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ABSTRACT

THE EFFECTS OF UNILATERAL FACIAL MANIPULATION AND SEX OF SUBJECT ON THE EXPERIENCE OF EMOTIONS

By

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Facial manipulations were used as a mood induction technique to examine the Valence Hypothesis of Emotion and possible sex-related differences in cerebral lateralization for emotion. Two primary predictions were that 1) subjects would make more negative responses following left-face manipulations (right hemisphere) and more positive-like responses following right-face manipulations (left hemisphere) and 2) that men would be more clearly lateralized than women on the mood induction task. Baseline data was gathered from 40 male and 40 female subjects using the DACL and POMS-BI. Subjects manipulated each side of their face (alternating sides each time), completed parallel forms of the DACL following each manipulation, and completed a second POMS-BI following the last manipulation. Data were tested using repeated measures ANCOVA and findings did not support either prediction. Possible explanations are given for the unsupported hypotheses, clinical implications of this research are discussed, and future research possibilities are suggested.

DEDICATION

I dedicate this Thesis to my wife Sandy. It represents not only my hard work but also Sandy's unwavering support and timely encouragement. Without Sandy I would not have reached this seminal point in my academic career. I am both deeply in love and forever grateful.

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CHAPTER 1
INTRODUCTION

After more than a century of research dating back to the 1860s, there is now abundant evidence that the two cerebral hemispheres of the human brain play different roles in the initiation, regulation, and execution of certain higher functions (Benson & Zaidel, 1985). The general conclusions from this research credit the left hemisphere with primary control over language and the right hemisphere with primary control over visuo-spatial and perceptual functions. Language and spatial perception are conventionally regarded as cognitive functions. In the case of functions that are not so regarded, namely feelings and emotions, laterality studies do not allow such clear distinctions. Some evidence points to right hemisphere dominance for all emotional behaviors; other evidence suggests that both hemispheres contribute in different ways depending on the valence of the emotion, that is, whether it is predominantly positive or negative. One of the aims of this study was to help elucidate this point.

Sex-Related Differences in Cerebral Organization for Language and Visuo-Spatial-Perceptual Functions

For language and visuo-spatial-perceptual functions, the question also has been raised whether generalizations about cerebral organization apply equally to males and females. One reason for raising this possibility are the well-documented sex-related differences in performance on verbal and visuo-spatial tasks. For instance, males typically perform at a higher level than females on tasks with a strong visuo-spatial component. These include tasks requiring mental rotation, target-directed motor skills (e.g., guiding and intercepting a dart), disembedding simple shapes from complex pictures, and right-left discriminations. Females, on the other hand, typically perform at higher levels than males on tests of perceptual speed, memory for location of common objects, verbal fluency, and fine-motor skills (e.g., Benton, 1959; Harris, 1979, 1981; Harris & Gitterman, 1978; Maccoby & Jacklin, 1974; Kimura, 1992).

Evidence suggests that at least some of these differences are related to upbringing and social training. For example, boys are often encouraged to engage in activities that incidentally can enhance visuo-spatial skills (Sherman, 1976; for review see Harris, 1979, 1981). Neuropsychological evidence, however, raises the possibility that the more fundamental force may lie in sex-related differences in cerebral organization. This evidence, from both the clinical and non-clinical literature, suggests that the general conclusions cited earlier about laterality and cognitive functions apply more strongly to males than to females (e.g., McGlone, 1980; McGlone & Kertesz, 1973; Kimura, 1992). Put another way, language and spatial functions tend to be under a greater degree of unilateral control, or a lesser degree of bilateral control, in males than in females. What still remains to be shown, however, is precisely how such differences in cerebral organization might be translated into performance differences in verbal and non-verbal tests of the kind cited above. If, for example, greater unilateral organization gives males an advantage on spatial tasks because the right hemisphere is more purely committed to non-verbal processing, it is not clear why the same should not apply in the case of left hemisphere skills, that is, why males should not have the same advantage for verbal skills as well. There appears to be slippage between the neuropsychological evidence and the cognitive performance data.

Sex-Related Differences in Cerebral Organization for Emotion?

Given the evidence for sex-related differences in cerebral organization for language and visuo-spatial functions, the question arises whether there may also be sex-related differences in cerebral organization for emotion. Another aim of this study is to address this possibility.

One reason to raise this possibility is that, just as the search for sex differences in neurological organization for language and visuo-spatial processing has been spurred, in part, by demonstrations of sex differences in performance on language and visuo-spatial tasks, so is there evidence for sex differences on tests of "emotional" functions.

Some of the evidence pertains to the perception of emotion. For example, it is often said that women perceive emotional stimuli more readily than men, that they are more likely than men to "see when something is wrong with a friend" or to "hear a problem in a friend's voice." Such accounts are largely anecdotal, but the general theme finds support in scientifically rigorous studies. For example, Soloman and Ali (1972) found that women were better than men in identifying the affective implications of tone of voice. Soloman and Ali interpreted this to mean that females have a better understanding of emotional situations. Buck, Savin, Miller, and Caul (1972) found that females were better than males in identifying emotional expressions in faces, and Natale, Gur, and Gur (1983) found that females were better than males on tasks that required discriminating between faces depicting different expressions.

Other evidence suggests that females and males also express and experience emotions differently. For instance, researchers using data from psychotherapy clinics have found that females report more symptoms of depression than males (Klerman, Weissman, Rounsaville, & Chevron, 1984). Also, surveys have found that females report higher average levels of depression and anxiety compared to males (Aneshensel, 1992; Mirowsky & Ross, 1986) and exhibit more warmth and compassion than males (Deaux & Lewis, 1983; cited in Deaux, 1984; Intons-Peterson, 1988). It is unclear, however, whether these data reflect a sex-related difference in the expression or in the experience of emotion, or perhaps both.

Most attempts to account for the kinds of sex differences cited earlier see them as products of social training and experience. Three such attempts are the *response-bias theory,* the *gendered-response theory,* and the *structured-strain theory*. In support of the idea that the main difference between the sexes is in greater female expression of emotions, the *response-bias* theory proposes that women and men differ in their likelihood of expressing emotions or feelings to an interviewer (Phillips & Segal, 1969; Ritchey, LaGory, & Mullis, 1993; Seiler, 1975). According to Mirowsky and Ross (1995), the reason is that, for women, emotional expression does not have a negative connotation. Instead, it symbolizes the transmission of signals between connected individuals. To men, however, the expression of emotion does have a negative connotation because such behavior may feel to them that they are revealing weaknesses. According to this hypothesis, womens' greater *apparent* distress results primarily from differences in their willingness to talk openly about distress and not from differences in the amount or quality of emotional experience. One type of data offered in support of this hypothesis shows that, in experimental and survey situations, when men and women are asked to report how happy they are, women do not report less happiness than males (Wood, Rhodes, & Whelan, 1989; Stoppard & Gruchy, 1993). It would be difficult to reconcile the contradiction that women are more distressed than men but equally happy.

Where differences in the experience of emotion are concerned, the *gendered-response* theory suggests that for negative emotions, the type of emotional response may be different when depression is influenced by sex-role socialization (Mirowsky & Ross, 1995). Specifically, depression is thought to be the by-product of frustration of desires and aspirations and that this frustration generates rage and hostility (Rosenfield, 1980). Depression is seen when an individual focuses the anger inward, punishing the self for the perceived failure and deficiency. Furthermore, men are generally socialized for aggressive and combative roles that permit the outward expression of anger and hostility whereas women are generally socialized for nurturing and supportive roles that discourage such expression. Thus, the gendered-response theory proposes that frustration makes men angry and women depressed (Dohrenwend & Dohrenwend 1976, 1977). Also, it has been proposed that standard indices for measuring distress ask more questions about depression and anxiety than about anger and hostility. Such question biases would make females appear more distressed than males even though they may experience the same amount of overall distress (Rosenfield, 1980).

Although the gendered-response theory may seem intuitively reasonable, some data have not supported it. In a clinical study, Frank, Carpenter, and Kupfer (1988) followed women and men through treatment for recurrent depression and found that when entering treatment, women reported significantly more anger and hostility than men. In another study Conger, Lorenz, Elder, Simons, and Ge (1993) reported results from a survey of 451 rural Midwestern married couples that showed that wives reported significantly greater marital hostility than their husbands. Although the survey results were interpreted as reflecting sex-related differences in experience, the possibility exists that these *survey* findings are the product of sex-related reporting bias, making it possible that both an experience and reporting bias affected these results.

The third explanation of sex-related differences in emotion is offered by the *structured-strain* theory, which incorporates both the expression and experience differences described above. The structured-strain theory proposes that gender inequality, gender roles, and gender-based frequency of contact with social stressors account for differences in the amount of distress reported by men and women. Gove and Tudor (1977), Pearlin (1989), and Ross and Huber (1985) claim that women's positions in the labor force and in the family disadvantage them compared to men because of the women's greater burden of demands and limitations. This pressure creates stress and frustration and becomes evident in higher levels of felt- and reported-distress.

While not denying the important contributions and influence of social training and response-biases to sex differences, as represented by the *response-bias, gendered-response, and structured-strain* theories, the evidence for sex differences in cerebral organization for language and visuo-spatial functions at least raises the possibility that these differences in emotion likewise reflect some degree of cerebral "hard-wiring." Even so, environmental influences should not be assumed to play an insignificant role.

