2 (region: frontal, parietal) X 2 (hemisphere: left, right) X 7 (time block) ANOVA on beta activity revealed a main effect of region, $F(1, 29) = 131.99$, $p < .0001$, a main effect of hemisphere, $F(1, 29) = 21.53$, $p < .001$, a region X hemisphere interaction, $F(1, 29) = 21.31$, $p < .0001$, a main effect of time, $F(6, 174) = 13.65$, $p < .0001$, a marginally significant region X time block interaction, $F(6, 174) = 2.87$, $p = .06$, a hemisphere X time block interaction, $F(6, 174) = 5.19$, $p < .02$, and a region X hemisphere X time block interaction, $F(6, 174) = 4.45$, $p < .02$.

Individual Differences in Social Anxiety

Level of social anxiety did not interact with ratings of familiar versus unfamiliar stimuli.

Alpha activity. For alpha activity, an ANOVA revealed two effects involving social anxiety level: a region X time block X social anxiety interaction, $F(6, 150) = 3.42$, $p < .02$, and a marginally significant familiar X time block X social anxiety interaction, $F(6, 150) = 2.62$, $p = .06$.

The familiar X time block X social anxiety interaction was followed up by conducting 2 (familiar) X 2(time block) ANOVAs for each socially anxious group. These analyses indicated that the interaction occurred only in the low socially anxious group, $F(1,12) = 2.55$, $p < .03$, and it indicated that in time block seven, more alpha activity occurred in response to viewing the unfamiliar than the familiar stimuli, $t(72) = 2.53$, $p < .01$.

Delta activity. An ANOVA on delta activity revealed a hemisphere X time block X social anxiety level interaction, $F(6, 150) = 4.18$, $p < .03$, and a familiar X region X hemisphere X time block X social anxiety level interaction, $F(6, 150) = 2.36$, $p = .05$. ANOVAs for each social anxiety group revealed that the four-way interaction occurred only for persons low in social anxiety, $F(6, 72) = 3.02$, $p < .05$. A 2 (familiar) X 2 (region) X 2 (hemisphere) ANOVA for each level of time revealed that the 3-way interaction occurred during time block two, $F(1, 12) = 11.02$, $p < .006$. A 2 (familiar) X 2 (hemisphere) ANOVA was then conducted for each region. The two-way interaction was significant for the parietal region, F(1, 12) = 9.01, p < .02, indicating that in the left hemisphere more delta activity occurred while viewing the unfamiliar (M=.59) as compared to the familiar (M=.55), t(12) = 2.40, p < .05, and in the right hemisphere, more delta activity occurred to the familiar (M=.31) than to the unfamiliar (M=.27), t(12) = 1.84, p < .10.

Theta activity. An ANOVA revealed a familiar X hemisphere X time block X social anxiety interaction, F(6, 150) = 3.07, p < .04.

This four-way interaction was followed up by conducting three-way ANOVAs for each social anxiety group. The three-way interaction was only (marginally) significant for persons low in social anxiety, F(6, 72) = 2.57, p < .07. Follow-up 2 (familiar) X 2 (hemisphere) ANOVAs within each time block indicated that the effects emerged during blocks two and three, F(1,12)=5.49, p<.04; F(1,12)=5.35, p<.04. These significant two-way interactions indicated that more theta activity occurred in response to the unfamiliar (M=.37; .40) than to the familiar (M=..34; .37) in the left hemisphere, t's(12) > 2.37, p's < .05; no differences between familiar and unfamiliar occurred in the right hemisphere, p's > .20.

Beta activity. No significant interactions involving level of social anxiety occurred. However, a region X familiar interaction did emerge, F(1, 25) = 7.41, p < .02. (This interaction was marginally significant when no grouping factor was included in the ANOVA, $F(1,29) = 2.85$, $p = .10$, and the pattern of means was identical to those produced in the present ANOVA.) This interaction was significant for the persons high in social anxiety, but not for the persons low in social anxiety. It indicated that in the parietal region, beta activity differed between the familiar (M=-.31) and the unfamiliar (M=-.32), $t(13)=2.42$, $p < .05$, and that in the frontal region, beta activity differed between the unfamiliar (M=-.03) and the familiar (M=-.04), $t(13)=1.85$, $p < .10$.

EMG activity. For EMG activity, a marginally significant familiar X time block X social anxiety interaction emerged, $F(5, 130) = 1.98$, $p = .10$. This interaction was followed up by conducting 2 (familiar) X 2 (time block) ANOVAs for each socially anxious group. The familiar X time block interaction did not emerge for either group. A 2 (social anxiety) X (familiar) ANOVA for each time block revealed that during time block three, low socially anxious participants displayed more EMG activity to the familiar than to the unfamiliar stimuli, but high socially anxious participants did not.

Individual Differences in Amplification

No significant effects involving somatosensory amplification occurred for ratings of the stimuli, alpha activity, delta activity, or EMG activity.

