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# THE EXPRESSION AND EVALUATION OF FACIAL EMOTION ACROSS THE LIFE SPAN: AN EXAMINATION OF THE COHORT BIAS EFFECT

by

SANDRA A. YECKER

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

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# Abstract

THE EXPRESSION AND EVALUATION OF FACIAL EMOTION ACROSS THE LIFE SPAN: AN EXAMINATION OF THE COHORT BIAS EFFECT

by

Sandra A. Yecker

Adviser: Professor Joan Borod

The purpose of this study was to examine changes in the expression and perception of facial emotion as a function of age. Additionally, the cohort bias effect, a possible decoding advantage for the processing of emotional cues by same-age peers, was systematically investigated. The developmental component of this study tested the theory that right-hemisphere processing of facial expression declines with advancing age.

Positive (happiness and pleasant surprise) and negative (sadness and disgust) emotional expressions, along with a neutral or "relaxed" facial expression, were posed by 30 young (21-40 years; $\underline{M}$ = 30.1), 30 middle-aged (41-60 years; $\underline{M}$ = 49.2), and 30 older women (61-80 years; $\underline{M}$ = 69.9). The resultant facial stimuli were presented to 12 young (25-35

years; M = 31.0), 12 middle-aged (45-55 years; M = 50.7), and 12 older women (aged 65-75 years; M = 67.2). Posers and raters were matched across age groups on demographic and cognitive variables. Raters made judgments about 1.) intensity of facial musculature, 2.) accuracy of the poser's intended facial expression, 3.) confidence in their accuracy judgments, and 4.) poser's probable age. These judgments about facial stimuli represent a variety of tasks that tap the processing of emotionally-laden and non-emotional facial characteristics. Women were studied because there is evidence that they are better encoders and decoders of emotional stimuli than are men. High levels of interrater reliability were obtained (accuracy alpha = .95, intensity alpha = .99)

Findings revealed that a cohort bias effect was not operative in this data set and suggested that this bias can be controlled by thoroughly matching rater groups on task-specific neuropsychological abilities, e.g., visual perception and facial recognition. Overall, the expressions of the older posers were rated as less accurate and with less confidence than those of the young and middle-aged posers. Intensity of emotional expression was not found to diminish with age, but the neutral face was rated as more intense for the young and middle-aged posers than for the older posers. These results replicate the findings of Moreno (1987) who used a small set of young raters. Exploratory investigations of depressive symptomatology and non-emotional cues from the facial stimuli were also conducted.

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This dissertation research could not have been accomplished without the dedication and assistance of my chairperson, Dr. Joan Borod. Committee members, Drs. Howard Ehrlichman, Sandra Shapiro, and Joan Welkowitz, generously provided their guidance and support. Also, for the doctoral defense, Dr. Nancy Foldi graciously served as an outside reader. I appreciate the respective efforts of each of these individuals and sincerely thank them for their contributions to my academic career.

In addition to these mentors, this work would not have been possible without the 1987 dissertation research of Dr. Caridad Moreno, Lateralization of Emotional Expression as a Function of Aging. I am grateful to Dr. Moreno for her meticulous attention to detail in the original study, and for her conscientious preservation of the records and facial stimuli.

The good-natured cooperation of the 36 women who served as raters must be gratefully acknowledged, as well as the support from members of Dr. Borod's colleagues and research team: Stephanie Berns, Ilana Grunwald, Nancy Madigan, Shelley Peery, Larry Pick, Larry Solanch, Stacy Wasserman, and Dennis Zgaljardic.

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Finally, I wish to acknowledge some individuals whose regard for academia reflects a broad range of opinion. With a few exceptions, most have no connection to "the Ivory Tower." Nonetheless, each, in their own fashion, has encouraged the completion of this project solely because it was important to me. Some have made personal sacrifices; others have extended kindness and listened at length. At very critical times, they rallied around me, went out of their way to assist, and asked no favors in return. For their affection, and especially their encouragement during the writing of this manuscript, I thank: Bruce Bomberger, Emily Eichelberger, Marty and Ken Frey, Tracy Lesher, Bill Luckenbaugh, Patrick Murray, and Gail Stauffer.

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# Introduction

## Rationale

Several decades of research have led emotion theorists to a multifaceted view of the complex and interleaved responses which form the context of daily emotional experience. Rather than overarching schemes which integrate aspects of emotional behavior, the extant neuropsychological and physiological literature suggests that autonomic responses, e.g., physiological arousal, are likely mediated by mechanisms independent of those for expressive behavior, e.g., facial affect or prosody. Similarly, arousal and expressive behaviors are likely independent of perceptual processes. Borod (1993) has developed a model for both conceptualization and investigation of the brain-behavior relationships that regulate emotion. Known as the "componential approach," this scheme recognizes 1.) processing modes, 2.) communication channels, 3.) experiential qualities, and 4.) lexicons as integrated constructs which contribute both independently and collectively to "emotional" behavior. The approach suggests that each of these components is multidimensional. For example, the modes of emotional processing include: detection, perception, arousal, expression, experience, and/or reaction (Borod, 1993). Additionally, the stimuli initiating and mediating this processing might be communicated through any combination of facial, prosodic, lexical, gestural, or postural channels. The meaning of nonverbal cues, such as facial expressions, gestures, and/or tone of voice contributes to a lexicon or

dictionary of affective semantics for both internal and externally perceived events (Bowers, Bauer, & Heilman, 1993).

This is a vast and useful framework, but obviously each component need not be addressed in a single examination. The hope would be that any proposed research in the field might align itself with the theory and be able to isolate specific components under study. The present examination was inspired by the componential approach, focusing on the production of emotional expressions and the detection of emotion conveyed through the facial channel. Specifically, there were three aims of the study: 1.) to examine the effects of aging on both the expression of facial affect and the perception of facial emotions; 2.) to systematically examine perceptual biases in normal adults that might influence decisions about emotional and non-emotional facial stimuli; and 3.) to compare changes in the perception of facial affect to other types of cognitions involving both emotionally-laden and non-emotional/ analytical information conveyed through the face.

## Age and Cohort Effects on Emotional Processing

Facial expression of emotion (or "facial affect") and perception of facial expression are two aspects of emotional processing that are likely mediated by the right hemisphere. Additionally, changes in right hemisphere physiology and functioning with age have been posited. This examination of age and facial expression was intended as a partial replication of the work of Moreno (1987). As part of a larger study

investigating emotional processing as a function of age. Moreno examined posed facial expressions produced by young, middle-aged, and older healthy female adults. Posed expressions of five emotions (2 positive, 2 negative, and 1 neutral) were rated by three female college students for 1.) "intensity," or amplitude of muscular contraction in the expressions, and 2.) "accuracy," or ability of the poser to encode and produce the intended emotional expression, e.g., "happiness". The raters' judgments of intensity and accuracy were guided by procedural instructions developed in the laboratory of Dr. Borod. The raters were trained to a high level of interrater reliability (alpha = 0.93) such that their judgments could be treated as an instrument for both the detection of muscular intensity in facial expressions and for the categorization of emotional expression. These measurements were used to evaluate differences in the capacity of the young, middle-aged, and older women in Moreno's sample to both produce spontaneous facial emotions and to portray an intended expression.

Moreno (1987) found no changes in expression intensity as a function of age, but for accuracy of posed expression, older subjects were judged to be less accurate expressers/encoders than younger subjects. The finding of no changes in intensity with age, but changes in accuracy of posed expression suggested differential mechanisms within the right hemisphere for production of discrete emotions and mediation of expressive motor output. However, just after Moreno's study concluded, Malatesta, Izard, Culver, and Nicholich, (1987) reported that the closer in

age raters were to posers, the more accurately spontaneous expressions were rated. In the Malatesta, et al. (1987) study, videotaped spontaneous facial expressions were rated by young, middle-aged, and older raters/decoders. Their identification of a possible "cohort bias effect," accruing from experience with age related peers, implied a possible confound (decoding advantage) in Moreno's design. Thus, definitive proof of dissociation between access to the emotion lexicon (e.g., happy, sad, angry, etc.) and conveyance of that emotion through facial-motor channels was not obtained. (See Moreno, Borod, Welkowitz, and Alpert [1990] and Moreno, Borod, Welkowitz, and Alpert [1993] for published outcomes of Moreno's doctoral thesis.)

During a study which focused on character attributes assigned to photographs of smiling faces as a function of gender and age, Otta, Abrosio, & Hosino (1996) inadvertently been provided some insights to the cohort bias effect. Their procedures were akin to those of Moreno (1987), in that intensity levels were represented by their stimuli, and a neutral pose was compared to expressions conveying happiness for young, middle-aged and older posers. Four stimulus categories were reported by Otta et al. (1996): the neutral expression, a closed mouth smile, an "upper" smile, and a broad smile. Production of these four categories clearly required differing levels of muscular involvement, or expression intensity. Young raters were asked to assign personal attributes (attractiveness, happiness, extroversion, sympathy, kindness, submission, ambition, and intelligence)

on a scale of 1-7 to each of the photographed faces. Otta et al. (1996) reported that multivariate analyses revealed no interaction between Poser Age and Stimulus Type. Thus, their raters (aged 18 -29 years ) assigned equivalent degrees of character traits, despite poser age, and did not appear to be biased for higher-order processing of information conveyed through the facial channel. It can also be inferred from Otta et al.'s (1996) description that their young, middle-aged, and older posers produced a fairly homogeneous set of happiness expressions. If intensity of expression had diminished with advancing poser age, a Stimulus Type by Poser Age interaction might have arisen in the Otta et al. (1996) study.

Since many studies on facial affect include subjects or raters of only one age group, (e.g., Moreno's raters [1990]), or span a broad range of undifferentiated ages, (e.g., Hager and Ekman's encoders [1985]), cohort effects have rarely been systematically examined as an independent variable. The accrual of a perceptual bias through repeated experience or familiarity with peers is not, however, unique to decoding emotions conveyed through facial channels. Racial/ethnic biases have also been suggested for attribution of emotional and non-emotional adjectives to neutral faces, e.g., Rhodes and Lynskey (1989).

Biases Commonly Controlled for in Facial Expression Studies

Variables that could affect expression/encoding of facial stimuli, such as unilateral brain damage (Borod & Koff, 1984; Bruyer, 1981), or

specific psychiatric conditions, such as unipolar depression (Jaeger, Borod, & Peselow, 1986), are known to have an impact upon emotional processing. Neuropathological conditions and psychiatric disturbances influencing perception of facial stimuli have also been studied ( Borod, Martin, Alpert, Brozgold, & Welkowitz, 1993; Mikhailova, Tatjana, Vladimirova, Iznak, Tsusulkovskaya, & Sushko, 1996). Additionally, there is also a left visual field bias inherent to the decoding of facial expression by normal, right-handed adults who exhibit no brain injury or psychopathology (Burt & Perret, 1997; Drebing, Federman, Edington, & Terzian, 1997; Levy, Heller, Banich, & Burton, 1983; Borod, St. Clair, Koff, & Alpert, 1990). This natural viewing advantage can be quantified using the Çhimeric Face Test (Levy, 1983) and, along with differential predispositions for asymmetric facial expression of specific emotions (Borod & Caron, 1980; Sackeim & Gur, 1978), can be methodologically controlled by use of procedures such as statistical covariation, counterbalancing experimental conditions, or reversal of stimulus orientation.

Factors that Affect Decoding of Facial Expressions. Perceptual analysis or decoding of facial stimuli involves the "cool cognitions of emotion," as defined by Bowers et al. (1993), in that the process requires knowledge about species-specific emotional signals that are not intensely felt emotional experiences. However, since knowledge about nonverbal

expression appears to be mediated by the right hemisphere, any state which alters right cortical functioning could alter judgments about facial expressions. Major depression, a pathological state, is known to influence expression and perception of emotions, in part, through its physiological effects. (See, for example, Jaeger, Borod, & Peselow [1986].)

Individuals exhibiting fewer symptoms of depression than necessary for a diagnosis of major depression might also judge emotional facial stimuli differently than non-depressed controls. Persad and Polivy (1993) reported that depressed psychiatric patients, as well as depressed college students, made more errors than non-depressed college students on a task requiring identification of the emotions portrayed in a set of standardized facial expressions. Conceivably, these "depressed" students (ages 18 - 53), who were identified by scores greater than or equal to 10 on the Beck Depression Inventory (BDI), were still functioning well enough to be in school, and thus represented a milder level of symptomatology than that typically considered in studies of emotional processing and unipolar depression.

Though the range of scores for the depressed college students and the depressed patient groups in the Persad and Polivy (1993) sample did overlap, there were significant differences in the degree of symptomatology. For the depressed college students, Persad and Polivy (1993) reported a mean BDI score of 16.12, while that for the depressed patients was 37.06. Comparatively, the mean BDI score for non-depressed

college students) was 3.75. These scores alone, do not reveal the types of symptoms endorsed by individuals in each group. Thus, the decrement in depressed college students scores cannot be fully attributed to changes in affective processing as there might also have been a contribution from vegative symptoms and cognitive slowing.

In another study which used the BDI to classify degree of symptomatology, Hale, Jansen, Brouhuys, and van der Hoofdaker (1998) found that partners of clinically depressed patients performed differently on a task of facial affect assessment than both the depressed patients and controls. Specifically, the task was to rank the degree to which a line drawing (or schematic face) communicated an intended expression, e.g., happiness. As compared to the Persad and Polivy (1993) sample, Hale, et al.'s (1998) patient partners (or intermediate symptom group) more closely resembled healthy subjects in their BDI responses. For patient partners, the mean BDI score was reported to be 5.5 and was not significantly different ($p = 0.054$) from that of the healthy controls (BDI = 2.6).

evidence that subclinical variations in decoder characteristics may also have pervasive effects on the perception of facial expressions is provided by Cooley and Norwicki (1989). They reported that clinically-depressed individuals and "disturbed" control subjects were slower than healthy controls in a facial emotion comparison task, but not slower than normals in a word comparison task. This finding suggested that mood and/or personality features might differentially affect right- and left-

hemisphere processing. Non-depressed, "disturbed" subjects were defined by Cooley and Norwicki (1989) as having, at least one elevated score on any Minnesota Multiphasic Personality Inventory (MMPI) scales other than: Scale 2 - Depression, Scale 5 - Masculinity-Femininity, or Scale 0 - Social Introversion. This criterion suggests that disturbed subjects were a fairly heterogeneous group, with possibly broad variation in their personality features.