Where sex-related differences in cerebral "hard-wiring" are concerned, in some mammals and birds the differences appear to have their origins in at least two periods of development: 1) prenatal and 2) around the onset of puberty. Prenatally, hormones set in motion the process of organizing the sexually undifferentiated brain into distinct "male" and "female" type brains (Harris, 1981). At the onset of puberty, when many distinctly male and female characteristics present more clearly, hormones again can be found in the central nervous system in increased quantities. Although these findings come from studies of animals and birds, they may also hold true for human beings (for a more detailed explanation see Harris, 1979, 1981). Examples of the environmental influences that are also assumed to impact these processes were explained when the *response-bias*, *gendered-response*, and *structured-strain* theories were discussed and, therefore, will not be covered here.

Epi-genetic models like the ones discussed above have been the subjects of research studies in a variety of fields. For instance, some researchers use epi-genetic models partially to explain sex-related differences for approaching tasks such as divergent thinking, object synthesis, and ideational flexibility (Coren, 1995). Clinical psychopharmacologists have studied possible sex-related differences in the behavioral and physiological mechanisms of responses to threat and stress, hypothesizing that those differences contribute to the diagnostic over-representation of women in anxiety disorders (Blanchard, Greibel, & Blanchard, 1995). In both examples, it is believed that the physiological and behavioral/environmental systems interact by reinforcing the other.

The rest of this manuscript reviews the evidence for possible cerebral differences for cerebral organization of emotion. To begin, a review of two hypotheses about cerebral organization for emotion will be presented. After that, a review of the evidence for sex differences in this organization and discussion of some possible explanations for inconsistent results is presented. Following this, is a discussion of the rationale for a new study including possible clinical implications for studies of the neuropsychological organization of emotion. Finally, a description is given of a new experimental test of the sex-differences hypothesis.

Neuropsychological Theories of Emotional Processing

Historically, the brain region named as the primary area for the initiation and control of emotional behavior has been the limbic system (Rinn, 1984; Joseph, 1992). More recent research shows that neo-cortical regions also play key roles. Some of the research has focused on the perception of emotion (e.g., Bever, Hurtig, & Handel, 1976; Safer & Leventhal, 1977; Landis, Assal, & Perret, 1979; Coffey, 1987), some on the expression of emotion (e.g., Campbell, 1978; Sackeim, Gur, & Saucy, 1978; Borod & Caron, 1980; Rubin & Rubin, 1980), and some on the experience of emotion (e.g., Davidson & Schwartz, 1976; Davidson, Schwartz, Saron, Bennett, & Goleman, 1979). Such studies have given rise to two main hypotheses about hemispheric specialization for emotion: the so-called Right Hemisphere Hypothesis and the so-called Valence Hypothesis. These hypotheses are summarized in Tables 1a and 1b.

According to the Right Hemisphere Hypothesis (Table 1a), the right hemisphere is specialized for the perception, expression, and experience of emotion and takes the leading role regardless of the valence of the emotions, that is, whether it has a more positive or negative quality (Ley & Bryden, 1982; Borod, Koff, & Caron, 1983; Buck, 1984; Heilman, Bowers, & Valenstein, 1985).

The Valence Hypothesis (Table 1b), follows the Right Hemisphere Hypothesis in proposing that the right hemisphere has primary control over the perception of emotion, regardless of valence. It then proposes different hemispheric roles for expression and experience, depending on valence, with the left hemisphere having primary control over positive emotion, the right hemisphere for negative emotion (Borod, 1992).

Evidence for the Right Hemisphere Hypothesis

Evidence for the Right Hemisphere Hypothesis comes from a variety of sources. Evidence that the right hemisphere plays the leading role in the perception of emotion includes dichotic listening studies showing a left ear, or right hemisphere, advantage for perceiving non-speech, positive and negative sounds such as laughing and crying (Kimura, 1964; King & Kimura, 1972), as well as positive and negative affectively-toned speech (Haggard & Parkinson, 1971). Similar hemispheric differences have been reported in visual-recognition studies. For example, using a tachistoscopic method[1], Strauss and Moscovitch (1981) found a left-visual field advantage (right hemisphere) in subjects' perceptions of facial expressions, both smiles and frowns, depicted in photographs, cartoons, and line drawings.

A proposed limitation of the tachistoscopic method is that it necessarily restricts the subject's head-movement and greatly restricts viewing time of the stimulus. Zaidel's (1975) Z-lens is less restrictive. As described by Springer and Deutsch (1993, p. 43), the Z-lens is a contact lens that permits free movement of the eyes, without a time limit, while ensuring that only one hemisphere receives the visual information. Regardless of the proposed limitation mentioned above, where the visual recognition studies are concerned, studies using the Z-lens have often produced results consistent with those using the

[1]A *tachistoscope* projects visual information onto a screen in either the subject's right- or left visual field, allowing only one hemisphere to receive the stimuli.

tachistoscopic method (e.g., Dimond & Farrington, 1977).

Some of the evidence for the Right Hemisphere Hypothesis for emotional expression comes from clinical studies. For example, Borod, Koff, Lorch, and Nicholas (1986) compared patients with right hemisphere damage, left hemisphere damage, and normal controls on tests of facial expression in posed and spontaneous conditions. For positive and negative expressions alike, patients with right hemisphere damage were significantly impaired compared to patients with left hemisphere damage and normal controls.

Other evidence for the Right Hemisphere Hypothesis comes from non-clinical studies. For instance, Moscovitch and Olds (1982) compared side of facial activation in adults while they were engaged in spontaneous conversations. Any change from a neutral facial expression was considered a valid data point. Therefore, both positive and negative expressions were recorded (e.g., smiles, snickers, sneers, and frowns). The results showed that, overall, subjects had greater left than right side expressivity, indicating that facial expression was mediated by the right hemisphere. Similar findings were reported by Borod, Koff, and White (1983). In their study, adults generally showed greater expressivity on the left side of the face.

Evidence for the Valence Hypothesis

Inasmuch as the Valence Hypothesis is identical to the Right Hemisphere Hypothesis for the perception of emotion, all the evidence on perception already cited would apply here too. The only difference between the models, therefore, would be for studies of expression and experience, where valence is now hypothesized to play a role.

Support for the Valence Hypothesis comes from a variety of sources. One consists of studies of emotional changes in patients with lateralized brain injuries. Gainotti (1972) found that patients with left hemisphere lesions were three times more likely than right hemisphere-lesion patients to show catastrophic reactions, whereas right hemisphere-lesion patients were more likely to be indifferent to their emotions or even to show a “euphoric” reaction. Goldstein (1939) originally characterized the catastrophic reaction as "crying, pessimistic statements, guilt, feelings of nothingness, indignity, despair, and complaints and worries about the future," whereas the euphoric reaction constituted "lack of comprehension, smiling, joking, laughing, mimicry, relaxation, optimism, and a sense of well being" (cited in Silberman & Weingartner, 1986, p. 336; Goldstein page reference not given). Additional support for these findings is reported by Robinson and Price (1982). They found that patients with left hemisphere damage were more likely to be clinically depressed than patients with right hemisphere damage. Robinson (1983) also found that patients with right- but not left-sided strokes became inappropriately cheerful. Similar differences were reported by Sackeim, Greenberg, Weimen, Gur, Hungerbuhler, and Geschwind (1982) in a review of studies of pathological laughing and crying following destructive lesions. Left hemisphere lesions were more likely to produce catastrophic reactions, whereas right hemisphere lesions were more likely to produce euphoric reactions.

Gainotti (1972) interpreted findings such as these to mean that the left hemisphere is dominant for the <u>experience</u> and <u>expression</u> of positive emotions, whereas the right hemisphere is dominant for the <u>experience</u> and <u>expression</u> of negative emotions. The reasoning behind this interpretation draws on Hughlings-Jackson's (1874) inhibition theory. That theory supposes that both hemispheres are normally in a state of balance, with each exercising a measure of control, or inhibition over the other, as the site of greater arousal passes from one side to the other. The catastrophic reaction associated with left hemisphere damage thus is seen as a product of the left hemisphere's release of inhibition over the right hemisphere. The inverse is also true; the euphoric reaction associated with right hemisphere damage reflects the release of right hemisphere inhibition over the left hemisphere.

Support for the characterization that the left hemisphere usually inhibits the right hemisphere, and that the right hemisphere usually inhibits the left hemisphere, has also come from patients who have undergone the Wada procedure, a pharmacological method that selectively anesthetizes one cerebral hemisphere at a time. Several early studies reported that when the left hemisphere was anesthetized, the patient often exhibited a "catastrophic reaction" whereas when the right hemisphere was anesthetized, the patient more often showed a "euphoric reaction" (Alema, Rosadini, & Rossi, 1961; Perria, Rosadini, & Rossi, 1961; Rosadini & Rossi, 1967; Terzian, 1964). The assumption is that whatever behaviors are lost following this procedure lie within the province of the anesthetized hemisphere, whereas whatever behaviors are retained or newly emerge are under the control of the other hemisphere.

The problem with these data is that both the catastrophic and the euphoric reactions occurred when the anesthesia was lessening, which means that the emotional change could represent the actions of either side. In other words, it is possible that when either hemisphere was "waking-up," it was able to produce the emotion usually under its own control.

This problem of interpretation is clarified by data reviewed by Sackeim et al.

(1982) on epileptic patients during ictal episodes. The data revealed that left-side ictus was more often identified with laughter, and right-side ictus with crying. Because, during ictus, there is increased electrical activity, blood flow, and metabolic activity associated with the side of epileptic discharge, the laughter and crying are assumed to reflect the direct activity of the left hemisphere and right hemisphere, respectively, and thus to be consistent with the left hemisphere-positive, right hemisphere-negative Valence Model.

In summary, given all of the aforementioned research, there is ample evidence to support the Valence Hypothesis.