Theta activity. For theta activity, a significant familiar X amplification interaction emerged, $F(1, 26) = 6.11$, $p < .03$. The interaction indicated that persons low in amplification tended to respond with more theta activity to the unfamiliar (M=.31) than to the familiar (M=.28), $t(26) = 1.89$, $p < .10$, whereas persons high in amplification tended to respond with more theta activity to the familiar (M=.29) than to the unfamiliar (M=.27), $t(26) = 1.60$, $p = .15$.

Beta activity. For beta activity, a hemisphere X familiar X time block X amplification interaction, $F(6,156) = 4.29$, $p < .02$, emerged. It indicated that among persons low in amplification, but not among persons high in amplification, beta activity differed as a function of hemisphere and familiarity in time block two. Activity in the right hemisphere differed between familiar (M=-.17292) and unfamiliar (M=-.16661) stimuli, $t(13) = 11.58$, $p < .001$; and activity in left hemisphere differed between familiar (M=-.20603) and unfamiliar (M=-.22280) stimuli, $t(13)=18.85$, $p< .001$.

APPENDIX B: HUMAN SUBJECTS APPROVAL

Human Subjects Committee

THE UNIVERSITY OF ARIZONA. HEALTH SCIENCES CENTER

95.003

1622 E. Mabel St.
Tucson, Arizona 85724
(602) 626-6271

5 October 1994

Eddie Harmon-Jones, M.A.
John J. Allen, Ph.D.
Department of Psychology
Building 521, Room 138 MAIN CAMPUS

RE; HSC A94.71 PSYCHOPHYSIOLOGICAL RESPONSES TO SELF-RELEVANT QUESTIONS

Dear Investigators:

We received your 14 September 1994 research proposal and 22 September 1994 letter and sample questionnaire, and 3 October 1994 revised consent form as requested for the above-cited project. All of the conditions as set out in our 19 September 1994 and 23 September 1994 letters to you have been addressed. The procedures to be followed in this study pose no more than minimal risk to participating subjects. Regulations issued by the U.S. Department of Health and Human Services [45 CFR Part 46.110(b)] authorize approval of this type project through the expedited review procedures, with the condition(s) that subjects' anonymity be maintained. Although full Committee review is not required, a brief summary of the project procedures is submitted to the Committee for their endorsement and/or comment, if any, after administrative approval is granted. This project is approved effective 5 October 1994 for a period of one year.

The Human Subjects Committee (Institutional Review Board) of the University of Arizona has a current assurance of compliance, number M-1233, which is on file with the Department of Health and Human Services and covers this activity.

Approval is granted with the understanding that no further changes or additions will be made either to the procedures followed or to the consent form(s) used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and your College or Departmental Review Committee. Any research related physical or psychological harm to any subject must also be reported to each committee.

A university policy requires that all signed subject consent forms be kept in a permanent file in an area designated for that purpose by the Department Head or comparable authority. This will assure their accessibility in the event that university officials require the information and the principal investigator is unavailable for some reason.

Sincerely yours,

WFDenny

William F. Denny, M.D.
Chairman, Human Subjects Committee

WFD:rs

cc: Departmental/College Review Committee

APPENDIX B: HUMAN SUBJECTS APPROVAL

Human Subjects Committee

THE UNIVERSITY OF
ARIZONA.
HEALTH SCIENCES CENTER

1622 E. Mabel St.
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13 April 1995

Eddie Harmon-Jones, M.A.
John J. Allen, Ph.D.
Department of Psychology
Building 521, Room 138
Main Campus

RE: HSC A94.71 PSYCHOPHYSIOLOGICAL RESPONSES TO SELF-RELEVANT QUESTIONS

Dear Investigators:

We received your 11 April 1995 letter and accompanying revised consent form for the above referenced project. Protocol changes include discontinuance of self-reflection portion of study and recruitment of sorority members in addition to Introductory Psychology students; also sorority volunteers to be compensated $10 and Psychology students $10 or course credit (consent form revised accordingly). Approval for these changes is granted effective 13 April 1995.

The Human Subjects Committee (Institutional Review Board) of the University of Arizona has a current assurance of compliance, number M-1233, which is on file with the Department of Health and Human Services and covers this activity.

Approval is granted with the understanding that no further changes or additions will be made either to the procedures followed or to the consent form(s) used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and your College or Departmental Review Committee. Any research related physical or psychological harm to any subject must also be reported to each committee.

A university policy requires that all signed subject consent forms be kept in a permanent file in an area designated for that purpose by the Department Head or comparable authority. This will assure their accessibility in the event that university officials require the information and the principal investigator is unavailable for some reason.

Sincerely yours,

WF Denny

William F. Denny, M.D.
Chairman
Human Subjects Committee

WFD:rs

cc: Departmental/College Review Committee

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