Looking at other personality traits, Harrison and Gorelczenko (1990) reported that individuals with Type A and Type B traits were not different in their abilities to perceive happy and sad expressions portrayed in photographs, but rather that individuals with Type A behavior patterns were more likely to assign angry labels to the neutral face. This affective bias did not, however, influence response time which was equivalent between the two groups.

Severity of alexithymia has also been associated with differential processing of emotionally-laden stimuli. Jessimer and Markham (1997) demonstrated that college students who endorsed many symptoms of alexithymia did not demonstrate the typical left hemispace bias that is often observed with chimeric face tasks. In their study, 180 high school students and college freshmen were sampled. The performance of subjects with the highest ranking scores (25% of the sample) on the Toronto Alexithymia Scale (TAS-20) was compared to that of subjects with the lowest ranking responses (25% of the sample).

Bouhuys. Bloem. and Groothuis (1994) sampled non-depressed medical students (BDI: M = 1.8. SD = 2.2) and demonstrated that ambiguous schematic faces are assigned more characteristics of negative affect when a "depressive mood" is simply induced by listening to music. Collectively. these studies on facial perception suggest that the presence of mood symptoms that are subclinical in severity (and even transient) might impact upon judgments of emotional expression. Though psychiatric and neurological variables are typically screened in facial processing studies and sometimes used as covariates in statistical analyses (e.g.. McDowell. et al.. 1994: Moreno et al.. 1993). subtleties of emotional state and symptomatology that fall below levels for formal diagnosis have not been systematically examined.

Heller. Etienne. and Miller (1995). have provided compelling evidence for assessing mood factors in allegedly "healthy" populations. Their findings that: 1.) 93/986 (nearly 1 in 10) college students endorse clinically significant levels of both high anxiety and high depression and 2.) that high anxiety or high depression levels (.04 combined in 10) predict differential performance on the Chimeric Faces Test. strongly argues for very careful screening of raters. especially when a small sample size is used. Their findings demonstrate that the ability to cope in a role might indicate a "subsyndromal (Heller et al.. 1995)" state. but not necessarily unaffected emotional processesing.

Factors that Affect Encoding/Production of Facial Expressions. Information on the interaction of psychogenic variables and the ability to encode or pose facial emotions is also limited. Malatesta-Magai, Jonas, Shepard, and Culver (1992), reported that individuals with Type A and Type B personalities differentially displayed spontaneous facial expressions of anger.

Interaction of Age and Psychogenic Factors. An age component was also revealed in the Malatesta-Magai et al. (1992) study. Using an emotion induction paradigm to elicit facial expressions, older individuals were found to be more expressive than younger subjects across a range of emotions, regardless of personality type.

It has been theorized (e.g., Shultz [1985]) that personality traits might also be differentially expressed by young and old individuals. Theorists, such as Levenson, Carstensen, Friesen, & Ekman (1991), have speculated that age-related neurophysiological changes could influence facial expression or might impact on the experiential qualities of emotion. In fact, different patterns of autonomic nervous system (ANS) responding have also been reported for young and middle-aged adults when expressions are both posed or elicited by mental imagery tasks (Ekman Levenson, & Friesen, 1983; Levenson, Ekman, & Friesen, 1990). However, with increasing age, the adult threshold for ANS reactivity to environmental stressors appears to lower (Bondareff, 1980; Eisdorfer, 1970; Powell, Eisdorfer, and Bogdonoff, 1964). Thus, the Malatesta-

Magai et al. (1992) finding of strongly felt emotion could reflect greater emotional sensitivity by older individuals due to a lowered neurophysiological threshold for reactivity.

The literature reviewed demonstrates that subclinical degrees of depressive symptomatology, and possibly personality traits, may influence investigations of facial affect and are worthy of further investigation. To date, there is no study which has systematically examined the interaction of age and perceiver mood variables (in one subject sample) on the decoding of information conveyed through facial stimuli. For the present examination, facial stimuli recreated from Moreno (1987) allowed for examination of four facial components: 1.) affective expression, 2.) the "neutral" or normative face, and 3.) objective poser characteristics (e.g., age of poser). Detection of these features reflects a range of perceptual processing demands that may be differentially mediated by right-hemisphere mechanisms for wholistic processing and left-hemisphere mechanisms specialized for serial/analytic reasoning. For instance, the right hemisphere most likely mediates processing of facial affect, while assignment of age to a photographed face may require analytical judgments. The objective of this investigation was to examine sources of bias that could affect perception of facial features. Specifically age cohort advantages and depressive symptomatology were examined as a function of affect-laden and non-affective facial features. Judgments about these stimulus variables provided a variety of tasks from which emotional

processes in young, middle-aged and older women could be examined.

## Theoretical Background

In addition to the scientific framework provided by the componential model, the neuropsychological literature proposes two main hypotheses about hemispheric specialization for emotional processing (Borod, 1993). The "right hemisphere hypothesis" states that perception and expression of affect are largely mediated by right-hemisphere structures (e.g., Borod, 1992; Bryden and Ley, 1983; Buck,1984; Heilman & Bowers; 1990). By contrast, the "valence hypothesis" suggests that the processing of positive emotions, e.g., happiness or pleasant surprise, is mediated by the left hemisphere, while the processing of negative emotions, e.g., sadness or disgust is right-hemisphere dependent (e.g., Ahern & Schwartz, 1979; Sackeim, Greenberg, Weiman, Gur, Hungerbuhler, & Geschwind, 1982; Silberman & Weingartner, 1986). A variant of the valence hypothesis suggests that expression is differentially mediated by the positive or negative nature of the affect, but that perceptual functions are specific to the right hemisphere (Bowers et al., 1993; Borod, Koff, Perlman-Lorch, & Nicholas, 1986; Davidson, 1984, 1987).

### Design Issues

Sample Selection. These alternative theories have arisen, in part, from studies of normal adult and patient populations. Sackeim and

have noted that results from studies of unilateral brain damage and and affective behaviors, such as emotional expression or mood state, have historically contributed to the valence hypotheses. The study of induced mood states has also been cited as contributing to this set of hypotheses (Borod, Koff, Yecker, Haywood, & Schmidt, in press). On the other hand, Sackeim et al. (1988) and Borod et al. (in press) suggest that a vast array of studies designed to look specifically at processing of emotionally laden information (conveyed through varying channels, e.g., vocal or facial), have largely contributed to the right hemisphere model of emotional lateralization.

Task Dimensions. Different techniques for presentation of facial stimuli may also be responsible for the conflicting results about emotional processing (Borod, 1993; Sackeim, et al. 1988). For instance, differential effects of free-field or tachistoscopic presentations could account for discordant findings. Additionally, the exposure duration for tachistoscopic presentations may also influence processing or differentially evoke hemispheric advantages. The impact of methodological techniques on perception of emotional expressions is paralleled by observations from face discrimination studies, where the duration of the stimulus appears to dictate those aspects of the stimulus pattern that will trigger either right-sided/gestalt processing or analytic/left-hemisphere analysis. Thus, there appear to be many variations of stimulus dimensions, presentation

conditions, and/or perceiver characteristics that can interact to determine which decoding mechanisms will be active in any one procedure.

Subject Characteristics

Age Effects. A perceiver characteristic of particular interest in this study was age. There are relatively few studies which examine emotional processing as a function of normal aging in adult subjects. Cognitive changes with advancing age have been identified for visuoperceptual abilities (Arenberg, 1978; Benton, Eslinger, & Damasio,1981); visual spatial organization (Wasserstein, Thompson, Surman & Barr,1982); facial recognition (Benton, et al., 1981; Crook & Larrabee, 1992); constructional skills (Farver, 1975); executive motor (Mitrushina, Fogel, D' Ella, Uchiyama, & Satz, 1995) and somatosensory functions (Bender, 1975).

These reports have led theorists, such as Albert and Kaplan (1979), Brown and Grober (1983), Brown and Jaffe (1975) to suggest that right-hemisphere abilities decline with age. At times referred to as the "right hemi-aging hypothesis (e.g., McDowell et al. [1994])," this phenomenon is far from invariable. Studies such as those of Borod and Goodglass (1980), Obler, Woodward, and Albert (1984), Levine and Levy (1986), and Moreno et al. (1990) the presumption that age-related cognitive declines for processing of affectively laden, as well as non-emotional information, are associated with uniform changes in cortical functioning for both hemispheres.

Both face recognition and basic visual perception abilities (which are germane to evaluation of facial expressions) have been shown to decline with age (e.g., Benton et al. [1981]). Viewing a standardized set of facial expressions, Moreno et al. (1993) found that there were no changes in the ability to identify the expressed emotion, e.g., happiness as opposed to pleasant surprise, as a function of age. In that study, the integrity of left- and right-hemisphere cognitive functions was measured and used as either a characteristic for sample matching or as a correlative control.

Malatesta et al. (1987) used an emotion-induction procedure to elicit spontaneous expressions of negative emotions in their cohort bias study. Their stimuli were videotaped segments of expressions elicited from posers who recounted a recent experience of negative emotions: anger, sadness, fear/anxiety. Malatesta et al.'s (1987) findings are likely applicable judgments of posed expressions, because previous work (Zuckerman, Hall, DeFrank, & Rosenthal, 1976) suggests that posed and spontaneous expressions are rated with similar accuracy. However, as Moreno, Borod, Welkowitz, and Alpert (1993) point out, Malatesta's raters were not screened for perceptual abilities other than visual acuity. Consistent with Malatesta et al.'s (1987) findings, McDowell et al. (1994) reported that an older group of raters was less accurate at identifying negative and neutral affect portrayed in standardized photographs. Compared to younger subjects, the older group also considered posed expressions to be more intense.

Using a different type of experimental design, Bosegole and Weisman (1995) reported that perception of angry expressions appear to decline during the fifth decade of life. As part of a large developmental examination of affect perception across many communication channels, Brosgole and Weisman (1995) asked subjects to discriminate among black-and-white cartoon renderings of animals displaying happy, sad, or angry faces. Though Brosgole and Weisman (1995) reported that facial affect labeling was the least affected of all their tasks (visual and auditory), older participants ($\underline{M}$ = 75.2 years) made significantly more discrimination errors for identification of the angry face than did middle-aged participants ($\underline{M}$ = 52.5 years). The findings for both groups were significantly different from those for four other younger groups that represented ages 2 - 43 years.

For comparison of expressions presented to different visual fields, McDowell et al. (1994) additionally reported that young and old subjects discriminated positive affect stimuli faster when they were presented to the left hemisphere. Negative stimuli were responded to more slowly by elderly than younger subjects when presented to the right hemisphere. From this same laboratory, Billings, Harrison, and Alden (1993) reported that identification of expressions presented tachistoscopically was faster by younger than older women, but that response times were not significantly different as a function of hemispheric presentation. Both studies suggest a decline for right-hemisphere perception and processing of facial affect with

age. Additionally, McDowell et al.'s (1994) results challenge the hypothesis that emotional expressions are differentially mediated by the right and left hemispheres as a function of expression valence.

Looking at the ability to emote or encode facial expressions as a function of age, Moreno et al. (1990) reported no changes in expression intensity with age. Some physiological observations corroborate this finding. Levenson et al. (1991) demonstrated that the ANS activity accompanying both induced spontaneous expressions and purposefully-posed emotional facial expressions did not differ as a function of age, though older women experienced more intense emotion than younger women while reliving memories during an induction paradigm.

Mood Factors. In preparation for the Diagnostic and Statistical Manual-IV, epidemiological studies concerning the prevalence of negative mood symptoms in community-dwelling individuals not receiving mental health treatment were reviewed for samples across the United States (Katon & Roy-Byrne, 1991). This article identified numerous studies which indicated that mixed symptoms of anxiety and depression are frequently endorsed on various self-report measures of symptomatology. Hiller, Zaudig, & Rose (1989) reported that over fifty percent of the individuals with levels of anxiety and depression lower than necessary for a clinical diagnosis of mood disorder, reported mixed symptoms of anxiety and depression.

When age is considered, the mixed symptom profiles for seniors and young-adults may, however, be different (Perkins-Newmann, Engel, & Jensen, 1991). Feldman (1993) noted that general symptoms of negative mood, rather than discrete symptoms of anxiety and depression, were revealed on self-report scales of theses traits.

Consistent with symptom profiles repeatedly identified in studies reviewed by Katon and Roy-Byrne (1991), Watson, Clark, and colleagues (1995a, 1995b) have proposed a "Tripartite Model" of anxiety and depression. Their reports suggest that the tripartite model discriminates among self-reported mood symptoms, parceling experiences of anxiety from those of anhedonia, and general distress. The latter factor is thought to reveal the link between symptoms of anxiety and symptoms of depression which present concurrently in Mood Disorders.

Burns and Eidelson (1998) have recently attempted to replicate Watson et al.'s (1995a, 1995b) findings. Their results suggest that non-specific symptom scales for anxiety and depression, similar to Watson et al.'s general distress scales, may better characterize the unique contributions of depressive and anxious symptomatology to mood dysfunction. Though the scientific community has not yet responded to Burns and Eidelson's (1998) report, both camps continue to acknowledge the additive nature of mood symptoms for differentiation of distinct mood syndromes.