Mood-Induction Studies

So far, we have reviewed a variety of methods for studying hemispheric specialization for emotion and for testing the Right Hemisphere Hypothesis and Valence Hypothesis. In recent years, still another method has come into common use, namely the experimental induction of mood. This method will be discussed separately from the rest, and, because it offers certain advantages over prior methods, it is the method used in the current study.

Dozens of techniques have been used to induce mood-states, including the playing of music (Thaut & de l'Etoile, 1993; Bouhuys, Bloem, & Groothuis, 1995; Lewis, Dember, Schefft, & Radenhausen, 1995), self-generated imagery (Harman & Ray, 1977), the tachistoscope and Z-lens presentations of visual stimuli (Graves, Landis, & Goodglass, 1981; Landis, Assal, & Perret, 1979; Rizzolatti, Umilta, & Berlucchi, 1971; Geffen, Bradshaw, & Wallace, 1971; Dimond, Farrington, & Johnson, 1976), and the presentation of words and other verbal stimuli (Banich, Stolar, Heller, & Goldman, 1992). In general, the results of these studies support the Valence Model.

For example, Dimond and Farrington (1977) used the Z-lens procedure to study subjects' reactions to films presented selectively to each hemisphere. The films were either humorous, pleasant, unpleasant, or horrific. The subjects' heart-rates were measured, with increases used as an index of an emotional response. The result was that heart-rate changes were greater for films presented to the right hemisphere than to the left. The subjects independently also rated the films as more pleasant when presented to the left hemisphere and as more unpleasant and horrific when presented to the right hemisphere. The results thus are consistent with the Valence Hypothesis.

Further support comes from a study by Davidson, Schwartz, Pugash, and Broomfield (1976). They showed infants films of a woman smiling or frowning. At the same time, they recorded electroencephalographic activity from the infants' frontal and parietal lobes. The results showed greater right hemisphere activity to the frowning face and greater left hemisphere activity to the smiling face. Even though the infants' overt behaviors were not described, it seems reasonable to suppose that the smiling woman elicited a positive state, and the frowning woman a negative state, so that the cortical activation patterns may be assumed to reflect the infants' experiential state while viewing the films. The results thus would be consistent with the Valence Hypothesis.

Harman and Ray (1977) used events from a subject's past to elicit both positive and negative emotions. Cortical EEG measures were used to study the effect of the valence on each hemisphere. The results showed that the left hemisphere had a significant increase in power for positive emotions and a significant decrease in power for negative emotions. The right hemisphere changes were in the reverse direction but to a much lesser extent. Again, these results are consistent with the Valence Hypothesis.

As a last example, Banich, Stolar, Heller, and Goldman (1992) induced depressed or neutral mood-states in college students, as measured by self-rated sadness and decreased happiness, using a combination of both music and imagery. On a task requiring right hemisphere processing, subjects induced into a depressed mood showed longer reaction times (i.e., poorer performance) than did subjects induced into a neutral mood. The depressed subjects, however, were not slower on tasks requiring left hemisphere processing. The authors interpreted this pattern of results as evidence that depression was being regulated by the right hemisphere.

The current study used a new type of mood induction procedure. This procedure, developed by Schiff and Lamon (1989), uses facial manipulations to selectively stimulate each hemisphere and, thereby, to induce different mood-states. To explain how a facial manipulation may be able to change mood, we first must note certain features of the anatomy of the facial sensory and motor pathways. After that, we can examine the Schiff and Lamon (1989) study in detail.

The facial sensory and motor pathways in the lower two-thirds of the right side of the face primarily enervate the left hemisphere of the brain. Similarly, the lower two-thirds of the left side of the face primarily enervate the right hemisphere. The effects of contracting the facial muscles on the lower two-thirds of one side of the face thus would be expected to be on the contralateral hemisphere. Still, it is not clear where exactly the stimulation is taking place (beyond the motor strip and somatosensory strip), or what other cortical areas are being affected. Even so, following the Valence Hypothesis, one-sided facial contractions would be expected to produce either a positive or a negative mood, depending on the side of contraction.

The first such experiment was performed by Schiff and Lamon (1989, exp. 2). In this experiment, 30 college undergraduates were instructed to "pull back and lift each corner of their mouth" (p. 925), manipulating one side of their face at a time. Side of manipulation was alternated, with each manipulation lasting 45 seconds. The subjects were then instructed to "attend to their feelings rather than to thoughts or facial sensory experiences" (p. 929). Between contractions, there was a 30-second relaxation period during which the subjects reported any feelings that they experienced. Each session was audio taped and transcribed. The transcriptions were randomized and two judges read the transcripts and then classified each mood report as positive or negative. Of a total of 120 mood reports from 30 subjects, two judges were in agreement about 106 reports. Fifty-six of these agreements were that the report followed either a left- or right-facial contraction. The other 50 reports on which the judges agreed were that the reports could not be classifiable (e.g., “I felt nothing” or “I felt the same as before”). Since these reports were not classifiable, Schiff and Lamon did not include these data in their analyses. The remaining 14 responses on which the two judges disagreed were ones for which one judge believed the response was unclassifiable (B.B. Schiff, personal communication, September 12, 1996)[2]. Ultimately, only unambiguous responses were included in the analysis. Results showed that the left facial contraction produced more positive remarks and the right facial contraction produced more negative remarks, consistent with the Valence Hypothesis.

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[2]This information was available in Schiff and Lamon’s (1989) original publication. The way in which they handled the data was clarified, however, through a personal communication with Dr. Schiff.

These data were based on unstructured self-report, which can be problematic for statistical validity and reliability. Schiff and Lamon (1989) therefore had another group of 36 college undergraduates perform the same facial contractions and then tell stories about selected pictures from the Thematic Apperception Test (TAT). Three cards were used. Card #11, depicting a mountain side with a prehistoric-looking creature sticking its head and long neck out of the side of a cave and preparing to attack an animal resembling a buffalo, was chosen as the target card because it is known to offer clues about a subject's mood (Bellak, 1986 cited in Schiff & Lamon, 1989). The other two cards, #13B, depicting a young boy, barefoot and dressed in overalls, with an ambiguous look on his face (e.g., perplexed, concentrating, thinking), sitting in the doorway of a wooden building (perhaps a log cabin), and #14, depicting the silhouette of a man in a dark enclosure looking out an open, and back-lighted window, "were chosen as practice pictures because they were described as not being sensitive to emotional states" (Schiff & Lamon, 1989, p. 931). Again, the subjects' responses were taped and transcribed. The responses were classified into "propositions" defined as "an idea unit loosely consisting of a topic and a comment about that topic" (p. 932). Two raters evaluated a total of 924 propositions as either positive, negative, or neutral for emotional tone. The raters agreed on over 90% of the propositions.

There were no differences in the tone of the subjects' stories on the practice cards. On the target card, however, responses differed according to the side of facial manipulation. The left face contraction produced more negative propositions than the right face contraction and also produced stories that were distinctly negative in tone. The right face contraction produced more positive and neutral propositions than the left face contraction; however, the stories were not readily characterized as to emotional tone (Schiff & Lamon, 1989, p. 933).

Based on these results, Schiff and Lamon (1994) suggested that "Unilateral contraction of any muscles with comparable sensory motor organization [comparable to the face] should be effective in inducing emotion" (p. 247). To test this idea, Schiff and Lamon (1994) used hand contractions instead of facial contractions. Because the hand-brain connections are fundamentally the same as the lower-face-brain connections (i.e., contralateral connections are stronger than unilateral connections), they reasoned that right-and left-hand contractions should have effects in the same direction as right- and left-face contractions.

In this study, 57 undergraduates were asked to squeeze a rubber ball as hard as they could for 45 seconds and then to relax for 10 to 15 seconds for a total of four trials. Again, the three TAT cards were used, along with the same instructions for responding, and responses were classified into positive, negative, and neutral propositions. There also was a control group that gave stories to the TAT cards without performing the hand contractions.

The results corroborated the facial contraction studies with one exception. As in the facial contraction studies, subjects told significantly more negative propositions about the target picture after left-hand contractions than after right-hand contractions, and told more positive propositions after right-hand contractions. The exception, for the experimental groups, was in response to picture #13B. Because #13B is generally considered a non-emotionally sensitive picture, left-and right-hand differences were not expected. There were, however, more negative responses to this picture following left-hand contractions than right-hand contractions. Schiff and Lamon (1994) were unable to account for this finding but did note that the result at least was consistent with the results for the target picture. Finally, the control group produced significantly fewer negative propositions about the target picture than the left-hand contraction group. Taken together, these results are consistent with the Valence Hypothesis and serve to validate Schiff and Lamon's' mood induction technique.

Other studies support Schiff and Lamon's' (1989, 1994) findings. For example, Brockmeier and Ulrich (1993) used an assortment of standard mood induction techniques proposed by Velton (1968) and Brewer and Doughtie (1980), including the life event recollection technique. Brockmeier and Ulrich (1993) predicted that, in a semi-standardized face-to-face interview, subjects would show greater right-sided lifting of the corners of the mouth during positive mood states and greater left-sided lowering during negative mood states. A video camera and microphone recorded the subjects' responses to the mood induction. Brockmeier and Ulrich (1993) examined those video segments comprising a single frame of motion that was unrelated to speech or other gestures. Each selected instance was at least one minute apart from the others so that it was clearly distinct. The results were consistent with both predictions.

In summary, the results of these mood induction studies are consistent with the Valence Hypothesis. That is, expression and experience of positive emotions are regulated primarily by the left hemisphere, whereas expression and experience of negative emotions are regulated primarily by the right hemisphere.

Sex-Related Differences in Laterality Studies of Emotion

With this review of the literature on the Right Hemisphere Hypothesis and Valence Model of emotion, we now can re-examine the literature to see how the results compare when the sex of the subject is taken into account. This review must be somewhat limited because many of the published studies either did not report analyses for possible sex differences or included only male subjects (e.g., Schiff & Lamon, 1989, 1994; Brockmeier & Ulrich, 1993). As for the studies that did make this comparison, no clear, consistent picture about the nature of or direction of the differences emerges. For instance, in some studies laterality effects appear only in males, in others only in females, and in still others, in both males and females. Furthermore, where laterality effects do appear in both sexes, sometimes they are stronger in men, sometimes in women. A review of these findings is presented here. The review will be divided into two broad categories — first, studies of perception, then studies of expression and experience.

Studies of Perception of Emotion

Beginning with studies of the perception of emotion, the first question is, do men and women alike show the right hemisphere advantage for the perception of emotional stimuli, irrespective of valence?

Bryden, Free, Gagne, and Groff (1991), using a dichotic listening technique, had subjects listen to four words presented in happy, sad, angry, or neutral tones' of voice. These four words were paired with nine other stimulus words that differed both in emotional tone and phonetic content. For the emotional recognition task, subjects were asked to listen for a specific emotional tone and to report whether it had or had not been used in a dichotic pair presentation. The results indicated that, for subjects who showed an ear-advantage, 80% of the men exhibited a left-ear advantage compared to only 62% of the women, showing a sex difference on the emotion task.

McKeever and Dixon (1981) tested the abilities of men and women to recognize tachistoscopically-projected pictures of previously memorized faces. The results showed that women, but not men, had a left visual field (right hemisphere) advantage when the faces were paired with negative affective imagery (induced by having the subject imagine a negative scene). However, when the faces were paired with neutral imagery, neither men nor women showed significant visual field asymmetries.

Ladavas, Umilta, and Ricci-Bitti (1980) tested men's and women's ability to discriminate emotional stimuli on three distinct levels: discriminating emotional faces from neutral faces, regardless of the emotion being expressed, deciding whether the emotional expressions were the same or different, independent of the emotion being expressed, and recognizing discrete, specific emotions. Six different human faces were shown in six expressions: happiness, surprise, fear, sadness, anger, and disgust. The faces were presented either to the subject's left or right visual field, and the task was to identify the face that displayed the same emotion as the target emotion. The subjects responded by pressing a button when the target appeared while the researcher measured the subjects' reaction time only to correct responses. Women had faster reaction times with left visual field presentation, indicating right hemisphere superiority for this discrimination task. Men showed no consistent lateralization effects.

In a similar study Rizzolatti and Buchtel (1977) showed pictures of either positive or negative emotional faces to men and women. Each picture was presented either to the subjects' left or right visual field. Subjects were instructed to press a key if the emotion was positive but not to press if it was negative. Again, only the reaction time for accurately recognizing the positive emotion was recorded. This time, only the men showed a significant laterality effect. They responded the fastest for faces displaying positive emotions presented in the left visual field (right hemisphere). Females showed no significant visual-field differences for either emotion. The authors do not report the responses or response times for the negative emotions presented to the right visual field (left hemisphere). They do state, however, that although there were very few errors, between 10-15%, most males made fewer errors than females, and the male performance for faces presented to the right hemisphere was the most accurate of all.

In summary, Bryden et al. (1991) reported a non-significant trend towards a male left-ear (right hemisphere) advantage on an emotional perception dichotic listening task. In Rizzolatti and Buchtel's study (1977), only men showed a right hemisphere advantage for the perception of emotional faces, whereas in McKeever and Dixon's (1981) and Ladavas et al's. (1980) studies, only women did.

Studies of Expression and Experience of Emotion

We turn now to the laterality studies that compare the sexes in the expression and experience of emotion. In studies using electroencephalography (EEG), Davidson and Schwartz (1976) and Davidson, Schwartz, Pugash, and Broomfield (1976) measured EEG activity while subjects generated both positively and negatively charged visual images. For both positive and negative images, EEG activity was greater in the right hemisphere than the left hemisphere for both males and females. Yet, female subjects' right hemisphere activity was greater than male subjects' right hemisphere activity. These results thus support the Right Hemisphere Hypothesis for both sexes but suggest that the degree of the lateralized control may actually be stronger in women than in men.

Previously, the study by Moscovitch and Olds (1982) was discussed with regard to their general findings. In addition to those general findings, they also looked at sex differences, comparing side of facial activation in men and women while they were engaged in spontaneous conversations. Again, any change from a neutral facial expression was considered a valid data point, and both positive and negative expressions were recorded (e.g., smiles, snickers, sneers, and frowns). As previously mentioned, the results showed that, overall, both men and women had greater left-than right-side expressivity. However, women had a significantly greater left-side expressivity than did men. These findings indicate that for both sexes, facial expression was mediated by the right hemisphere but perhaps more selectively for the women, thus showing support for the right-hemisphere hypothesis. Similar sex-related findings were reported by Borod, Koff, and White (1983). In their study, both men and women showed greater expressivity on the left side of the face, with the left side expression being more exaggerated for females than for males. This was true, however, only for negative expressions. For positive emotions, males showed significantly greater expressivity on the left side, and females showed a non-significant asymmetry on the right side. Other studies have reported similar sex differences for the intensity and quality of asymmetries in facial expressions. These studies thus suggest that both sexes show greater left-side expressivity but that the differences are larger in women than in men (Campbell, 1978; Strauss & Kaplan, 1980).

Finally, in their study of mood changes associated with ictus, Sackeim et al. (1982) found that pathological crying and dysphoric mood responses occurred more commonly in women than in men in association with right hemisphere site. When these changes occurred in men, however, the response was more intense.

In summary, based on the mood induction and facial expressivity studies, the research for the Valence Hypothesis seems to be as compelling as the dichotic listening and facial expressivity studies, which supported the Right Hemisphere Hypothesis. Furthermore, the overall results from expression and experience studies that included sex differences reveal many inconsistencies. Again, Davidson and Schwartz (1976) and Davidson, Schwartz, Pugash, and Broomfield (1976) found support for the Right Hemisphere Hypothesis and for the notion that, where experience is concerned, the degree of the lateralized control may be stronger in women than in men. Moscovitch and Olds (1982) and Borod, Koff, and White (1983) showed that for the expression of positive emotions, men showed significantly greater left-side facial expressivity (right hemisphere) and women showed a non-significant asymmetry on the right side. Yet, in other studies of expression (Campbell, 1978; Strauss & Kaplan, 1980), the results suggest that both sexes show greater left-side expressivity but that the differences are larger in women than in men.

The data presented so far demonstrate that our current level of knowledge is at least incomplete in the area of hemispheric lateralization for emotion, especially where possible sex-related differences are concerned. The data from both hemispheric studies of emotion and sex-related differences in emotion are difficult to understand because the results are inconsistent. An attempt is made here to explore a few of the possible explanations for the inconsistencies. Following these explanations, a rationale is presented for the current study. The rationale includes important clinical implications that could result from such a study.

Rationale

Why Such Inconsistent Findings?

The conflicting results in the literature may be partly attributable to the use of different experimental techniques and measurement methods by different researchers. The abundance of methods used is partly the result of the difficulty researchers have faced in defining the feelings that presumably underlie different emotions. For instance, feeling cocky, or smug, is often described differently by different people, so that where one experimenter may consider an emotional response to be valid, another experimenter may disagree. The conflicting results thus may stem, at least in part, from the use of different labeling criteria in each experiment.

Without a consensus on the value of one experimental design over another, researchers are encouraged to use different methods; different methods, however, may produce results that differ slightly but noticeably from one another. For example, recall the previously mentioned list of studies that used a variety of techniques to induce mood-states: playing music (Thaut & de l'Etoile, 1993; Bouhuys, Bloem, & Groothuis, 1995; Lewis, Dember, Scheffi, & Radenhausen, 1995), self-generated imagery (Harman & Ray, 1977), the tachistoscope and Z-lens presentations of visual stimuli (Graves, Landis, & Goodglass, 1981; Landis, Assal, & Perret, 1979; Rizzolatti, Umilta, & Berlucchi, 1971; Geffen, Bradshaw, & Wallace, 1971; Dimond, Farrington, & Johnson, 1976), and the presentation of words and other verbal stimuli (Banich, Stolar, Heller, & Goldman, 1992). Although many of these techniques produced research findings that were significant, and some produced findings that supported other research, such methodological inconsistencies still make it difficult to draw reliable comparisons between studies. That is, it is difficult to know how the methodological differences presented above affect the studies that do not generate significant results or results that are consistent with previous studies.

Since no consensus has been reached in support of either the Valence Hypothesis or the Right Hemisphere Hypothesis, or for the strength or direction of laterality differences between sexes, it is presumed that by replicating past studies one may either validate or invalidate past findings. Schiff and Lamon's (1989) facial manipulation study is an example of a technique that was well documented in the original report and that produced significant results but that has never been successfully replicated by researchers other than Schiff and Lamon (1994). The current study is the first attempt at a replication. As in Schiff and Lamon's study (1989), the subjects were college undergraduates, enrolled, like Schiff and Lamon's subjects, in an Introductory Psychology Course. Aside from the difference in citizenship (American in the current study, Canadian in Schiff and Lamon's study), the only sample difference was inclusion, in the current study, of an adequate number of men and women to permit analysis of possible sex-related differences.