Aging and mood. The notion of changes in emotional experience

with age is not uncommon. Studies such as those of Botwinick (1973), Carstensen (1987), Newton, Lazarus, and Weinberg (1984), and Palmore (1981) have suggested that male and female individuals become more introverted, cautious, and less responsive to their social environment with increasing age, while studies of mood and existential factors, e.g., Alstonet al (1974), Clemente and Sauer (1976), Cameron (1975), Edwards and Klemmack (1973), Larson (1978), and Witt, Lowe, Peek, and Curry (1980), have been quite variable. The propensity for depression with age has been noted for some time (Blazer, 1982; Shultz, 1985; Zung, 1980). More recently, Perkins-Newmann et al. (1991) found that age predicted the types of symptoms reported on the SCL-90 Depression Scales for cohort groupings that spanned ages 51-92 years. Younger individuals in this range reported more poignant symptoms and depressive ideation (feelings of guilt, despair, and distress), while older individuals tended to endorse symptoms of depletion (disengagement and withdrawal), along with anhedonia, sleep disturbances, and low energy. These findings complement those of Newmann, et al. (1991) on the differences in mixed-symptom mood disorders across age cohorts and suggest that emotional experience or emotional milieu is also dynamic throughout the life span.

## Overview and Hypotheses

The current study was designed to test hypotheses about changes in emotional processing as a function of advancing age. The specific facial

emotional expressions and the types of facial cues (emotional and non-emotional) were chosen to provide information about the prevailing neuropsychological theories on hemispheric specialization for emotional processing. The first objective was to replicate the Moreno (1987) findings on encoding capacity and to examine the effects of any age related perceptual changes on decoding of facial stimuli. To achieve this, 36 healthy, adult females (12 young, 12 middle-aged, and 12 older) rated a total of 450 expressions (happiness, pleasant surprise, neutral, sadness, and disgust) that were produced by the 90 young, middle-aged and older posers from the Moreno study. Four different dependent measures were obtained by rating: 1.) the degree or "intensity" of muscular involvement in facial expressions; 2.) decoder accuracy in the production of target facial expressions; 3.) rater confidence about accuracy ratings; and 4.) the age of the poser. Balancing rater and poser age group designations (young, middle-aged, and older) allowed for examination of cohort bias advantages for the four perceptual tasks. Thus, the principal objective of this study was to examine emotional processing across the life span.

The influence of depressive symptomatology on these four perceptual tasks was also considered. While perception of poser age from photographs has been studied as a simple discrimination task (Burt and Perrett, 1997) the identification of age, as a non-emotional, and possibly analytic task, were explorative in this study and do not appear to have been previously researched.

Hypotheses about Age and Expression

1. Consistent with the report of Moreno et al. (1990), ratings of expression intensity were not expected to change as a function of posers' age. That is, the emotional expressions produced by older subjects were hypothesized to be just as intense as those produced by younger subjects.

2. Also based on Moreno's findings, decreases in the accuracy or appropriateness of target expressions were expected with advancing age. Overall, younger women were expected to be better encoders of the target emotions than older women.

Hypotheses about Age and Perception

3. Ratings of emotional intensity were not expected to vary as a function of perceiver's age. Specifically, the intensity ratings made by older women were not hypothesized to differ from those produced younger women.

4. It was also hypothesized that there would be no perceptual advantage associated with decoding of same age-cohort faces. For each of the four dependent variables, younger women were not expected to 1.) assign greater intensity of expression, 2.) find greater expression accuracy, 3.) be more confident, nor 4.) more easily identify the ages of young posers than middle-aged and older posers. That is, rater age and poser age interactions, for which young subjects rated young poses highest and old

poses lowest were not expected. These patterns were also not predicted for older raters.

5. For the neutral face, raters were expected to perceive greater intensity of expression as a function of age. This was owed to increasing facial lines and wrinkles that accompany normal aging. Raters were not expected to differentially evaluate other stimuli as a function of age.

Exploratory Topics

6. Other than the fact that depressive symptomatology was suspected to influence judgments about facial emotional expression, there were no preconceptions about the relationships between symptoms and dependent variables.

7. For age judgments about the neutral face, it was suggested that since the task had no components of emotional processing, performance differences between this and emotionally laden tasks might allow for speculation about differential lateralization of facial processing.

8. Finally, since emotional expressions were available for comparison to the neutral face, we asked: Will the emotional content of an expression change the rating of age? It was speculated that posers expressing sadness might be rated as older than posers expressing happiness.

# Method

## Subjects

The participants in this study were 1.) posers of facial expressions, and 2.) raters who were recruited to evaluate the stimuli produced from the posers' facial expressions. The posers were participants in the Moreno study Lateralization for Emotional Expression as a Function of Age (1987).

Since men and women differ in laterality of emotional processing (Strauss & Moscovitch, 1981) and in their responsivity to emotional stimuli (Buck, Miller, & Caul 1974; Duda & Peter, 1984; -and more recently, Otta, Abrasio, & Hoshino, 1996), Moreno (1987) decided to employ a single gender design. As the present study intended to partially replicate Moreno (1987), it was also limited to female subjects. The use of one gender facilitated methodological control by reducing sample variance and maximized the probability of observing age related changes.

## Posers

Posers were 90 women who were divided into three groups by age: ages 21-39 years ($M$=30.1), ages 40-59 years ($M$= 49.2), and ages 60-81 ($M$=69.9) years. These groups, characterized as "young," "middle-aged," and "older," were similar for demographic variables of ethnicity, marital status, education, and occupational level. They were recruited from the vicinity of New York City in the mid 1980's.

All posers were native English speakers. They were right-handed,

had obtained at least a high-school education, and had no history of neurological disease. They reported no history of psychiatric disorder, substance abuse, facial injury, or facial nerve pathology. Their reports were corroborated by additional screenings with measures of depressive symptomatology, general intelligence, basic visual perception, face perception, and facial and oral motor function. The battery used to screen for normal range performance was comprised of the following indices: Mattis Dementia Rating Scale (Mattis, 1976)- mental status; WAIS-R Vocabulary Subtest (Wechsler, 1981)- estimated level of intellectual functioning; Visual Form Discrimination Subtest (Benton, Hamsher, Varney, & Spreen, 1983)- basic visual perception; Facial Recognition Test-Short Form (Levin, Hamsher, & Benton, 1975)- face perception; Extra pyramidal Rating Scale (Chouinard & Ross Chouinard, 1982)- oral and facial range of movement; and Self Rating Depression Scale (Zung, 1965)- depressive symptomatology.

Raters

Thirty-six females: 12 young (25-35 years of age, $\underline{M}$=31.0 $\pm$ 2.63), 12 middle-aged (45-55 years, $\underline{M}$=50.7 $\pm$ 2.99), and 12 elderly ( 65-75 years, $\underline{M}$=67.2 $\pm$ 2.52) were recruited in Lancaster County, Pennsylvania, and offered $8.00 per hour for their work as raters of facial stimuli. Preliminary criteria for study inclusion were: female, Caucasian, native English-speaking, high-school educated individuals who were coded above 5 for occupation on the Occupational Scale of the Hollingshead Four-Factor

Index of Social Status (1977). This cut-off score ensured that the raters were middle-class representatives of the population. Because occupational status is multiply determined, yet fairly stable in adulthood, this stringent level for occupational achievement predicted that the groups of raters would be very similar in distribution of educational experience and major life events.

The age brackets chosen for the raters in this study were also influenced by Moreno (1987). However, to ensure that any perceptual findings could be attributed to the differences in age, discrete deciles (25-35 years), (45-55 years), and (65-75 years) were selected for the rater groups. For posers, the young middle-aged and older groups were continuous: 21-39 years, 40-59 years, and 60-81 years, respectively.

## Procedures

Recruitment and Respondent Screening. Raters were recruited through newspaper advertisements, neighborhood flyers, and word-of-mouth. A total of 97 people contacted the investigator for information about the study. Respondents were told that the investigators were searching for individuals with typical medical and educational backgrounds to participate in a study about womens' faces. Each respondent was briefly screened during the initial telephone contact. If they considered themselves to be in good health, reported no major medical conditions, and met the base criteria for study inclusion (gender, language, and education), they

were invited to participate in the screenings for normal range cognitive performance. To allow ample time for meeting prospective participants and for administering the screening measures, two hours were scheduled for each screening session. However, in reality 60-75 minutes of contact were more than adequate. When time permitted, appointment confirmation letters were sent to the respondents. Potential participants were assured of confidentiality about their participation, and informed consent was obtained before any personal information was solicited. Within 1-3 days of the screening, the measures were scored, and the participants were informed by telephone of their selection as raters for the study.

Only one participant did not meet the neuropsychological criteria. Because she had a background in teaching, she was very interested in the study and scheduled a second appointment during which she was paid and debriefed.

Measures of Rater Characteristics. Demographic and medical information obtained during the initial telephone contact was confirmed using a more in-depth self-report form derived from those used by Jaeger (1986), Moreno (1987), and Yecker et al. (1992). The cognitive screening battery included: the Coren, Porac, & Duncan Handedness Inventory (1979); Dementia Rating Scale; WAIS-R Vocabulary Subtest; Visual Form Discrimination Test; the Facial Recognition Test-Short Form; and the Zung Self-Rating Depression Scale. To increase the likelihood of obtaining a

close match between Moreno's posers and the present raters. Moreno's cut-off scores for these indices were adopted for use in this investigation. See Table 1.

Table 1

Acceptable Scores for Subject Variables

| SCREENING VARIABLES | | |
|---|---|---|
| Variable | Measure | Acceptable Score |
| DEMOGRAPHIC | | |
| Education | | ≥8 years |
| Occupation | Hollingshead Rating Scale | ≥6 |
| SCREENING | | |
| General Cognitive Functioning | Mattis Dementia Rating Scale | ≥130 total |
| Intelligence | WAIS-R Vocabulary Subtest | ≥8 ACSS |
| Basic Visual Perception | Benton Visual Form Discrimination Test | ≥27 |
| Facial Processing | Facial Recognition Test - Short Form | ≥41 |
| Depressive | Zung Self-Rating Depression | < 50 T-scr |

Before ratings of expression intensity or expression accuracy began, two additional measures of rater characteristics were administered. First, the Chimeric Faces Test (Levy et al., 1983) was used to obtain data on

perceptual laterality for viewing facial expressions.

Second, raters were asked to complete an additional self-report measure of negative mood symptoms, the Mood and Anxiety Symptom Questionnaire (Watson & Clark, 1991). The purpose for administering this scale was to determine whether different types of negative mood symptoms, such as anxious arousal or anhedonia/depression predicted any of the perceptual or expression findings.

Materials

Cognitive Battery.

1. Inventory of Lateral Preference (Coren, Porac, & Duncan, 1979), queries handedness, footedness, and ear preference (right or left) for 13 activities and yields a laterality index score. This measure allowed confirmation of handedness.

2. The Mattis Dementia Rating Scale (Mattis, 1976) was used to screen for signs of intellectual deterioration. It contains items similar to those used for appraisal of mental status in a neurological exam but is expanded and organizes responses into factors for attention, initiation/ perseveration, construction, conceptualization, and short-term recall.

3. The WAIS-R Vocabulary Subtest (Wechsler, 1981) is a test of expressive vocabulary skill requiring the examinee to produce definitions of progressively more advanced words. Vocabulary being the single best predictor of overall IQ function, this subtest (in consideration with the MDRS results) allowed for inference of the rater's general intellectual

level.

4. Visual Form Discrimination Test (Benton, Hamsher, Varney, & Spreen, 1983) requires the comparison of simple, geometric, line drawings and contains 16 trials. Presented in a multiple-choice format, the examinee is required to select from a set of four, the item that matches the target stimulus. The test screens basic visual-perceptual function.

5. Face Recognition Test- Short Form (Levin, Hamsher & Benton, 1975) is a fairly challenging test of facial recognition skill. Also presented in a multiple-choice format, the test contains 13-item sets. The target stimulus is a photographed face that must be matched with one of six photographs in the response set. However, the faces in the response set are presented at various camera angles and under various lighting conditions. A rater's ability to recognize faces must also be confirmed because impairment of facial recognition skill can occur even when other modes of visuospatial perceptual skill are intact.

6. Chimeric Face Test (Levy et al., 1983) provided an index of lateralization for free-field facial viewing that has been demonstrated to be very stable across the life span (Levine & Levy, 1986; Moreno et al., 1990). It effectively discriminates dextrality and served as an additional measure of laterality, to confirm homogeneity of the sample. The Chimeric Face Test task involves simple comparison of paired chimeric faces for determination of which looks happier. The resultant laterality score, which falls within the range of -1.00 to +1.00, serves to quantify relative free-

field viewing biases for left hemiface smiles to right hemiface smiles, respectively. The actual test stimuli are not published, but are distributed at Levy et al.'s discretion. The materials used in this study were third generation pictures created from an archival set.

7. Zung Self-Rating Depression Scale (Zung, 1965) was used to measure symptoms of depression. It contains twenty statements which relate aspects of depression, including physiological symptoms and psychiatric disturbance. Response choices are coded from one to four and correspond with the responses "none or little" to "most or all" Some of the items are reverse scored. The raw scores are converted to SDS Index scores, that range from 25-100.

8.) Mood and Anxiety Symptom Questionnaire (MASQ; Watson & Clark, 1991) was used in this study because it is based on a mixed-symptom model of mood disorder. Subjects are requested to endorse 90 items on the long version which cluster around five different factors of symptomatology: 1. General Distress: Mixed Symptoms; 2. General Distress: Anxious Symptoms; 3. General Distress: Depressive Symptoms; 4. Anxious Arousal; and 5. Anhedonic Depression. The response choices range from one to five, and many of the items are reverse coded. Like the Chimeric Faces Test, this measure is not published it was given to the examiner by Dr. Watson for use in this study.

Stimuli

1. Elicitation of Expressions. The expressions posed were as follows: two positive emotions, two negative emotions, and a neutral or "relaxed" facial pose, which provides a morphological baseline for statistical comparison. The positive emotions portrayed were happiness and pleasant surprise. The negative emotions portrayed were sadness and disgust. These negative valence emotions were chosen because of strong evidence (e.g., Borod, Koff, & Caron, 1983) that they are mediated by the right hemisphere in studies of facial asymmetry.