Probably the most important difference between Schiff and Lamon's and the current study was in the dependent measure. Instead of the TAT used by Schiff and Lamon (1989), the current study used the Depression Adjective Check List. The DACL is considered a well-validated and reliable way to measure emotional responses. This is demonstrated by the number of studies that use the DACL as a comparison test or a "gold standard" for validating new instruments (Lubin, 1993a, 1994a; Lubin, Fielder, & Van Whitlock, 1996; Lubin, Van Whitlock, Dale, & Kelly, 1996; Lubin & Van Whitlock, 1995). The DACL's well-established history and strong statistical support as a valid and reliable measure should give confidence in validity and reliability of the results.

This study is also important because it tackles a fundamental question pertaining to sex differences. That is, almost no one would argue that differences between men and women do not exist. Many, however, would argue that differences are primarily a product of the environment, as represented by the three different theories reviewed earlier, while others would argue that the physiological/biological influences are more important. Unfortunately, current methods of studying hemispheric lateralization of emotion, such as showing movies through a Z-lens or listening to music, do not exclude the unwanted influence of the environment. After all, society is not immune to promotions pushing the notion that "men like action movies and women like love-dramas." This type of influence could have an unwanted effect on the subject watching a movie that is intended to induce an emotional response. The facial manipulation technique, however, would not seem to be contaminated in this way. That is, it would be hard to make the case that society has influenced peoples' willingness or desire to manipulate one side of one's face. Moreover, no equipment such as Z-lenses or tachistoscope are needed, making facial manipulations a readily available technique for the future.

Clinical Implications

In addition to the important scientific questions about possible sex-related differences in cerebral lateralization for emotion, there are equally important clinical implications to this research. For example, if the results provide a clearer understanding of the human "emotional system," they could improve the clinician's ability to serve clients. This is particularly important in the therapeutic climate that exists today; therapists are being pressured to develop techniques that are more time-efficient. Research using facial manipulations that stimulate emotional responses could offer one more way for therapists to understand their clients' emotions and to implement time efficient techniques. For instance, if males were found to be more clearly right hemisphere dominant than females for the expression and experience of negative emotions, and therapists become aware that imagery is a process that maybe largely controlled by the right hemisphere (currently the evidence explaining hemispheric control of mental imagery is mixed; Farah, 1984; Farah, Gonzzaniga, Holtzman, & Kosslyn, 1985; Kosslyn, 1987; Sergent, 1990), a therapist who currently does not use imagery may be encouraged to, specifically for men. Such techniques might help facilitate access to negative emotions.

It is at least possible that one reason why more women than men seek therapy is that therapists have often used a procedure (i.e., talk therapy) better suited to the female than male processing style. Although this supposition may not have documented support, there is precedence for similar findings in the literature. That is, recent research suggests that other groups who have not been large users of therapeutic services (i.e., African-Americans, Asians, Hispanics) have felt that the therapy process conflicted with their styles, beliefs, or backgrounds (Sue, 1987, 1994; Takeuchi, Sue, Yeh, 1995). As more information is gathered showing how these groups can be served more effectively, it is predicted that they will seek therapeutic services more readily.

From another perspective, it has been argued that, although psychopharmacology has made advances in developing antianxiety, antidepressant, and antipsychotic medications since the 1950s, and the availability of these medications to individuals suffering from distress has greatly increased in recent years, the sites of action for these medications are only recently becoming understood. For instance, Haldol, a commonly used antipsychotic agent, is known to antagonize dopamine receptors. It is also known, however, that dopamine receptors are found in many areas of the brain including the limbic system, frontal cortical areas, the hypothalamic-pituitary axis, as well as certain centers of the brainstem (Julien, 1988). Although there are theories that specific receptor areas have primary control over certain behaviors, if males and females differ in cerebral organization for emotions, medications that affect all of those areas could actually act at sites different for men and women. So, when a non-medical therapist consults a psychiatrist about using medication with a client, the client's sex could be an important factor to consider. Furthermore, if the American Psychological Association's currently unresolved decision about prescription privileges for therapists were to be resolved by granting such privileges, the possibility of individual differences in cerebral organization of emotion could become an important and helpful knowledge base for therapists.

CHAPTER 2
CURRENT EXPERIMENT

The current study used Schiff and Lamon's (1989) mood induction technique in an attempt to elucidate potential interactions between sex and hemispheric lateralization for emotion.

Primary Predictions

Since both the Right Hemisphere Hypothesis and the Valence Hypothesis are supported by a substantial amount of research, and since there are discrepant results where sex and hemispheric lateralization for emotion are concerned, making predictions with conviction is difficult. Nevertheless, three primary predictions are made along with three secondary predictions. The rationales for these predictions stem from research in different but related areas.

Right Hemisphere Hypothesis vs. Valence Hypothesis. First, in choosing between the Right Hemisphere and the Valence Hypotheses, it was predicted that the Valence Hypothesis would be supported. The main reason was that the current study was designed to be a partial replication of Schiff and Lamon's study, the results of which did support the Valence Hypothesis. In the current study, therefore, it was predicted that subjects will make more negative responses (e.g., report feeling low, somber) following manipulations of the left side of their face (right hemisphere) and more positive-like (e.g., report feeling smug-like, cocky) responses following manipulations of the right side (left hemisphere) of their face.

Sex-Related Differences. Given the modest but statistically significant evidence for sex-related differences for lateralization of cognitive tasks, a second prediction was that men would be more clearly lateralized than women on the mood induction task. Thus, following left-face manipulations (right hemisphere), it was predicted that men would produce greater change toward more negative profiles resulting in higher scores on the DACL's (i.e., higher depression scores) than women, and following right-face manipulations (left hemisphere) men would produce greater change toward more positive profiles resulting in lower depression scores than women. Also, when the last manipulation was a left-face contraction, it was predicted that the POMS-BI, the additional measure used to rate emotional responses, would show men producing more intense negative responses resulting in higher scores on negative items than women. When the last manipulation was a right-face contraction, this measure would show men producing more intense positive responses resulting in higher scores on positive items than women.

Sex-Related Response Patterns. Third, as stated above, the majority of research studies comparing questionnaire response patterns between men and women suggest that women report more emotion than men. Based on the results from these studies it was predicted that women would report more overall emotion than men. In other words, regardless of having performed either a left- or right-face manipulation, it was predicted that women would select more DACL adjectives, both positive and negative, than men.

Secondary Predictions

Timing of Manipulation (part 1). Following Schiff and Lamon's supposition (1989; see also Schiff & Lamon, 1993) that a subject notices a difference between the effects of two manipulations more than the effects of manipulating one side alone, it was predicted that the effect of the manipulations would be more apparent after a subject manipulated both sides of the face than after only the first manipulation. On the DACL, this means that scores following the second facial manipulation would be more exaggerated, suggesting increasing affective experience, than scores following the first manipulation.

Timing of Manipulation (part 2). Likewise, the effects of the third and fourth manipulations would produce an increase in affective experience beyond that of the first and second manipulation resulting in higher scores following the last two manipulations compared to the first two manipulations.

Timing of Manipulation and Sex of Subject. Finally, on the hypothesis that men are more clearly lateralized than women, it was predicted that DACL scores following the last two manipulations ought to be more exaggerated for men than for women.

CHAPTER 3
METHOD

Subjects

Subjects were 40 right-handed male and 40 right-handed female undergraduate students from the Psychology Department Human Subjects Pool at Michigan State University. Their age ranged between 18 and 27 years old. This population was selected because of its availability and because of the desire to select a healthy population. Subjects received credit in their undergraduate psychology course for their participation. Anyone with a history of depression, other psychiatric disorders, and/or facial paralysis was excluded for the following reasons: 1) it would be unethical to induce potentially dysphoric emotions in someone with a history of depression or other psychiatric disorders, and 2) an individual with facial paralysis may be unable to perform the facial manipulation as required by the experimental protocol. To eliminate these individuals from the study, criteria for exclusion were clearly stated on the subject sign-up sheets, on the informed consent form, and on the medical history questionnaire.

Design

This study used a 2 x 2 x 2 within-subjects design with side of the facial contraction (left vs. right) and sex of subject (male vs. female) and condition (RLRL vs. LRLR) as the independent variables. The side that was contracted first was counterbalanced across subjects. Half of the subjects, therefore, began with a right-sided contraction (RLRL) and the other half began with a left-sided contraction (LRLR). The dependent variables were the subject's emotional responses after facial contractions as measured by Lubin's (1994b) Depression Adjective Check List (DACL) and by Lorr and McNair's (1988) Profile of Mood States-Bipolar (POMS-BI). Each subject performed two left-sided and two right-sided face contractions, alternating the side of the contraction each time[3].

Materials

The materials used included an informed consent form, a subject identification form, a medical history questionnaire, a participant background and demographic survey, an 8-item handedness questionnaire, the DACL, and the POMS-BI.

Informed Consent Form. The Informed Consent Form (Appendix A) includes the following information: 1) that this is a study of the effects of facial muscle contractions on mood in a normal, healthy population, 2) that the subject will be asked to complete a medical history questionnaire, a background and demographic survey, an 8-item handedness questionnaire, and two adjective checklists, 3) that the subject will be asked to pull back and lift one corner of his or her mouth and to hold that position for 45 seconds, 4) that the subject will perform four such contractions, alternating sides for each contraction, and 5) that the subject will be asked to complete a checklist, as quickly as possible, following each contraction.

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[3]Schiff and Lamon (1993) found that having subjects alternate side of facial contraction after each trial (as opposed to performing several sequential same-side contractions) produced more robust and reliable mood states.

Subject Identification Form. On the Subject Identification Form (Appendix B), the subject's name and identification number was recorded for the purpose of maintaining confidentiality. This was the only form that identifies and links subject name to identification number. Only the investigator and his designates had access to this information. All other documents had only the subject's identification number on them.