Posers were randomly assigned to one of five different expression elicitation orders. To ensure that future ratings (especially those for facial asymmetry) would be based on a complete image of the face rather than on a partial facial profile, the posers were seated in a chair with a headrest, which encouraged the upright and forward-looking position of the head. They were asked to look straight at the camera, a 35mm Nikon F-3 fitted with a 105mm F2.5 (portrait) lens. A fast black and white film, 400 ASO-TriX with a minimal shutter speed of 1/60 second was used. A Nikon MD-4 motor drive was used for multiple recordings of each expression. Attention was also paid to illumination by use of a light meter to record and insure equal lighting to each side of the poser's face. A black background was used, and posers' hair and clothing were masked by dark, solid colored hair scarves and aprons. A tripod was used to steady the

photo equipment, and shots were taken from an average distance of 5 feet.

Two photos were taken of each facial pose. The Moreno raters (N=3) generally rated the first photo of each pose. The second was used if the first was of poor quality or contained movement artifact. As this study is, in part, a replication of the Moreno (1987) study, the specific poses used for that study were "re-rated" in the present study.

To facilitate the display of the best possible expressions by each poser, facial exercises were done to familiarize posers with the task of producing expressions. During this practice phase of the task, all parts of the face (i.e., mouth, eyes, cheeks, nose, and chin) were involved, and posers were given feedback on the flexibility of their facial movements. Additionally, this "warm-up" procedure was designed to focus the subject's attention on the task, thereby increasing the probability that cortically-controlled, voluntary expressions would be produced.

After the practice phase, posers were requested to pose each of the four emotions and the neutral pose two times in response to a verbal command (e.g., "Show me how you look when you feel sad. Exaggerate your expression. Ready, go!"). These procedures for eliciting expressions have been developed by Borod et al. for use with normal (Borod & Caron, 1980; Borod et al., 1983), neurological (Borod et al., 1986), and psychiatric populations (Jaeger et al., 1986).

2. Stimulus Preparation. In the original study (Moreno,

1987), the 90 posers produced five expressions each for a total of 450 possible facial poses. To control for perceiver asymmetries which have since been demonstrated to influence judgments about facial stimuli, Moreno (1987) duplicated all of the poses in an orientation that was reversed or mirror-imaged from that of normal observation. This procedure was designed to counterbalance any systematic error contributed by raters' tendencies to focus on the left side of space (right hemiface) when making judgments about emotionally laden facial stimuli.

As Borod et al. (1988) and Moreno (1990) reported no main effects or interactions involving the orientation factor, the counterbalancing for the present study was accomplished by randomly assigning reversed or normal orientations to half of the posers in each age group. The original Moreno negatives were retrieved and reprocessed to form 450 stimuli for use in the present study.

The photos were processed by a commercial vendor who verbally agreed to process them on the same lot of stock black and white photo paper and to hold constant the exposure settings for the automatic processing machine. Reportedly, only one senior lab technician processed the photos. He was to receive extra compensation from his employer for his extra care and attention to an otherwise automated procedure. In the original study, 5"x7" photos were professionally developed by hand, but for present purposes, this mode of processing was not cost effective. It should also be mentioned, that Moreno's (1987) photographs were

eventually assembled into chimeric or composite (right-right and left-left) stimuli. Ratings of these chimeric faces were not replicated in the present study.

Production of the original and reverse orientation photos was partially randomized to account for any unforeseen variations in the developing of the photos. Photo orientations were confirmed and image quality was checked by three experienced researchers for quality standards such as clarity, exposure, and pose centering. Questionable products were returned to the vendor for reprocessing. The end result was 432 4"x6" photos. The remaining 18 poses were recreated from Moreno's composite stimuli. These 18 second generation prints were randomized across age groups, emotions, and orientations.

The 90 raters were randomly assigned to a stimulus orientation before the negatives for their photographs were developed. As a result, the 450 expressions could be divided into a group of 225 original-orientation and 225 reversed-orientation stimuli An equal number of young (N=15), middle-aged (N=15), and older posers (N=15) were assigned to each group. Thus, since all the poses were available for study, there were also an equal number of happy, pleasant surprise, sad, disgust, and neutral expressions in each orientation set. For the purposes of this study, the back of the photographs was marked with codes for poser identification, orientation, expression, and pose number.

The 450 stimuli were randomized and divided into five sets of 90

poses each. Slight adjustments were made so that each set contained roughly the same number of happy, pleasant surprise, sad, disgust, and neutral expressions, as well as young, middle-aged, and old faces. The five sets of 90 stimuli were then color coded (pink, yellow, blue, green, or purple), and a corresponding colored 4" x 6" card was placed in the sleeve, behind the photo, to cover the stimulus identification code. The cards were marked 1-450, such that 1-90 corresponded to pink; 91-180 to yellow, 181-270 to blue; etc. These coding procedures served to identify the stimuli for future retrieval and literally masked the identifying labels from the rater. The five color-coded sets were then bound to a 8"x 10" easel for presentation to the subjects. Please see the Pilot Efforts section of the Procedures for more about these easels.

Data Collection and Experimental Tasks. Data collection occurred over the course of ten weeks during the Summer of 1997. Informed consent was obtained for participation in both the screening and rating procedures of this study. The screening phase of this experiment, i.e., collection of personal, demographic, medical and cognitive measures, required between 60 and 75 minutes to complete. Rating the facial stimuli was expected to require up to 5 hours of rater time; the actual range was 3 - 5.25 hours. This time range did not reflect actual time on the task, as much as it did raters' varying degrees of interest in the experimental procedures, comments about the stimuli, and active participation in the

debriefing discussion.

Each subject was asked to tentatively schedule a minimum of three appointments over the course of two weeks. Most required only one week and desired to "work" in a concentrated fashion on consecutive days. To maintain the rate of stimulus presentation, the examiner assumed the role of psychometrician. Breaks from the rating tasks were allowed as needed and suggested about every 30-40 minutes. No session lasted longer than two hours.

With an exception for the individual who did not pass the neurocognitive screening, debriefing occurred for all participants after data collection was concluded. The purpose and experimental hypotheses of the study were discussed and provided in writing. Table 2 summarizes the recruitment of raters.

1.Test Site and Record Keeping: Nine of the 36 (2 young, 4 middle-aged, and 3 older) participated in the experiment at their homes. In the rater homes, data collection was typically under-taken at kitchen or dining-room tables where there was overhead lighting. Usually, theses areas were near windows which also provided natural light.

The remaining 75% of the raters were examined at a single test site. The testing area was 12'x18' with three floor-to-ceiling glass walls. A 10'x10' adjoining room was used as a waiting area. The design of the

Table 2

Subject Recruitment Summary

I A total of **97** people from Lancaster County, Pennsylvania, responded.

II **57** of the 97 were contacted or screened but were not included in the

The following is a break-down of the various reasons.

| | |
|---|---|
| **13** | Not interested or never called back after hearing the study description. |
| **14** | Dropped-out due to time constraints or life crises (family priorities, personal illness, or marital problems). |
| **5** | Did not keep their initial screening appointment, i.e., "No shows". |
| **8** | Disqualified by some aspect of their medical history. |
| **1** | Volunteered but passed-away unexpectedly. |
| **1** | Did not pass Phase 1 - Neuropsychological criteria. |
| **8** | Did not meet some other demographic criterion: Left handed, male, non-English language, wrong age, etc. |
| 7 | Called too late to be included. |
| 57 | |

-- Of these 57 respondents, **35** saw our add in the newspaper, **2** saw a flyer, and **25** heard from friends or family about the study.

III **4** of the 97 respondents served as "pilot subjects," or practice subjects. These individuals gave feed-back to the researchers and helped to develop the experimental procedures.

IV **36** women from the original group of 97 respondents were included in the study. They were between the ages of 25-35 years, 45-55 years, and 65-75 years. Each was right handed and received "normal range" scores on the neuropsychological tests.

- Of these 36 final/ actual subjects, **19** were recruited by word-of-mouth, **17** were recruited from newspaper adds, and zero responded to flyers that were posted in the local supermarkets.

-The amount of time needed to complete the entire study ranged from 3.75 to 6.25 hours. The average amount of time was 4.75 hours.

testing area allowed for the stimuli to be evaluated in bright, but indirect, natural light. On cloudy or rainy days, the natural lighting could be supplemented with a bank of recessed fluorescent lights that surrounded the room on all window/wall sides. The room was very well ventilated but not air conditioned. The raters worked with the examiner at a sturdy 4' x 4' card table. Magazines were available for participants during the waiting periods. During breaks, the participants were offered a variety of beverages and allowed use of the telephone as needed.

2. Pilot Efforts on Experimental Materials. Piloting efforts occurred several different points in the study. First, few of Moreno's negatives were developed and examined to assess the quality of the automated developing process.

As mentioned in the Materials Section, the stimuli for administration of the Chimeric Faces Test were third-generation products. Before being used in the actual experiment, these stimuli were administered to and scored for 12 women to ensure that they were perceived in a fashion similar to the originals.

Also, as noted above, the five sets of color-coded stimuli were presented to the raters on 8"x10" easels. The photographs measured 4" x 6", so when they were placed on an easel, a greyish-white background was apparent. The back ground was selected for its contrast and reflection of the black and white stimuli. The stimuli were presented with an easel, so that the facial expressions would be viewed in a near vertical plain that

could be equated to en face viewing. The vertical presentation also helped to equate viewing between raters who wore bifocals and those without lenses or bifocal corrections. Many individuals who wear bifocals raise the plain of their viewing material towards the 90-degree axis. The easel precluded looking down upon the materials and helped to equate visual angle among raters.

Development of the instructional materials (discussed below), also included a pilot phase with a group of four raters, one young and three from the older age group. The revised materials were based on pilot rater input and the examiner's observations.

Along with the piloting of the instructional materials, dry runs of the cognitive screening tests were also conducted. At a point in the screening after completing the self-report mood measures, the pilot rater was directly asked, "Are you depressed?" This question was added because there is a report that for oncology patients the response to this question is the single-best predictor of major depression. However, when asked this, the pilot raters immediately became either concerned or suspicious. It was decided that this procedure was not worth the anxiety it could create. Thus, the question was added to the medical questionnaire. In the actual experiment, every subject answered the question, but no one reported being depressed.

Instructions to Raters. A similar format was used to introduce and train the procedures for each experimental task: 1.) muscular intensity, 2.) emotion accuracy plus rater confidence, and 3.) age ratings of neutral,

happy, and sad faces. Scripted instructions were used to define each measure, present examples, train procedures, provide feed-back, and present practice items. The instructions for each task were accompanied by examples from the standard Ekman and Friesen (1975) set. The ten practice items were excerpted from the overall set of Moreno (1987) stimuli. The practice items contained two examples of each facial expression. Expressions from young, middle-aged, and older posers were used and a continuum of intensity was presented. Two representatives were selected for each of the third, fourth, fifth, and sixth decades of age. One was selected from the late 70's and one from the 20's to reflect the continuum of ages in the study. The same practice items were returned to for training about each judgment. Raters were first trained on intensity. Then they completed the intensity rating task. Usually, at a third appointment they learned about accuracy and confidence, made their ratings, and then were trained on the judgment of age.

1. Rating Intensity. The examiner introduced the task by explaining that an "intensity" rating involved judgments about the physical attributes of a face. The first example was a picture of a young woman expressing moderately-intense happiness. Raters were told that expression intensity refers to the degree of facial muscle involvement in the production of an expression. They were then oriented to the facial cues that define intensity: These include: wrinkles in the face caused by the

tightening of skin around the eyes and mouth, the depth of the nasolabial fold, and the drawing-up of the cheeks and eyebrows give clues to the extent of muscular involvement.

Next, the Likert-type rating scale was introduced and defined as ranging from 1 (not at all intense) to 7 (extremely intense ). The rater was instructed to give an impression of the intensity for the example happy expression. This initial rating was then reinforced.

Next, the training turned from the introduction phase, to a study phase where the rater was introduced to a continuum of intensity for one emotion, e.g., happy, as expressed by a single poser. Developing self consistency in use of the intensity scale (1-7) was discussed, and then the subject was presented with two examples of six different expression that demonstrated the continuum of intensity from 1-7.

When the rater completed her study of the materials, the experimenter launched into a practice series of ten items. The raters completed the practice series and were given feedback based on predetermined performance criteria. The ten practice items were pre-rated, and a proficiency level of 8/10 within one point of the predetermined intensity rating was required.

2. Rating Emotional Category/Accuracy and Confidence. For identification of the intended emotional expression, raters were asked to choose the emotional expression portrayed by each face. They were

provided with the following possibilities: happiness, pleasant surprise, sadness, disgust, and neutral. The neutral or normative face was defined as a face at rest, i.e., "relaxed" and not posing an emotional expression. The raters were given written descriptions of the five possible expressions, and asked to familiarize themselves with the morphological characteristics or "clues" that signal each expression. Taking "happy" as an example, raters were told that the facial features often associated with happy, include: 1.) drawn up corners of the mouth or lips, 2.) raised cheeks, 3.) bilateral wrinkles from the nose to the corners of the mouth, and 4.) wrinkles under the eyes. The descriptions of each expression, were adapted from Borod, Koff, and White (1983), Ekman and Friesen (1975), and Kent (1975) and Moreno (1987). The written materials were supplemented by two examples of each expression- one of low intensity and one of high intensity.

After the rater completed her study of the accuracy materials, the experimenter introduced the concept of confidence. Confidence was rated on a 5-point anchored Likert scale, where "5" represented "extremely confident" about the category of emotion or "100% sure/ no doubt;" while a confidence rating of "1" was related as "not at all confident," or a complete guess.

3. Judging Age. Finally, the raters were asked to judge the age of the posers on a 6-decade scale representing ages from 20-79 years. The self-study stimulus for age was a continuum of six faces from the

Moreno (1987) stimulus set that were labeled with the proper decade for the poser. The example faces included two happy, two sad, and two neutral faces.

Presentation of the Experimental Stimuli. To recap, each subject began the study with the demographic and cognitive screenings. Table 2, page 36, presents a review of how the rater group was selected During the second and third sessions, the rating tasks were undertaken. At the beginning of the second session, informed consent was obtained, and subjects then completed the Chimeric Faces Test and the Mood Anxiety Symptoms Questionnaire. Order of the experimental tasks was fixed: intensity, accuracy with confidence, and age ratings. However, the starting point within the overall stimulus set was rotated by stimulus booklet (pink, green, yellow, blue, or purple) so as to randomize and minimize the effects of fatigue on any portion of the set.

Raters were trained and did practice ratings for ten items before beginning the experimental rating tasks. To maintain the pace of each session, the examiner presented the stimuli to the raters and recorded their responses. Raters were allowed up to ten seconds to make each judgment of intensity, accuracy, or confidence. When a response was not forthcoming the experimenter asked for a choice. Generally the raters gave fairly spontaneous ratings.

During each of the four tasks, the raters had continual access to

rating materials that depicted: 1.) the Likert scale for intensity ratings or confidence ratings, 2.) the possible expression types for accuracy ratings, or 3.) the continuum for age judgments. For each task, the experimenter worked from the 5 sets of 90 randomized photos that were color coded and numbered. The experimenter recorded the raters' responses on sheets color-coded to match the five stimulus books. For the intensity and the accuracy plus confidence judgments, ratings began with a particular stimulus subset, and each of the five sets was rated until all 450 stimuli were completed.

For determinations of poser age, the raters viewed only the neutral, happy, and sad stimuli. They were presented for rating in a different fashion than when used for the intensity and accuracy tasks. The objective was to obtain an age rating for every neutral face. Also, on an exploratory basis, the happy and sad expressions of each poser were to be compared. However, there was a concern about memory effects if all 90 posers were rated for age three-times over (neutral, happy, and sad) by each rater. The stimuli were presented so that every rater saw each of the 90 posers twice. Using the five sets of ninety stimuli, they rated each neutral pose and every other happy and every other sad pose. Since raters' starting points were rotated through the five stimulus sets, and the five stimulus sets were balanced for number of posers in each age group and number of expressions in each category, the likelihood of rating the same poser more than two times was reduced.

The procedure allowed the examiner to move through the stimuli quickly, without having to develop a different presentation set. The neutral, happy, and sad expressions totaled 270 stimuli, but each rater made approximately (and at least) 180 age ratings. 90 for the neutral face and at least 45 for each of the happy and sad stimulus sets. From the posers' vantage, every happy or sad expression was rated at least 6 times [6-8]. Obviously, this methodology resulted in unequal cell mean for statistical purposes, but the task was exploratory, and ease of presentation was emphasized.

Treatment of the Data

All analyses were conducted using the Statistical Package for the Social Sciences (SPSS) Graduate Pack, Advanced Version 6.1.1 for Power Macintosh computers. The complete set of 450 poses (90 posers x 5 expressions) was studied. Responses from the 36 raters yielded 16,200 observations (450 poses x 36 raters) for each of the dependent measures of 1.) expression accuracy, 2.) expression intensity, and 3.) rater confidence about accuracy ratings. A series of 3-way (3x5x3) repeated-measures Analyses of Variance (ANOVAs) were used to look at accuracy, intensity, and confidence ratings as a function of Poser Age Group (3), Expression (5), and Rater Age Group (3). In these mixed-design ANOVAs, Poser Age Group was a between-subjects factor, while Expression and Rater Age

Group were repeated measures, i.e., within-subject variables. The Newman-Keuls multiple comparison post-hoc procedure was used to evaluate all significant main effects and interactions.

For each of the analyses, mean scores were computed from the responses of the 12 raters comprising each rater age group. For intensity and confidence ratings, cell means represented a score that would fall on the respective Likert scales for each rating. For intensity, the scale was 1-7, and for confidence, the scale was 1-5. For accuracy, a dichotomous index was created such that a correct identification of the intended (or: target) expression was coded as a "1" and an incorrect assessment was coded as a "0". Thus, the mean score for any one stimulus/pose (e.g., Old poser no. 2, Happy expression) represented the proportion of correct identifications by a rater group. Careful training of the raters allowed for consideration of a rater's response as an actual measure of poser accuracy in posing the intended response.

The fourth dependent measure, judgment of poser age, provided a total of 6480 observations. 3240 of these were provided by the 36 raters who viewed neutral expressions for each of the 90 raters. Raters also assessed either a Happy or a Sad expression for each poser, such that 1620 age ratings were obtained for each expression. For the neutral face, a two-way, mixed ANOVA: Poser Age Group (3) (between) x Rater Age Group (3) (within) was conducted. Age ratings assigned to Happy and Sad expressions were compared in a second two-way ANOVA [(3) Rater Age

Group x (2) Emotion] where Rater Age Group and Emotion were both between-subjects variables, because each rater saw only half of the possible Happy and half of the possible Sad expressions. Correlation coefficients were calculated using the Spearman rank-order procedure to examine possible covariates and inter-correlation among the dependent variables. Since there were potentially many post-hoc and correlational comparisons to be made, a conservative alpha of $p \leq 0.01$ was adopted.

## Results

### Rater Variables

Descriptive statistics for demographic and neuropsychological screening variables that characterize the raters in this study are summarized in Tables 3 and 4. Individual one-way ANOVAs on each subject variable (e.g., education, WAIS-R age-corrected scaled scores, etc.) indicated that the raters were adequately matched across each of the three age groups (young, middle-aged, and older). With the exception of rater age (an independent variable manipulated in this study), there were no significant differences among rater age groups for any of the demographic or neuropsychological screening measures.

Table 3

Descriptive Statistics for Rater Demographic Screening Variables

| I | | | MEANS, STANDARD DEVIATIONS, & [RANGES] | | |
|---|---|---|---|---|---|
| Variable | Measure | Cut-off Score | Rater Age Groups | | |
| | | | Young | Middle | Older |
| Age | years | [25-35]<br>[45-55]<br>[65-75] | 31.0<br>± 2.63<br>[28-35] | 50.67<br>± 2.99<br>[45-54] | 67.17<br>± 2.52<br>[65-74] |
| Education | years attending | at least High School Equivalent | 13.87<br>± 1.88<br>[12-16] | 13.50<br>± 1.88<br>[12-16] | 13.37<br>± 1.64<br>[12-16] |
| Occupation | Hollingshead Rating Scale | 6 | 6.67<br>± 1.07<br>[5-8] | 6.92<br>± 1.37<br>[5-9] | 7.33<br>± 1.23<br>[5-9] |

| II | FREQUENCIES | | |
|---|---|---|---|
| Variable | Rater Age Groups | | |
| | Young | Middle | Older |
| Corrective Lenses | 6/12 | 5/12 | 6/12 |
| Marital Status | | | |
| Single | 4/12 | --- | --- |
| Cohabitating | 1/12 | --- | --- |
| Married | 7/12 | 8/12 | 3/12 |
| Separated/Divorced | --- | 3/12 | --- |
| Remarried | --- | 1/12 | 2/12 |
| Widowed | --- | --- | 7/12 |

Table 4

Descriptive Statistics for Rater Neuropsychological Screening Variables

| Variable | Measure | Cut-off Score | MEANS, STANDARD DEVIATIONS, & [RANGES] Rater Age Groups | | |
|---|---|---|---|---|---|
| | | | Young | Middle | Older |
| General Intellectual Functioning | Mattis Dementia Rating Scale | 130 | 141.67 ± 1.78 [138-144] | 142.5 ± 1.24 [141-144] | 141.17 ±2.82 [138-144] |
| | WAIS-R Vocabulary | 8 | 11.00 ± 2.04 [9 - 16] | 12.50 ± 2.07 [10- 16] | 12.25 ± 2.67 [9 - 18] |
| Basic Visual Perception | Benton Form Discrimination Test | 27 | 31.08 ± 1.24 [29 - 32] | 30.50 ± 1.57 [28 - 32] | 29.58 ± 1.78 [27 - 32] |
| Facial Processing | Facial Recognition Test- Short Form | 41 | 50.33 ± 2.87 [45 - 54] | 47.75 ± 3.77 [41 - 54] | 49.83 ± 3.13 [43 - 54] |
| | Chimeric Faces | N/A | 0.62 ± 0.26 [.33 -1.0] | 0.45 ± 0.29 [.11-.94] | 0.54 ± 0.31 [.06 -.94] |
| Mood Symptoms | Zung-SDS | ≥50 | 38.33 ± 4.77 [28-46] | 38.50 ± 6.0 [29-49] | 38.25 ± 4.92 [29-49] |
| | Mood & Anxiety Symptoms Questionnaire (MASQ)Total Score | No cut-off used | 135.00 ± 28.46 [109-196] | 127.42 ± 21.70 [95-157] | 125.17 ±14.77 [111-159] |
| Handedness | Coren, Porac, & Duncan-Handedness | Dextral | 12.50 ±3.12 [5-15] | 13.75 ± 1.82 [10-15] | 13.25 ±1.91 [9-15] |

With the exception of a correlation between raters' age and education (Spearman rank order correlation rho = 0.57, $p < .001$), there were no meaningful or significant relationships among the raters' neurocognitive and demographic measures. Some overlap was observed among measures of depressive symptomatology, i.e., the Zung and the MASQ subscales, but this was expected since these self-report measures are designed to assess the same characteristics, i.e., symptoms of negative mood. Table 5 displays significant correlations among mood variables. Raters' scores on measures of cognitive functioning and measures of mood symptomatology were not, however, significantly correlated.

Looking at measures of laterality, the raters' scores on the Chimeric Faces Test did not correlate with their measures of handedness ($r = 0.08$, $p < .65$). Additionally, CFT did not significantly correlate with any variable examined, including those for depressive symptomatology. Rater subject variables were also compared with each of the dependent measures, (i.e., intensity, accuracy, confidence, and age ratings), to determine the need for covarience. The inter-correlations among these variables were examined as a function of four possible rater groupings: combined age groups (N=36), young raters (N=12,) middle-aged raters, (N=12), and older raters (N=12). There were no systematic correlations between any of the rater demographic or neurocognitive variables and the four dependent measures. This was true for correlations using all 36 raters and correlations within rater subsets: young, middle-aged, and older. Of particular interest, rater

Table 5

Correlations among Measures of Rater Mood Symptoms

| Comparisons | Rater Groups | | | |
|---|---|---|---|---|
| | Combined N=36 | Young N=12 | Middle-aged N=12 | Older N=12 |
| MASQ Total & Zung | r = .56 *** | r = .60 * | r = .73 ** | r = .65 * |
| GDM & Zung | r = .66 *** | r = .60 * | r = .73 ** | r = .69 ** |
| GDD & Zung | r = .54 *** | --- | r = .68 * | --- |
| GDA & Zung | --- | --- | r = .67 * | --- |
| MASQ Total & GDM | r = .77 *** | r = .85 *** | r = .78 ** | r = .76 * |
| MASQ Total & GDD | r = .56 *** | r = .62 * | r = .78 ** | --- |
| MASQ Total & GDA | r = .56 *** | --- | r = .84 *** | --- |
| MASQ Total & AD | r = .70 * | r = .71 ** | r = .91 ** | --- |
| MASQ Total & AA | r = .32 * | --- | --- | --- |
| GDM & GDD | r = .68 *** | --- | r = .84 *** | --- |
| GDM & GDA | r = .70 *** | --- | r = .87 *** | r = .62 * |
| GDM & AD | --- | r = .59 * | --- | --- |
| GDM & AA | r = .68 *** | r = .57 * | --- | --- |
| GDD & GDA | r = .56 *** | --- | r = .81 *** | --- |
| GDD & AA | r = .47 ** | --- | --- | --- |

ZUNG = Zung Self-Rating Depression Scale;
MASQ = Mood & Anxiety Symptom Questionnaire Total Score:
GDM = MASQ General Distress: Mixed Symptoms;
GDD = MASQ General Distress: Depressive Symptoms;
GDA = MASQ General Distress: Anxious Symptom;
AD = MASQ Anhedonia Depression;
AA = MASQ Anxious Arousal

*** $p < .001$
** $p \leq .01$
* $p \leq .05$

age did not correlate with intensity, accuracy, confidence, or age judgments.

When measures of mood symptomatology were considered, systematic significant correlations were observed between MASQ subscales and confidence ratings for the young rater group. Interestingly, raters' scores from the Zung did not correlate with confidence ratings. See Table 6. Correlations between the other dependent measures: intensity, accuracy, and age judgments and the MASQ and Zung were also not systematic, and fewer than would have been predicted by chance.

For ratings of intensity, accuracy, confidence, and age (neutral expression) interrater reliability was examined using Cronbach's alpha. For the 36 raters, the overall reliability for intensity was alpha = .988. For accuracy, alpha = .838. Tables 7 - 10 display the overall alphas for each of the four possible rater groups as a function of age group. Review of item-total correlations suggested strong internal consistency as these alpha levels could not be substantially improved by removal of any individual raters from the data set as a whole or from any of the three subgroups: young, middle-aged, or older raters. The consistency across raters allowed us to use the mean of the 12 raters in an age group for each dependent variable.