Medical History Questionnaire. The Medical History Questionnaire (Appendix C) asked whether the subject currently or at any time in the past had been clinically diagnosed with any of the following disorders: 1) Major Depression, 2) Bipolar, 3) Generalized Anxiety, 4) Panic, 5) Post Traumatic Stress, 6) Substance Abuse, 7) Schizophrenia, 8) Hypertension, 9) any other emotionally related disorders, or 10) a history of facial paralysis. This measure was created to screen out individuals who would be inappropriate for psychological or physical reasons.

Personal Information and Background Questionnaire. The Personal Information and Background Questionnaire (Appendix D) asked for the subject's age, sex, years of education, academic major, and ethnicity/race. The reported age and sex of each subject was used to score responses on both the POMS-BI and the DACLs; both measures use age and sex of subject as scoring variables. Years of education, academic major, and ethnicity/race were obtained in order to provide the experimenter with a more complete understanding of each subject's background. These variables were not assumed to be important to the hypotheses and are considered only if they appear to relate to differences between the groups.

Laterality Questionnaire. Only right-handed subjects were used in this sample. Limiting the sample to right-handers is methodologically important since research has suggested that left-handers have different cerebral organization from right handers (Bulman-Fleming & Bryden, 1994; Levy & Reid, 1978; Luh, Redl, & Levy, 1994). In order to verify subject handedness, a Laterality Questionnaire (Appendix E) was used. The questionnaire asked the subject to choose which of the following descriptions best describes the subject's general handedness: 1) strongly left-handed, 2) moderately left-handed, 3) ambidextrous (either-handed), 4) moderately right-handed, or 5) strongly right-handed. It then asked the subject to indicate his/her hand preference for eight common tasks: 1) write a letter, 2) hammer a nail, 3) throw a ball at a target, 4) unscrew lid of a jar, 5) use a knife to cut bread, 6) use a tooth brush, 7) hold a match while striking it, and 8) hold a tennis racket. Strength of hand preference was rated on a five-point Likert Scale, from 1 (always left) to 5 (always right). Subjects also had to indicate whether they write with an inverted or non-inverted hand posture by circling one of two pictures depicting the two writing postures[4]. Lastly, subjects were asked whether anyone (including themselves) has ever tried to change what hand they use for certain tasks. This question was included to check for the possibility that a person who was once left-handed may have changed hand-use for certain tasks, either because of instruction from a teacher, parent, or grandparent, or because of certain life experiences, such as difficulties in using tools designed for right-hand use. Many left-handers report such experiences and, therefore,

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[4]The reason for using this measure is that research findings have shown that there may be a difference in the cerebral organization between left-handers who write with an inverted posture and left-handers who do not (Levy, 1982; Levy & Reid, 1976; Levy & Reid, 1978).

come to use their right hands for certain tasks (Harris, 1990).

Depression Adjective Check List. The Depression Adjective Check List (DACL) (Appendix F) is a multiple-item paper- and pencil-checklist measuring either state or trait transient moods, feelings, and emotions (in this case only *state* moods, feelings, and emotions were considered) (Lubin, 1993a). Seven parallel forms exist, making the DACL useful in studies where these factors are measured repeatedly. In the current study, subjects' emotional experience was measured five times using five of the seven highly correlated (Table 2) state-DACL forms (i.e., Forms A, B, C, D, G). Each form includes adjectives that represent state negative mood sub-scale (S-Neg) and state positive mood sub-scale (S-Pos). As described in the manual, the S-Neg sub-scale depicts the degree of state negative mood and is calculated by adding the negative valence adjectives endorsed. The S-Pos sub-scale depicts the degree of state positive or elated mood and is calculated by adding the positive valence adjectives endorsed. Using these sub-scales, a Total score is calculated. The Total scores is the total number of adjectives, both positive and negative valence, endorsed by a subject. Although elevated S-Pos scores suggest higher levels of state positive mood, S-Pos is used differently to calculate the Total raw score. That is, "Because one component of depression is conceptualized as the *absences of positive mood*, the Total raw score is calculated as the sum of the negative adjectives endorsed and the number of positive adjectives that *were not endorsed* (i.e., [10 minus S-Pos])" (Lubin, 1993b, p. 7).

Finally, Total scores were converted to standardized scores (both t-scores and percentile scores) according to normative data separating subjects' by age and sex (Lubin, 1993b). In the following analyses, unless otherwise specified, all statistics are generated from percentage scores.

Profile of Mood States-Bipolar. The POMS-BI (Appendix G) is a 72-item paper and pencil test that reportedly measures the following mood dimensions in terms of six bipolar affective states: 1) composed-anxious, 2) elated-depressed, 3) agreeable-hostile, 4) energetic-tired, 5) clear-headed-confused, and 6) confident-unsure. Table 3 shows the reported correlations between mood states reportedly measured by the POMS-BI (Lorr & McNair, 1988). Each subject rates the degree to which he/she subscribes to 72 adjectives on a four-point Likert Scale ranging from zero ("much unlike this") to three ("much like this"). The form is designed to rate the subject's feelings during the past few minutes. Adjectives include untroubled, relaxed, tense, uneasy, kindly, sympathetic, grouchy, annoyed, and vigorous.

The formula that is recommended for scoring the POMS-BI is as follows: the total score (S_T) is the sum of the positive item scores (S_P) minus the sum of the negative item scores (S_N) plus 18 ($S_T = S_P - S_N + 18$)[5]. The constant 18 is used to make all scores positive, making each scale's range from 0 to 36. Using this scoring procedure, a low total score represents a less negative profile and a high total score represents a more negative profile.

This POMS-BI scoring system can be used to gauge the intensity of the subjects' emotional responses. For this reason, the POMS-BI was administered as a pretest,

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[5]Initially, the procedure reported here was the intended scoring procedure for this study. Since the six-factor model put forth by Lorr and McNair (1988) was not found in this study, however, the scoring procedure was necessarily changed. The new procedure included summing the Likert-scale responses for selected adjectives on the positive and negative factors and then comparing the means of those responses.

measuring the subjects' emotional state at baseline (i.e., prior to performing an experimental manipulation) and as a post-test (i.e., following the last experimental manipulation). The post-test measure was used to assess the intensity of the last facial manipulation; comparing left- and right-face contractions. In contrast, the DACLs were administered between each experimental manipulation, as well as before the first manipulation and after the last manipulation. The DACLs, therefore, measure not only the emotional state at baseline but also the effects of individual facial contractions.

To estimate the degree of POMS-BI test-retest reliability, Lorr and McNair (1988) had a sample of 66 subjects complete the form a second time (see Table 4). As Table 4 shows, no significant differences in mean scores were found.

Procedure

Prior to the start of the experiment, 40 subject packets were numbered 001 through 040. These served as subject numbers and were used for female subjects only. All even-numbered packets were given to subjects in the LRLR condition, all odd-numbered packets to subjects in the RLRL condition. Additionally 40 packets, numbered 041 through 080, were used for male subjects. As before, all even-numbered packets were given to subjects in the LRLR condition, all odd-numbered packets to subjects in the RLRL condition. Using this system, the first female subject to tested was assigned subject number 001 and received the RLRL condition, the second female subjected was assigned number 002 and received the LRLR condition, and so on.

When the subjects entered the testing room, they were seated at a small table across from the experimenter and were given an Informed Consent Form to read and sign. This form was also read aloud by the experimenter. Following this, the subject who agreed with the conditions and signed the consent form completed a Medical History Questionnaire. Anyone who answered "yes" to any of the disorders listed on the questionnaire, was told that, for the purposes of this study, no one could be included who has suffered from any of the listed disorders (as previously mentioned, these criteria for exclusion were stated on the sign-up sheet). To understand the characteristics of persons who were excluded, information from the remaining pre-test measures was collected. If the disorders reported included histories of emotional distress (for example, depression, bipolar, generalized anxiety, or substance abuse), the subject was told that counseling services are available at the University Counseling Center. After completing the pre-test measures, these persons were excused and reminded that they still received full credit for their participation. Following this, all subjects completed the remaining three pre-test measures: 1) the Laterality Questionnaire, 2) the POMS-BI, and 3) the DACL.

Next, the experimenter, while facing the subject, explained how the subject was to perform the facial manipulations. The following instructions were read:

> I want you to pay close attention to the following instructions. Don't do anything yet; just listen. I want you to pull back and raise the left/right side of your mouth as much as you can, just like this [experimenter demonstrates by making the mirror-image movement]. Now you try it. [After the subject successfully demonstrates the movement]. That's fine. When the experiment starts, I want you to hold it in that position for 45 seconds until I say relax.

If necessary, further instructions were given until the subject understood how to perform the facial manipulation. Subjects were asked whether they understood the procedure. Once they understood what they were to do, the following instructions were read:

> Now when I say "start," I want you to pull back and raise the left/right side of your mouth in the same way you just did and to hold that position until I say "relax." Remember to pull back and raise your mouth as much as you can. While you're pulling back and raising your mouth, I want you to breathe normally and to look directly at me. I also want you to pay close attention to your mood, to how you are feeling.

The side of initial contraction depended on the predetermined order to ensure equal cells. After maintaining the contracted position for 45 seconds, the subjects were told to relax and to complete one version of the DACL. Following that, subjects were told to perform the same contraction on the opposite side of the face after which they were asked to complete another version of the DACL. This procedure continued until each subject had performed a total of four contractions and had completed a total of four versions of the DACL. After completing the fourth facial contraction and the fifth DACL, the subject completed another POMS-BI checklist. Subjects were then told that their participation in the study was complete. A debriefing period followed.

For the debriefing period the subjects were asked what they believed to be the nature of the study. The experimenter then explained its actual purpose. The subjects were asked whether they were feeling any emotional residue (either positive or negative) from their participation. When subjects reported feeling distressed or if the researcher detected stress (for example, if the subject was tearful or upset), the researcher (an advanced clinical psychology graduate student) continued to talk with the subject until both agreed that the subject's emotional state had stabilized. Through pilot testing, it had been demonstrated that the entire procedure took between 40 and 50 minutes to complete.

Statistics

All statistical procedures were performed using Statistical Package for Social Science (SPSS) and only findings resulting in $p > .05$ were considered significant. Frequencies and descriptive statistics were calculated for the age, year in school, and ethnicity/race for all the subjects. Since no assumptions were made regarding the subjects' age, year in school, or ethnicity/race, statistical analyses were not performed on these data. The data simply provide information about the subjects who participated.

CHAPTER 4
RESULTS

Two women and two men were excused from participating in the experiment due to positive responses on the Medical History Questionnaire. One woman reported having suffered a concussion following a sporting accident and said that she still felt the effects, and the second women has a history of Obsessive-Compulsive Disorder. The two men reported histories of Obsessive-Compulsive Disorder and Depression, respectively. In all four instances, subjects received full credit and were excused from further participation. These data suggest that the Medical History questionnaire effectively screened out subjects who were inappropriate for this study. The four excused subjects were replaced, permitting the originally intended sample size to be reached.

POMS-BI Factor Analyses

Factor analysis of the Profile of Mood States-Bi-Polar was performed using all time-one responses from all the subjects along with left handed male subjects from the related study, for a total N = 120. Since Lorr and McNair (1988), the developers of the POMS-BI, claim that the measure contains six bi-polar scales, a Principal Components Factor Analysis with orthogonal rotation was performed to test this claim[6]. The data did not support a six bi-polar scale factor structure. For example, results showed that 27% of

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[6]After the Principal Component Factor Analysis, all statistics were calculated on only right-handed male and female subjects.

the variance was accounted for by the first variable, which had an eigenvalue of 19.43, whereas the second variable accounted for only 8.8 % of the variance, with an eigenvalue of 6.31. As shown in Table 5, the remaining variables with eigenvalues greater than 1.0 accounted for only a small percentage of the variance. With so many factors, and with substantial item overlap, the six-factor solution would be difficult to interpret with any confidence.

Since the six-factor structure proposed by Lorr and McNair (1988) was not supported, Principal Component Analyses were performed forcing all 72 items into a five-, four-, three-, two-, and one-factor model. With each model, all items with eigenvalues over 1.0 were found to have identical loadings, to account for the same amount of variance as the original six-factor model (see Table 5), and to have substantial item overlap. These factor solutions, therefore, were also un-interpretable.

To generate a reliable bi-polar scale, items with eigenvalues over 1.0 were selected from the two-factor model. Labels for variables were attached to item numbers so that an adjective list could be generated based on content. Items that did not cluster into two factors based on content (e.g., one positive and one negative) were deleted from the potential list of variables. A Principal Component Factor Analysis forcing a two-factor structure, as well as a reliability analysis, were computed based on the remaining variables. The resulting two factors include a "positive" scale with 12 items and a "negative" scale with 15 items. Table 6 shows the adjectives selected and the inter-item correlations. Table 7 shows factor variables, factor loadings, the reliability coefficient for both factors, and the alpha variance if any of the items were to be deleted. The "alpha variance if item deleted" scores support the inclusion of each item in the factor. The content of the two factors suggest a bi-polar scale and the inter-item correlations support the distinction between the factors.

Demographic Information

These data pertain to demographic information about subjects in this study and do not pertain to the hypotheses or predictions.

Significant differences exist between male and female subjects' age, $\mu_{ageMale}$ = 20.02, SD = 1.95; $\mu_{ageFemale}$ = 19.02, SD = 1.64; $t(78) = -2.48$, $p = .015$, and year in school, $\mu_{year\ in\ school\ Male}$ = 2.08, SD = 1.05; $\mu_{year\ in\ school\ Female}$ = 1.53, SD = .72; $t(78) = -2.74$, $p = .008$. Significant differences did not exist, however, between male and female subjects' ethnicity/race, $t(78) = .737$, $p = .833$. Figure 1 shows frequency data for 40 male and 40 female subjects' age, year in school, and ethnicity/race.

Results of 8-Item Handedness Questionnaire

The results of 80 subjects' responses to the 8-item handedness questionnaire showed that all subjects were strongly right-handed (see Figure 2). Subjects self-reported their hand preference for completing eight specified tasks. A total of 640 responses were collected. Of those responses, 569 fell into the "right hand only and usually right hand" category, 65 in the "both hands" category, and 6 in the "usually left and left only" categories.

Results of Primary Predictions

Valence Hypothesis. Following the Valence Hypothesis, the first primary prediction supposed that left-face manipulations would produce a more negative affective experience and right-face manipulations would produce a more positive affective experience as measured by DACL scores, where the higher the DACL score, the higher the negative affect. Two steps were required for testing the Valence Hypothesis. The first step was to show that there is a significant interaction between the between-subject variable Condition (RLRL, LRLR) X the within-subject variable Time (DACL B, C, D, G). If the interaction was significant, one could say only that some effect took place between the Condition and Time variables. This information, however, would not explain whether these findings jibe with the Valence Hypothesis. So, given a significant interaction, the second step was to compare the average of all DACL scores following left-face manipulations with the average of all DACL scores following right-face manipulations. If the average following left-face manipulations proved to be significantly higher than the average following right-face manipulations, then the Valence Hypothesis would be supported.

To perform the first step in the analysis, the test for the interaction, a repeated measures ANCOVA was computed for all 80 subjects, with the pre-measure DACL-A as a covariate $t(1, 77) = 4.24$, $p \leq 0.00$.

The results from the ANCOVA analysis indicated that the Condition X Time interaction was significant $F(3, 234) = 2.96$, $p = .03$, and that Time had a large effect (see Table 8 and Figure 3). Therefore, the next step was to compare the average of all DACL scores following left-face manipulations ($\mu_{left\text{-}face} = 105.23$, SD = 13.78; see Figure 4) with the average of all DACL scores following right-face manipulations ($\mu_{right\text{-}face} = 105.15$, SD = 13.17; see Figure 4). For this comparison, a t-test for paired samples was used. The results showed that the difference was not significant $t(79) = 0.06$, $p = 0.95$; therefore, the

Valence Hypothesis was not supported.

Sex-Related Differences. The second prediction supposed that men would be more clearly lateralized than women on the mood induction task. Thus, following left-face manipulations it was predicted that men would produce greater change toward more negative profiles resulting in higher depression scores on the DACLs than women, and following right-face manipulations men would produce change toward more positive profiles resulting in lower depression scores than women.

To examine whether sex of subject had an effect on DACL scores (DACLs B, C, D, G), the same repeated measures ANCOVA presented above was used, this time including Sex (male, female) as an additional between-subject variable. To repeat, a 2 X 2 X 4 (RLRL, LRLR and Male, Female and DACL B, C, D, G) repeated measures ANCOVA was computed for 40 male and 40 female subjects, with the pre-measure DACL-A as a covariate $t(1, 77) = 4.24$, $p \leq 0.00$.

As shown in Figure 5, the Condition (RLRL, LRLR) X Sex (male, female) interaction was not significant $F(3, 228) = 0.89$, $p = 0.45$. Table 9 contains the means and standard deviations for male and female subjects in both conditions.

POMS-BI. This prediction supposed that when the last facial manipulation was a left-face contraction, men would produce more intense negative responses on the second administration of the POMS-BI, resulting in higher scores on negative items, than women[7]. Likewise, when the last manipulation was a right-face contraction men would produce more intense positive responses, resulting in higher scores on positive items, than

[7]Where the POMS-BI data is concerned, all data was analyzed using the two factor model described in the POMS-BI factor analysis portion of this report.

women. To examine these predictions, two simple factorial ANOVAs, each co-varying pre-measure POMS-BI at time 1, were computed for the between-subject variables Condition (RLRL, LRLR) X Sex (male, female) and for the within-subject variables Negative or Positive Adjectives from the POMS-BI Factor Analysis[8]. Neither the negative adjective analysis $F(1, 78) = 0.12$, $p = 0.73$ nor the positive adjective analysis $F(1, 78) = 0.09$, $p = 0.77$ produced significant results (see Table 10).

Sex-Related Response Patterns. For this hypothesis it was predicted that, *regardless of having performed either a left- or right-face manipulation*, women would select more DACL adjectives, both positive and negative, than men. To examine this prediction a 2 X 4 (male, female and DACL B, C, D, G) simple factorial ANOVA with Sex as a between-subject variable and DACLs as a within-subject variable, the mean number of adjectives endorsed by women on each DACL (DACL A, B, C, D, G) was compared to the mean number of adjectives endorsed by men on each DACL (DACL A, B, C, D, G).

As shown in Table 11, there were no significant differences between women and men at any time for any of the mean DACL scores.