## Poser Variables

To examine possible covariation between poser subject variables (collected by Moreno [1987]) and the four dependent measures, Spearman

Table 6

Correlation of Confidence Ratings with Measures of Mood Symptoms

| Comparisons | Rater Groups | | | |
|---|---|---|---|---|
| | Combined N=36 | Young N=12 | Middle-aged N=12 | Older N=12 |
| Zung | | | | |
| 5 Expressions[1] | r = - .35 ** | -------- | -------- | -------- |
| 4 Emotions[2] | --------- | -------- | -------- | -------- |
| MASQ Total | | | | |
| 5 Expressions | r = - .51 *** | r = - .80 ** | -------- | -------- |
| 4 Emotions | r = - .48 ** | r = - .75 ** | -------- | -------- |
| MASQ-GDM | | | | |
| 5 Expressions | r = - .39 ** | r = - .69 ** | -------- | -------- |
| 4 Emotions | r = - .36 ** | r = - .63 ** | -------- | -------- |
| MASQ-GDD | | | | |
| 5 Expressions | --------- | --------- | -------- | -------- |
| 4 Emotions | --------- | --------- | -------- | -------- |
| MASQ-GDA | | | | |
| 5 Expressions | --------- | --------- | -------- | -------- |
| 4 Emotions | --------- | --------- | -------- | r = + .64 * |
| MASQ-AD | | | | |
| 5 Expressions | --------- | --------- | -------- | -------- |
| 4 Emotions | --------- | --------- | -------- | -------- |
| MASQ-AD | | | | |
| 5 Expressions | --------- | r = - .59 * | -------- | -------- |
| 4 Emotions | --------- | r = - .63 * | -------- | -------- |

Note:

[1]Mean Confidence Score for 5 Expressions Correlated with Measures of Rater Mood.

[2]Mean Confidence Score for 4 Emotions Correlated with Measures of Rater Mood.

*** $p < .001$, ** $p \leq .01$, * $p \leq .05$

correlations were conducted. Although Moreno et al. (1990) originally found significant differences among her three poser age groups for years of education,WAIS-R Vocabulary subtest age-corrected scaled scores, and Zung Self-Rating Depression Scale scores, none of these variables systematically correlated with the intensity, accuracy, confidence, or neutral-face age ratings made in the current study. Moreover, the number of significant correlations occurring was not more than would be expected by chance. Poser age also did not correlate in any systematic fashion with any of the dependent measures. The means for the five expressions and the mean ratings for the four emotional expressions (without the neutral face) were considered.

Table 7

Interrater Reliability for Accuracy Ratings as a Function of Rater Group

| | ALPHA LEVELS FOR ACCURACY | | | |
|---|---|---|---|---|
| Rater Age Groups | Poser Age Groups | | | |
| | Combined N=90 | Young N=30 | Middle N=30 | Older N=30 |
| Young N=12 | 0.858 | 0.843 | 0.809 | 0.872 |
| Middle-Aged N=12 | 0.847 | 0.803 | 0.810 | 0.867 |
| Older N=12 | 0.827 | 0.821 | 0.811 | 0.816 |
| Combined N=36 | 0.947 | 0.939 | 0.936 | 0.954 |

Table 8

Interrater Reliability for Intensity Ratings as a Function of Rater Group

| Rater Age Groups | ALPHA LEVELS FOR INTENSITY<br>Poser Age Groups | | | |
|---|---|---|---|---|
| | Combined N=90 | Young N=30 | Middle N=30 | Older N=30 |
| Young (N=12) | 0.969 | 0.977 | 0.968 | 0.958 |
| Middle-Aged N=12 | 0.962 | 0.971 | 0.960 | 0.951 |
| Older N=12 | 0.960 | 0.972 | 0.957 | 0.947 |
| Combined N=36 | 0.988 | 0.991 | 0.987 | 0.983 |

Table 9

Interrater Reliability for Confidence Ratings as a Function of Rater Group

| Rater Age Groups | ALPHA LEVELS FOR CONFIDENCE<br>Poser Age Groups | | | |
|---|---|---|---|---|
| | Combined N=90 | Young N=30 | Middle N=30 | Older N=30 |
| Young N=12 | 0.856 | 0.858 | 0.835 | 0.844 |
| Middle-Aged N=12 | 0.779 | 0.789 | 0.790 | 0.785 |
| Older N=12 | 0.765 | 0.795 | 0.737 | 0.758 |
| Combined N=36 | 0.927 | 0.934 | 0.991 | 0.923 |

Table 10

Interrater Reliability for Age Ratings on the Neutral Expression as a Function of Rater Group

| Rater Age Groups | ALPHA LEVELS FOR AGE-NEUTRAL Poser Age Groups | | | |
|---|---|---|---|---|
| | Combined N=90 | Young N=30 | Middle N=30 | Older N=30 |
| Young N=12 | 0.987 | 0.935 | 0.961 | 0.894 |
| Middle-Aged N=12 | 0.989 | 0.931 | 0.961 | 0.892 |
| Older N=12 | 0.988 | 0.926 | 0.955 | 0.880 |
| Combined N=36 | 0.996 | 0.976 | 0.986 | 0.962 |

## Examination of Age Group Effects

To examine hypotheses pertaining to the performance of the posers and the raters as a function of their Age Group, repeated-measures 3-way ANOVAs were conducted with Poser Age Group (Young, Middle-aged, Older) as a between-subjects variable, and Rater Age Group (Young, Middle-aged, Older) and Expression (Happy, Pleasant Surprise, Sad, Disgust, Neutral) as within-subjects variables. Separate ANOVAs were conducted for accuracy, intensity, confidence, and age ratings.

Accuracy. When mean accuracy ratings for each poser were analyzed, there was no main effect of Rater Age Group, $F$ (2, 174) = 2.12, $p$ = .124, nor any interaction involving Rater Age Group. Thus, raters did not differ in their accuracy ratings of the facial expressions as a function of their own age.

There were, however, main effects of Poser Age Group, $F$(2, 87) = 15.97, $p < .001$, and Expression $F$(4, 348) = 12.35, $p < 0.001$. Using post-hoc tests, Older posers ($M$ = 0.73, $SD$ = 0.04) produced expressions with significantly less accuracy ($p$ <.01) than Middle-aged ($M$ = 0.84, $SD$ =0.03) and Young posers ($M$ = 0.87, $SD$ = 0.03); there were no significant differences between Middle-aged and Older posers. Because of the very high internal consistency for raters, it is assumed that these indices represent reliable differences in the posers' ability to encode or emote facial expressions.

In terms of expression, the order of accuracy from most to least accurately produced, was as follows: Happiness ($M$= 0.92, $SD$ = 0.03), Pleasant Surprise ($M$ = 0.82, $SD$ = 0.05) and Neutral ($M$ = 0.82, $SD$ = 0.07), Disgust ($M$ = 0.80, $SD$ = 0.06), and Sadness ($M$ = 0.70, $SD$ = 0.06). When post hoc tests were conducted, Happiness was expressed with significantly more accuracy than all other expressions. Additionally, Sadness was expressed with significantly less accuracy than all the of the other expressions. There were no significant differences among the expressions of Pleasant Surprise, Neutral, and Disgust.

Intensity. The 3-way ANOVA for intensity ratings was also based on the Poser Age Group (3) x Rater Age Group (3) x Expression (5) design. Main effects were observed for Rater Age Group, $F(2, 174) = 36.33$, $p < .001$, and Expression, $F(4, 348) = 223.13$, $p < .001$. For Rater Age Group, post-hoc comparisons revealed that the main effect was due to significantly lower intensity ratings by the Middle-aged raters ($M$=3.82, $SD$ = 1.36) than by the Younger ($M$= 3.95, $SD$ = 1.42) or Older ($M$ = 1.35, $SD$ = 1.40) raters. There were no significant differences between the latter two rater groups. This main effect was modified by a significant interaction between Poser Age Group and Rater Age Group (see section on Cohort Bias Effects, pages 65 - 68).

In terms of Expression, the order of expression intensity from most to least intense was as follows: Disgust ($M$ = 4.90, $SD$ = 0.25), Pleasant Surprise ($M$ = 4.85, $SD$ = 0.24), Happiness ($M$ = 4.39, $SD$ = 0.22), Sadness ($M$ = 3.13, $SD$ = 0.22) and Neutral ($M$ = 2.19, $SD$ = 0.20). Post-hoc tests indicated that these overall means were significantly different from one another, with the exception of the ones for Disgust and Pleasant Surprise.

This main effect of Expression was, however modified by two interactions. First, an interaction was observed between Poser Age Group and Expression, $F(4, 348) = 223.13$, $p < .001$. The means and standard deviations are displayed in Table 11.

Table 11

Cell Means for the Interaction between Poser Age Group and Expression on Intensity Ratings

| | INTENSITY<br>POSER AGE GROUP X EXPRESSION<br>$F(4, 348) = 223.13$, $p < .001$ | | | | |
|---|---|---|---|---|---|
| RATER | Happy | Pleasant Surprise | Sad | Disgust | Neutral |
| Young | M = 4.50<br>SD 0.27 | M = 4.97<br>SD 0.25 | M = 3.06<br>SD 0.23 | M = 4.85<br>SD 0.25 | M = 1.67<br>SD 0.24 |
| Middle | M = 4.55<br>SD 0.22 | M = 4.81<br>SD 0.29 | M = 3.13<br>SD 0.26 | M = 4.83<br>SD 0.27 | M = 2.12<br>SD 0.22 |
| Older | M = 4.11<br>SD 0.26 | M = 4.76<br>SD 0.28 | M = 3.20<br>SD 0.32 | M = 5.03<br>SD 0.30 | M = 2.77<br>SD 0.25 |

A pattern emerged such that older posers were more intense on the Neutral expression and on the negatively valenced emotions (Sadness and Disgust, overall $M = 4.12$, $SD = 0.94$) than the middle-aged (overall negative $M = 3.98$, $SD = 0.71$) and younger (overall negative $M = 3.96$, $SD = 0.73$) posers, but post-hoc tests for the individual expressions revealed that this pattern was only significant for the Neutral expression. Similarly, a tendency for the young posers to produce the positively valenced emotions (Happiness and Pleasant Surprise: overall $M = 4.68$, $SD = 0.47$ for the middle-aged posers and $M = 4.74$, $SD = 0.62$ for the younger posers) more

intensely than older posers (overall positive M = 4.44, SD = 0.63) did not bear up to post-hoc tests for the individual emotions. Post-hoc comparisons among the five expressions for each Poser Age Group indicated that all comparisons were significant except for: Pleasant Surprise versus Disgust for all three poser groups. Pleasant Surprise versus Hapiness and Disgust versus Happiness for young and middle-aged posers, and Sadness versus Neutral for older posers.

There was also a significant interaction between Rater Age Group and Expression for intensity ratings. The means for this interaction are displayed in Table 12.

Table 12

Cell means for the interaction between Rater Age Group and Expression on Intensity ratings

INTENSITY
RATER AGE GROUP X EXPRESSION
$F(8, 696) = 4.01$, $p < .001$

| RATER | Happy | Pleasant Surprise | Sad | Disgust | Neutral |
|---|---|---|---|---|---|
| Young | M=4.46<br>SD 0.17 | M=4.93<br>SD 0.20 | M=3.18<br>SD 0.31 | M=5.01<br>SD 0.27 | M=2.17<br>SD 0.07 |
| Middle | M=4.30<br>SD 0.31 | M=4.78<br>SD 0.32 | M=3.04<br>SD 0.16 | M=4.84<br>SD 0.28 | M=2.12<br>SD 0.08 |
| Older | M=4.40<br>SD 0.10 | M=4.84<br>SD 0.17 | M=3.17<br>SD 0.14 | M=4.87<br>SD 0.14 | M=2.27<br>SD 0.02 |

Within each rater age group, all comparisons among expressions were significantly different, with the exception of Disgust and Pleasant Surprise. Differences among the three rater age groups for each of the five expressions were also examined, but there was no systematic pattern of significant differences.

Confidence Ratings. The 3-way ANOVA for confidence ratings was also based on the Poser Age Group (3) x Rater Age Group (3) x Expression (5) design. Main effects were observed for each of the primary factors. For the between-subjects factor, Poser Age Group $F(2, 87) = 15.91$, $p < .001$, raters were significantly more confident about their identification of the facial expressions produced by young posers ($M = 4.38$, $SD = 0.17$), than those produced by the middle-aged ($M = 4.22$, $SD = 0.19$) and older posers ($M = 4.06$, $SD = 0.19$). When post-hoc tests were applied, all poser-group comparisons were significant.

The main effect of Rater Age Group F? on confidence ratings was due to significantly higher confidence ratings made by older ($M=4.26$, $SD = 0.51$) and middle aged ($M = 4.23$, $SD = 0.55$) raters, than by the young raters ($M = 4.18$, $SD = 0.59$). Post-hoc tests indicated a significant difference only between old and young raters. Due to the significant correlation between the confidence ratings for Young raters and their Mood Anxiety Symptom Questionnaire (MASQ) total scores, this finding was reevaluated with the MASQ score as a covariate. Covarying the 36 rater's MASQ scores, the difference between confidence ratings provided

by old and young raters was no longer significant, $F(2.32) = 0.62$, $p = .543$.

A main effect of Expression was also observed for confidence ratings. All comparisons were significant among expressions except for the ones for Pleasant Surprise versus Happiness and for Sadness versus the Neutral expression. Mean confidence ratings for each Expression ranked as follows: Pleasant Surprise ($M = 4.49$, $SD = 0.16$), Happiness ($M = 4.43$, $SD = 0.19$), Disgust ($M = 4.22$, $SD = 0.19$), Sadness ($M = 4.00$, $SD = 0.24$), and Neutral ($M = 3.96$, $SD = 0.22$).

Both of these main effects were modified by a significant interaction between the Rater Age Group and Expression $F(8, 696) = 5.76$, $p = .001$. When post hoc tests were conducted to examine rater age group differences for each of the five expressions, none of the comparisons was significant except for the ratings made by the old raters versus the young raters on the neutral face expression. Table 13 presents the means for this interaction. When post hoc tests were conducted to examine expression differences for each of the rater groups, all expression comparisons were significant except for Pleasant Surprise versus Happiness and Sadness versus Neutral.

Judgments of Poser Age. Two analyses were conducted to examine the perception of non-emotional communications from the face. For assignment of poser decade or "age judgments" on the neutral face, a Poser Age Group ( [3] between) x Rater Age Group ( [3] within) ANOVA was conducted. As would be expected, because Poser Age Group was the independent variable under study, there was a significant main effect for

Poser Age Group, $F(2, 84) = 182.62$, $p < .001$. Raters accurately detected the difference in ages between Old ($M = 63.5$), Middle-aged ($M = 44.8$), and Young Poser Age Groups ($M = 29.6$). Post hoc tests indicated that all comparisons were significant. A significant main effect of Rater Age Group was also obtained, $F(2, 168) = 5.16$, $p < .007$. Here, Older raters estimated all posers' ages as significantly older ($M = 46.3$, $SD = 15.41$) than did Younger raters ($M = 45.7$, $SD = 15.48$), but the differences in judgments between these two groups and those of the Middle-Aged raters ($M = 46.0$, $SD = 15.63$) were not significant. The mean age of all 90 posers in the study was actually 49.8 years.

Table 13

Cell means for the interaction between Rater Age Group and Expression on Confidence ratings

CONFIDENCE
RATER AGE GROUP X EXPRESSION
$F(8, 696) = 5.76$, $p < 0.001$

| RATER | Happy | Pleasant Surprise | Sad | Disgust | Neutral |
|---|---|---|---|---|---|
| Young | M=4.45<br>SD 0.18 | M=4.47<br>SD 0.10 | M=3.91<br>SD 0.28 | M=4.17<br>SD 0.16 | M=3.88<br>SD 0.22 |
| Middle | M=4.38<br>SD 0.26 | M=4.46<br>SD 0.15 | M=3.99<br>SD 0.25 | M=4.25<br>SD 0.27 | M=3.97<br>SD 0.26 |
| Older | M=4.47<br>SD 0.09 | M=4.54<br>SD 0.20 | M=4.03<br>SD 0.14 | M=4.09<br>SD 0.13 | M=4.24<br>SD 0.14 |

The age judgments assigned to Happiness and Sadness were compared in a second two-way ANOVA (Poser Age Group [3] x Emotion [2]), where Poser Age Group and Emotion were both between-subjects variables. As with the age judgments for the neutral expression, the expected main effect of Poser Age Group was observed, $F(2, 174) = 369.66$, $p < .001$, but there was no significant main effect of Emotion nor interactions among Poser Age Group and Emotion.

Examination of the Cohort Bias Effects

For each of the four dependent variables, interactions between Rater Age Group and Poser Age Group were inspected for evidence of cohort bias effects. Table 14 displays the magnitude of the ANOVA statistics for these interactions. Only the intensity ratings yielded a significant interaction of this nature, i.e., between Poser Age Group and Rater Age Group, $F(4, 174) = 3.32$, $p < 0.05$. See Table 15.

For the intensity ratings, when post-hoc tests were conducted to examine Rater Group differences for each group of poser faces, there were no significant comparisons for the young faces. For both the middle-aged and old faces, raters were assigned lower intensity ratings than did the older and young raters. Next, when post-hoc tests were conducted to examine poser-group differences evaluated by each set of raters, older and middle-aged faces were rated as more intense than were young faces by each set of raters. For the young and older rater groups, all poser group comparisons were significant, but for the middle-aged rater group, only

the comparison between older and young faces was significant. In spite of these findings, there was no evidence to support the predicted cohort advantage, i.e., older raters rating older faces as the most intense and young raters rating young faces as the most intense. Furthermore, the lack of significant interactions between Poser Age Group and Rater Age Group for accuracy, confidence ratings, and neutral-face age judgments further indicated that this particular data set does not provide support for a cohort bias effect in raters' ability to decode facial emotional or non-emotional information.

Table 14
Comparison of ANOVA statistics for all dependent variables on the interaction: Rater Age Group x Poser Age Group.

| ANOVA RATER AGE GROUP X POSER AGE GROUP | | | | | | |
|---|---|---|---|---|---|---|
| Dependent | df | SS | MS error | MS | F | p |
| INTENSITY | (4, 174) | 0.75 | 0.06 | 0.19 | 3.32 | .012* |
| ACCURACY | (4,174) | 0.01 | 0.00 | 0.00 | 0.28 | .89 |
| CONFIDENCE | (4,174) | 0.96 | 0.11 | 0.24 | 2.16 | .75 |
| NEUTRAL AGE JUDGMENT | (4,168) | 1.84 | 1.73 | 0.46 | 1.81 | .13 |

* Significant at $p < .05$

Table 15.

Cell means for the interaction between Rater Age Group and Poser Age Group on Intensity ratings.

| INTENSITY<br>RATER AGE GROUP X POSER AGE GROUP<br>$F(4, 174) = 3.12, p < .012$ | | | |
|---|---|---|---|
| RATER | Young | Middle-Aged | Older |
| Young | M=3.85<br>SD 0.22 | M=3.77<br>SD 0.20 | M=3.82<br>SD 0.12 |
| Middle | M=3.93<br>SD 0.22 | M=3.82<br>SD 0.21 | M=3.90<br>SD 0.12 |
| Older | M=4.06<br>SD 0.23 | M=3.86<br>SD 0.22 | M=4.01<br>SD 0.16 |

To confirm that cohort biases were not in affect for this data set, two-way ANOVAs ( [3] Poser Age Group x [5] Expression), were conducted on the accuracy and intensity data for each subset of raters, i.e., the Young, Middle-aged, and Older Rater Groups. When the data for these subsets of raters was examined, the pattern of overall effects remained constant. This comparison is presented on Table 16.

Table 16

P-values for Main Effects and Interactions for 2-way ANOVAs Involving Poser Age Group (3) and Emotion (5) as a Function of Rater Age Group

| | | ANOVA RESULTS | | |
|---|---|---|---|---|
| Dependent Variable | Rater Group | Main Effect Poser Group | Main Effect Expression | Interaction Poser Age Group &Expression |
| ACCURACY | Young | < .001 | < .001 | .685 |
| | Middle | < .001 | < .001 | .956 |
| | Older | < .001 | < .001 | .716 |
| INTENSITY | Young | .230 | < .001 | < .001 |
| | Middle | .776 | < .001 | < .001 |
| | Older | .230 | < .001 | < .001 |
| CONFIDENCE | Young | < .001 | < .001 | .142 |
| | Middle | < .001 | < .001 | .422 |
| | Older | < .001 | < .001 | .617 |

Supplemental Analyses

The repeated main effect of Expression and interactions with Expression in this data set prompted the query as to whether or not the dependent variables of accuracy and intensity were positively correlated. When the accuracy and intensity scores for each expression were correlated (using the Spearman rank-order procedure) for each poser age group and

all 90 posers, there were very few significant correlations between accuracy and intensity ratings and not more than would be expected by chance.

Finally, because there was a significant interaction between Poser Age Group and Expression that involved the neutral expression for older posers, an analysis of covarience was conducted for intensity, with the neutral face covaried on the four other emotional expressions. The pattern of effects from the initial ANOVA was, however, preserved, and suggests that changes in facial morphology with age do not necessarily accentuate the intensity of facial emotions produced by older posers.

## Discussion

### The Cohort Bias Effect

The results of this study indicate that a cohort bias effect was not operative in this data set. For any of the dependent variables (i.e., intensity, accuracy, confidence ratings, and poser age judgments), a cohort bias effect would have been indicated by interactions between the Rater Age Group and the Poser Age Group factors of this study. More specifically, the interactions would have to have taken the following direction. Young raters would have to have been most effective when rating the faces of their same age peers (i.e., young posers), and least effective when evaluating the faces of the older posers. Vice versa, the cohort bias effect would predict that older raters would be most accurate

when evaluating the faces of the older posers.

With the exception of intensity, none of the dependent measures revealed Poser Age Group by Rater Age Group interactions. For intensity, the pattern of significance did not indicate a perceptual advantage for viewing same cohort faces, but rather was due to middle-aged raters consistently assigning lower intensity ratings than young and older raters to the expressions of middle-aged and older posers.

The possibility of cohort biases understandably comes to mind when evaluating studies where performance differences are observed and where age is the main factor under manipulation. However, in the present study, where photographs of facial expressions were evaluated for aspects of emotional production, age cohort advantages did not arise. Taking the present methodology and findings into consideration, it may be that when raters are thoroughly screened for visuoperceptual ability, and both raters and posers are matched on variables, such as gender, occupation, general intellectual functioning, and mental health, that experimental biases which could mimic cohort effects are suppressed. An alternative explanation may be that when healthy individuals are trained in an extremely structured fashion to a high degree of interrater reliability, that cohort biases no longer apply. When both situations occur, as in the current investigation, it appears that healthy, adult subjects of most any age can be trained to judge faces with comparable efficiency.

Comparison of Cohort Methods and Results

Though the attempt to confirm Moreno's (1987) findings was achieved and the present research expands our understanding of how cohort biases may affect research designs, the present findings cannot be directly compared to those of Malatesta et al. (1987). Though both experiments dealt with the effects of aging on the production and assessment of facial expression, differences in screening, rater training, and stimulus preparation are sufficient to account for the differential conclusions about age cohort effects.

In the Malatesta et al. (1987) study which first demonstrated cohort effects for facial decoding, raters and posers were recruited at the same time from the same sources. They were matched for experiential variables, such as education and degree of social contact (during both work and leisure hours), but visual acuity was the only visuoperceptual ability assessed.

The present study did not exhibit the degree of balance/matching between poser and rater groups that was observed in the Malatesta et al.(1987) study. The raters in the current investigation met the same screening criteria as would have been necessary for inclusion in the original Moreno (1987) research, but the two groups were recruited at different times and from different geographical areas. Thus, there were some differences between the rater and poser groups. First, Moreno's posers were very highly educated and exhibited correspondingly high

vocabulary skill. The mean education and vocabulary scores of the present raters were within the average range, but somewhat lower than those of Moreno's posers. Though several of the raters in this study immigrated to Lancaster, Pennsylvania, from urban areas such as New York City, most were from suburban and rural sub-cultures. By comparison, Moreno's posers were recruited in the 1980's in New York City. However, looking within the samples, the posers and raters in this study were carefully screened and matched across age groups, so that definitive statements could be made about their neurocognitive characteristics. Additionally, highly reliable neuropsychological instruments were used to evaluate the raters and posers such that, if necessary, this information could be used to statistically control for any differences.

Though nicely balanced for social and cultural factors, the Malatesta et al. (1987) study did not possess the same degree of screening rigor, and it cannot be automatically assumed that the ten subjects in each of their rater and poser groups were adequately matched on aspects of cognitive functioning, such as general intellectual ability or especially visuospatial and perceptual skills.

The results of the present study suggest that when subject characteristics are carefully controlled and a high level of interrater reliability is achieved, cohort biases do not influence the overall ability of female raters to assess either emotionally-laden (i.e., expression type, expression intensity, and confidence ratings) or non-emotional information

(i.e., poser's age) as it is communicated through the facial channel during free-field viewing of static images. Cohort biases may, however, influence daily encounters or impact upon highly ecological tasks, such as evaluating videotaped segments (e.g., Malatesta et al.,1987). Based on the present study, we also cannot conclude that cohort biases do not influence tachistoscopic evaluations (e.g., McDowell et al.,1994) or that familiarity does not affect the speed at which conclusions about these factors are drawn. Using the present set of posers, a speed of processing or response time factor could be examined if the methodology and stimuli were adapted for computer presentation.

Because evaluation of posed static facial expressions is a fairly common procedure, it is worth noting that this study demonstrates how careful training and screening of raters is adequate to control for cohort effects in similar designs. Additionally, when these precautions are implemented, the number of raters need not be greater than that necessary to achieve adequate statistical power.

## Age Effects

Age was manipulated in this study for both the posers/encoders of the emotional expressions and for the raters/decoders of this information. Independent of the cohort bias effect, this procedure allowed for the investigation of age-related changes for both encoding and decoding of information conveyed through the facial channel.

Age Changes Associated with Poser /Encoder Tasks. The observation that raters, independent of their age group, were less correct in their assessment of the intended expression for the older posers suggests that older women may actually be less accurate encoders of facial emotion. This finding replicates that of Moreno (1987). It also supports findings from Malatesta et al. (1987), in that the expressions of older posers in their study were also significantly less accurate than those of their younger encoder groups. Similarly, Levenson et al. (1991) have reported that the facial configurations produced by older subjects in a directed facial action task were of lower quality for older than younger posers.

Regardless of their age group, all raters in the present study were most confident/assured of their accuracy ratings for young posers. They were less certain of their assignments for middle-aged posers, and least sure about their assignments for older posers. These findings complement those for accuracy of expression. One would expect raters to be less certain about their assignments for the older posers' expressions in this study, since these poses were, in fact, rated as less accurate than those of the young and middle-aged poser groups.

If there are performance changes in the ability to encode emotional expression with age, the first question would be whether this is a sign of right-hemisphere decline with increasing age. In her original doctoral dissertation, Moreno (1987) also looked at laterality indices associated with right-hemisphere function for these posers. Moreno et al. (1990) reported

no significant, age-related changes for these posers in facial asymmetry during emotional expression or in lateralized perceptual skills (via the Chimeric Faces Test; Levy et al., 1983). Thus, if these older posers are less accurate encoders, it does not appear that this finding is indicative of a global decline in right-hemisphere function.

Levenson et al. (1991) demonstrated that older individuals report and experience little generation of emotional signals during directed facial action tasks. They suggested that the older subjects in their study may not have been as cognitively engaged in the production of the facial configurations as their younger counterparts. Levenson et al. (1991) speculated that their older subjects may simply have found the task less compelling and that a lack of interest could have precipitated poorer quality expressions. Additionally, they suggested that this finding could reflect lessening of voluntary muscular control with advancing age.

Both explanations might generalize to Moreno's (1987) procedure for eliciting posed expressions. Additionally, the older subjects in Moreno's group may also have been more camera-shy or subscribed to different social display rules than their younger peers. Similarly, mild discomfort about being photographed (or about being photographed in an unbecoming cape and hair covering) might also have preoccupied the older posers or produced sufficient anxiety to disorganize their encoding/ production of a clear expression.

Malatesta and Izard (1984) used the Max Coding System (Izard,

1979) in a developmental examination of women's ability to pose facial emotions. The Max Coding System requires raters to evaluate individual muscle actions in various regions of the face. Though Malatesta and Izard (1984) reported no changes in expression frequency with age, they did find that older women's expressions more frequently evinced emotion blends, masking, and fragmentation or incomplete muscle involvement. Certainly, such characteristics would make expressions harder to decode. In the present study, we did not evaluate the stimuli for such characteristics. Many raters remarked, however, that the expressions did not really look like any of the five possible labels. Some of the raters were quick to provide their own names for the expressions, but these responses were not noted in a systematic fashion.

Having demonstrated that careful screening and matching of raters will control for cohort effects on our perceptual tasks, these same stimuli could be evaluated with a system like Max Coding or FACS. They might also be re-rated for expression category in a design which simply allows decoders to freely label the expressions. The latter procedure would certainly test the ecological validity of a notion like emotional blends.

For intensity of expression, the current data set suggests that facial emotional expressions are produced with similar intensity by young, middle-aged, and older posers. There was no evidence to suggest that expression intensity decreases with age.

An interaction between poser age group and expression indicated that

the neutral face of older posers was rated as significantly more intense than the neutral expressions of young and middle-aged posers. Most likely, this finding reflects morphological features of the older faces such as wrinkles. However, if wrinkles cause neutral expressions to be rated with greater intensity, then the Otta et al. (1991) results imply that wrinkles are in some way filtered out or are not sufficient to cause differences in the types of character traits assigned to faces.

Age Changes Associated with Rater /Decoder Tasks. There was no evidence from this data set to suggest that decoding of facial expression systematically changes with age. For the assessment of intensity, there was a significant effect of rater age group, such that middle-aged raters consistently assigned lower intensity values to the facial expression stimuli than did older and younger raters. Looking beyond the main effect of rater age group, there were no systematic findings that involved the middle-aged, young, or older raters when other factors, such as poser age group or expression type, were considered.

When accuracy ratings were examined as a function of rater age group, there were no differences among the overall scores produced by young, middle-aged, and older raters. This suggests that the raters' ability to perceive and decode the five facial expressions (happiness, pleasant surprise, sadness, disgust, and neutral) was similar across age groups.

Age effects have, however, been reported by Brosgole and Weisman

(1995), who found that the ability to discriminate and identify angry facial affect begins to decline around age 45. Since the present study and that of Borosgole and Weisman (1995) used very different facial affective stimuli and studied different sets of emotional expression, direct comparisons cannot be made. The developmental and componential scope of the Brosgole and Weisman (1995) study was, however, immense, and their findings may have important implications for research on aging and perceptual processing of approach/ avoidance emotions.

Alternatively, the absence of an aging effect in the present study is consistent with that reported by Moreno et al. (1993). They required the 90 participants (who served as posers for the present study)to identify the emotions portrayed on 16 Ekman and Friesen (1976) faces that depicted women and men's facial expressions of happiness, pleasant surprise, sadness, and disgust. Using these stimuli, Moreno et al. (1993) reported that there were no overall changes on perceptual accuracy for facial emotion as a function of age, but older subjects were found to be less accurate than middle-aged and younger subjects in their identification of neutral facial expressions. As mentioned above, raters of all age groups comparably rated the five expressions used in the present study. Additionally, the neutral face received a fairly high accuracy rating ($\underline{M}$=0.82) Thus, though the Ekman and Friesen faces are standardized examples of emotional expressions, the different findings of this and the Moreno (1987) study are most likely due to the vast difference in size of

stimulus sets used, i.e., 90 verses 4 neutral faces, respectively.

The task of identifying facial emotional expressions was also linked in the present study to a measure of self-assuredness or confidence about accuracy ratings. (In the original Moreno study (1987), there was no analogous task.) Independent of mood factors, older and middle-aged raters in this study reported significantly more confidence than younger raters about their judgments. However, when statistical controls were applied to correct for the effects of depressive symptomatology, there were no differences among the rater age groups. Since raters did not differ as a function of age in their ability to designate or identify emotional expressions, the finding that confidence and depressive symptomatology did interact, suggests that perceptual accuracy, as studied in this investigation, is robust to effects of mood. It appears that raters' cognitions about external stimuli (i.e., type of facial expression and its intensity as measured against specific criteria) were less affected by mood than was their assessment of the internal circumstances, i.e., self-confidence about rating performance.

Even if samples are taken from allegedly normal/typical populations, Heller, et al. (1995), demonstrated that psychological functioning can not be dismissed in studies of facial processing. No studies with sufficient methodological control were found, however, to suggest that subclinical degrees of symptomatology definitively influence the perception of facial expression.

A study by Bibawi, Cherry, and Hellige (1995) about the impact of menstrual cycle and associated hormonal changes on lateralized processing, may, in fact, hint that normal fluctuations in mood do not affect facial discrimination tasks. Bibawi et al. (1995) reported that the left-hemiface bias usually observed with CFT paradigms was not affected by hormonal status, but that performance on a left-hemisphere mediated task of chair discrimination did change with menstrual phase. Anecdotal reports would suggest that there is potential for change in mood state (though not necessarily full-blown PMS effects) with the onset of menses, thus the Bibawi et al. (1995) finding is not inconsistent with our finding of no significant correlation between CFT scores and measures of mood symptomatology. It also converges with the assumption that tasks strongly lateralized to the right hemisphere (such as the CFT or discrimination of facial affect as carried out in this study) may be unaffected by typical changes in mood for truly healthy participants.

Examination of Stimulus Content

Emotional Expressions. Although there were strong main effects of Expression for intensity, accuracy, and confidence measures, the patterns of significance did not lend themselves to any of the major theories about emotional expression. For instance we could not say that the positive emotions of happiness and pleasant surprise were rated in a systematically different way than the negative emotions of sadness and disgust, or that

ratings uniquely clustered around these two dimensions.

When accuracy scores were compared as a function of expression between the two studies, happy expressions were consistently viewed as having been more accurately produced than sad expressions. The orders of magnitude were the same for happiness and sadness, but Moreno's raters saw pleasant surprise and disgust as having been more accurately posed than did the raters in the current study. By way of comparison, the mean accuracy ratings for pleasant surprise were: Moreno's group (M=0.94) and the current group (M=0.82), and the mean accuracy ratings for happiness were : Moreno's group (M=0.89) and the current group (M=0.92).

The juxtaposition of findings between this and the original Moreno (1987) study suggests that the stimulus set and task instructions reliably elicit these perceptual findings for assessment of accuracy and intensity. Thus, the procedures could reasonably be used in future research.

Age Judgments. Designation of poser age was included in this study as a non-emotional comparison measure. It was assumed that the analytic nature of this judgment, i.e., assigning an age or decade category to each poser, could have comparative value for examining the differences between affective/emotionally-laden decisions and non-emotional decisions about facial stimuli. A main effect of poser age for the age judgments suggested that raters did correctly ascertain the age differences among the poser

groups. There were no interactions between the Rater Age Group and the Poser Age Group factors, but for the raters as a whole, young raters assigned significantly lower ages overall, than did the middle and older raters. Speculatively, the order of mean age ratings suggested a slight "age-centrism." That is, older raters assigned older ages to the neutral face, the middle-aged raters' mean was in the middle, and the young raters assigned younger ages to the neutral stimuli.

There were no statistical findings to suggest that the age labeling task was affected by mood symptoms nor evidence that it taps analytic/serial or left-hemisphere processes. Since age assessment was an exploratory measure, and consideration of non-emotional facial characteristics is rare, it is worth mentioning the findings of one other study. Burt and Perrett (1997) also took a brief look at facial age. Using a laterality paradigm, their task required subjects to determine which of two chimeric faces looked older. For their discrimination task, they found a left-hemiface bias suggesting that comparison of two faces for age character (e.g., "Which is older?") is mediated by the right hemisphere.

To see if raters differed in their age judgments as a function of the emotion portrayed, we also examined the ages assigned to happy and sad stimuli. To minimize the impact of memories about assignments to the neutral face, raters saw either a happy or a sad picture of each poser. The findings suggested that sad faces were not perceived as older than the happy faces in this study.

## Conclusions

Examination of age ratings and effects of depressive symptomatology were exploratory features of this study. Examination of age changes for encoding and decoding of the facial expression stimuli, along with a consideration of cohort bias effects, was theoretically based and driven by the extant literature on emotional expression and these experimental issues. Identification of design features which elicit cohort biases is an important contribution to the field. In the present study, special consideration was given to: (1.) the assembly of a large group of raters from which perception/evaluation of facial expressions could additionally be assessed, (2.) investigation of processing for both emotional and non-emotional (e.g., age) information communicated through the facial channel, and 3.) examination of subtle subject characteristics (e.g., depressive symptomatology) that vary within any sample of healthy subjects and that could contribute experimental bias.

The methodological contribution of this study is to highlight the importance of obtaining internal consistency and carefully matching rater groups on characteristics relevant to the encoding task. Matching the age of raters to poser groups, especially in developmental studies, is always preferable, but it is not sufficient for control of perceptual biases. In the present study, careful matching on demographic and neuropsychological factors allowed us to determine that age-related changes associated with making judgments about facial stimuli are minimized, if not eradicated,

when tasks are carefully trained and introduced with standardized instructions.

Consistent with the findings of Moreno (1987) about expressive or encoding changes with age, the current study confirmed that there is a decline with advancing age in the ability to accurately encode target emotional expressions. There was no evidence from this study to suggest that the decline in accuracy is specific to any one emotion or valence category. This change may be isolated to the particular facial encoding task used and may not necessarily be indicative of a global decline in emotional processing, facial perception, or other right-hemisphere functions.

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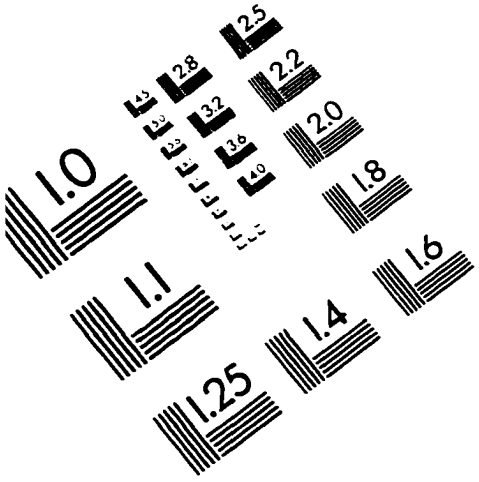
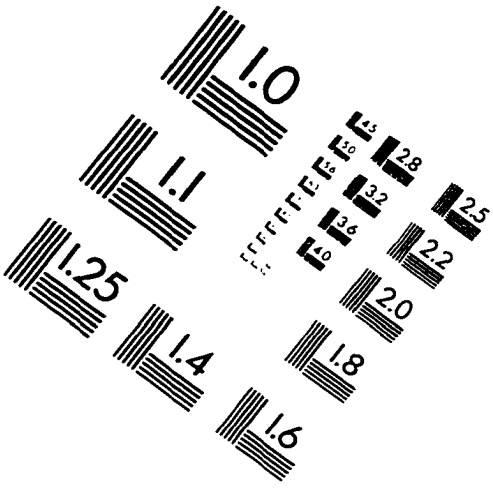
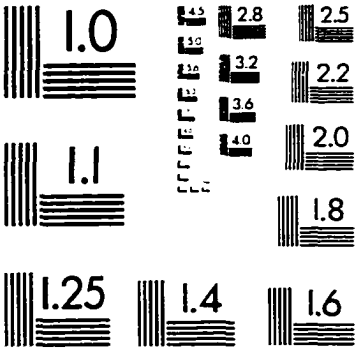
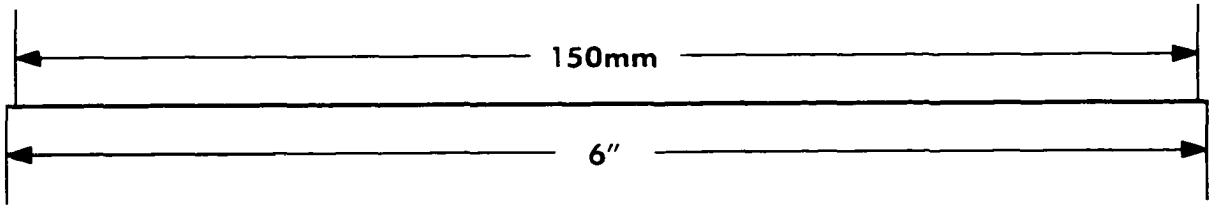
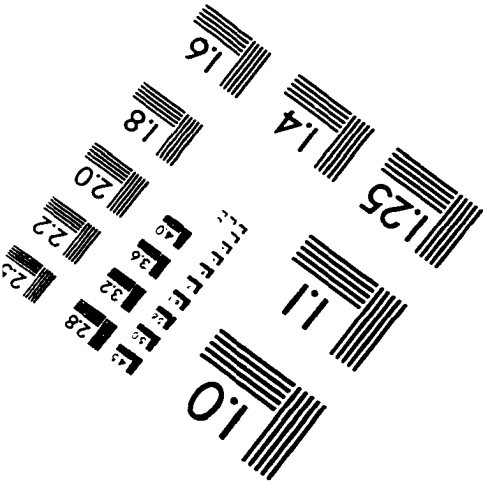
# IMAGE EVALUATION
# TEST TARGET (QA-3)

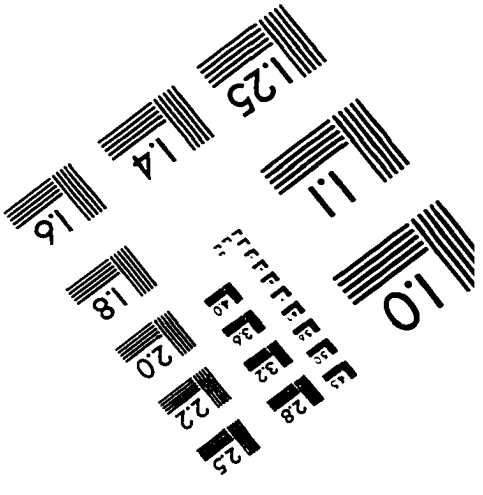
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