Results from Secondary Predictions

Timing of Manipulation (part 1). Next, it was predicted that the effect of the manipulations would be more apparent after subjects manipulated both sides of their face than after only the first manipulation. On the DACL, this means that scores following the

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[8]One subject had missing data for the second administration of the POMS-BI. That missing data was replaced with means from subjects of the same sex and same condition allowing for an N=80.

second facial manipulation would show an increased affective experience compared to scores following the first manipulation. To test this hypothesis, the absolute amount of change from the first manipulation to the second manipulation was computed for 20 male and 20 female subjects in the RLRL condition and 20 male and 20 female subjects in the LRLR condition (see Table 12). Said another way, DACL-B scores were subtracted from DACL-A scores producing a "DACL-AB difference score"[9]. Similarly, DACL-D scores were subtracted from DACL-C scores, producing a "DACL-CD difference score". These results were computed using a repeated measures ANCOVA, and co-varying pre-measure DACL-A. Once again, Sex and Condition (male, female and RLRL, LRLR) are between-subject variables and Time (DACL B, C, D, G) is a within-subject variable. Since the direction of change is not considered here, the absolute values of all difference scores were used in the repeated measures ANCOVA.

The results were not significant $F(1, 78)$ 1.72, $p = 0.19$; the effect of the second facial manipulation was not significantly different from the effect of the first facial manipulation.

Timing of Manipulation (part 2). In an extended version of the same hypothesis, it was predicted that the effects of the third and fourth manipulations would produce an increase in affective experience beyond that of the first and second manipulation. One would expect, therefore, greater absolute change following the last two manipulations

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[9]Two necessary conditions existed in this data that limit the risks associated with the use of "differences scores". First, there were no data points in danger of creating either a ceiling or a floor effect, and second, a co-variate (DACL-A) was available to support the reliability of the results (for further explanation Collins, 1996; Wilkinson, Blank, Gruber, 1996).

compared to the first two manipulations. To test this prediction, the sum of absolute change scores for DACLs-AB and DACLs-BC was computed for 40 subjects in the RLRL condition. Next, the sum of the absolute change scores for DACLs-CD and DACLs-DG was computed for 40 subjects in the LRLR condition. Finally, a repeated measures ANCOVA, co-varying the effect of pre-measure DACL-A, was computed to examine possible differences between the first- and second-set of manipulations. Here, Time (DACL absolute change scores) were within-subject variables and Condition (RLRL, LRLR) were between-subject variables.

The results were not significant $F(1, 78)$ 0.73, $p = 0.40$; compared to the first two manipulations, the last two manipulations did not produce an increase in emotional experience.

Timing of Manipulation and Sex of Subject. Finally, on the hypothesis that men are more clearly lateralized than women, it was predicted that DACL scores following the last two manipulations ought to be more exaggerated for men than for women. In light of the results presented above, it is clear that no differences would exist between men and women for this same hypothesis.

CHAPTER 5
DISCUSSION

Three primary predictions and three secondary predictions were investigated in this study. None of the predictions were supported. Although not a primary prediction, one interaction was statistically significant. The discussion that follows explores both the significant interaction as well as the non-significant findings. Also covered are discussions about possible reasons for discrepancies between the current experiment and past experiments, discussions about possible clinical implications of this research, and ideas for future research in this area.

The interaction that was significant was Condition (RLRL, LRLR) X Time (DACL B, C, D, G) whereby a dramatic increase in *negative* affect across time was seen. As shown in Table 8 and Figure 3, subjects' responses on the DACLs steadily increased creating a significant change over time (DACL B, C, D, G). Still, it is unclear why increases were found only in negative affective experiences. Although this is purely speculative, one possibility is that subjects were uncomfortable with the facial manipulation procedure. If they felt awkward about manipulating their faces, they may have been responding to that awkwardness and not to the effect of the manipulation itself.

Discussion of Primary Predictions

Valence Hypothesis. The first prediction supposed that, where the experience of emotion is concerned, subjects' responses to facial manipulations would support the Valence Hypothesis. The results presented above, however, did not support the Valence

Hypothesis. That is, contrary to Schiff and Lamon's (1989, 1993, 1994) results, subjects did not report more negative emotional experience following left-face manipulations (i.e., right hemisphere) or more positive emotional experiences following right-face manipulations (i.e., left hemisphere). Although there may be no definitive ways to explain these differences, several possible explanations can be suggested.

One possible explanation for different results follows from the use of different criteria to include and exclude data from final analyses. The current study analyzed all data that were collected and found results that are less clear but perhaps more accurate than Schiff and Lamon's (1989). In contrast, as previously noted (see page 16), Schiff and Lamon (1989 exp. 2) included only unambiguous responses in their analyses. Among the data that they excluded were subjects' responses that could not be agreed upon by raters or responses not clearly identified by raters as having followed a right- or left-facial contraction (i.e., "I felt nothing" and "I feel the same as before"). This lead Schiff and Lamon to exclude 64 of 106 data points. Although this procedure may have been sufficient for their purposes, excluding those data may have removed the ambiguity that would have led to less clear results. If the 64 responses left out of their analyses had been included, one wonders whether their data would look more like the data in the current study.

Another possible explanation for the disparate findings could stem from differences in the dependant measures used. In the current study, five of seven Depression Adjective Checklists, all designed to measure State depression, were used to measure subjects' affective experiences. As stated above, the DACL was selected as the primary dependant measure because its parallel forms could be used for repeated measurement, because it does not require a lot of time to pass between administrations, because it has been standardized on populations similar to the population from which subjects were drawn in the current study, and because the DACL has a reputation for being statistically sound (Lubin, 1993a, 1993b, 1994a, 1994b; Lubin, Fielder & Van Whitlock, 1996; Lubin, & Van Whitlock, 1995). For all these reasons the DACL was a good choice for a dependant measure.

Nevertheless, there may have been a limitation that was not foreseen; the DACL, while it appears to be adequate for detecting negative emotional experiences, may not have been designed to have the flexibility to detect the ambiguous *positive-like* responses supposedly produced by right-face manipulations. As Schiff and Lamon (1989, pp. 926) noted, "right-face contractions produced reports of positive affect ('up' 'good') and what can be characterized best as a mixture of positive affect and aggression ('cocky', 'smug'). Given this, the contrast between the negative and *positive-like* responses may have been diluted because the DACL is intended to detect clearly positive, not *positive*-like, responses.

Furthermore, because the DACL does place each response clearly into the positive or negative realm, using the DACL as the main dependent measure may have inadvertently forced the subjects to respond as if they were pressing the poles of the mood continuum and, thereby, limiting their willingness and ability to respond honestly. In hindsight, perhaps it was unreasonable to expect normal, healthy subjects to experience mood swings so dramatic that they would report feeling very negative emotions at one minute and then very positive emotions 45 seconds later. It may be more realistic to assume that a shift in mood would take place but that it would not press the poles of the mood continuum. If this is so, the DACL may be less useful in studies using normal healthy subjects and where both ends of the mood continuum are being evaluated.

To their credit, Schiff and Lamon (1989, exp. 2 and 3) may have circumvented these issues by using a more flexible dependant measure (i.e., TAT cards) able to capture subtle and ambiguous responses produced by facial contractions. Although users of the TAT do not usually use a statistically validated scoring system, its properties may have made it useful for evaluating the subtle changes in affect (Wagner, 1995; Obrzut, 1983).

Sex-Related Differences. The second prediction pertained to the possibility of differences in cerebral organization for emotion. It was predicted that men would produce more negative profiles than women following left-face manipulations, and more positive profiles following right-face manipulations. These predictions were not supported.

There may be several ways to explain this non-significant finding. The first possibility is that there are in fact no significant differences in the cerebral organization for emotion between men and women. In other words, the null hypothesis was correctly not rejected. Although this explanation is plausible, it does not explain those experiments that, whether focusing on the expression or experience of emotion or on either the Right Hemisphere Hypothesis or the Valence Hypothesis, found significant sex-related differences in hemispheric control of emotion (Davidson, Schwartz, Pugash, & Broomfield, 1976; Moscovitch & Olds, 1982; Borod, Koff, & White, 1983; Campbell, 1978; Strauss & Kaplan, 1980). Other possible explanations for the absence of sex-related differences, therefore, must be considered.

One other possibility is that the lack of sex-related differences is due, at least in part, to male examiners testing all subjects. There is a large literature replete with examples of experimental confounds produced by an interaction of sex of examiner and sex of subject (Franco, 1985; Kupke, 1983; LeVine, 1983), so it is possible that the sex of the examiner had an influence here as well. Given this possible explanation of the null findings, coupled with the unusual finding of men reporting more overall emotion than women (even though there was no significant difference; see Table 11), one could hypothesize that women had a harder time than men reporting emotions to the male examiner. Although the potential influence of this confound was recognized before the study began, the constraints of time and resources prohibited an appropriate remedy. Namely, it would have meant doubling the sample size and the number of examiners (two female examiners) to control for the influence of sex of examiner on subjects. Although the price for not taking these precautions can be substantial, realistic constraints must also be recognized.

The current results — the absence of sex-related differences and the unusual finding that men responded to more adjectives than women, albeit not significantly more, — therefore, can be added to the growing number of studies already mentioned that have reported inconsistent results for sex-related differences for the experience and expression of emotion (e.g., Davidson & Schwartz, 1976; Davidson, Schwartz, Pugash, & Broomfield, 1976; Moscovitch & Olds, 1982; Borod, Koff, & White, 1983).

Here, attempts will be made to expand the possible explanations for inconsistent findings in studies of sex-related differences in emotion. The inconsistencies, in part, might turn on the distinction between the terms "sex" and "gender." Although these terms are often used interchangeably, there is a difference between them that is useful to keep in mind when doing this type of research. The term "sex" refers to physiological characteristics, including those hemispheric differences reported in the cognitive literature. The term "gender," however, refers to those socio-psychological characteristics used to define traits stereotypically considered either male or female. Although the technical difference is reasonably clear, the actual product of these differences is difficult to tease apart.

The primary focus of the current study was to test the possibility of *sex*-related differences in the cerebral organization of emotion. A smaller part of this study, the one that predicted support for the *response-bias* theory, focused on *gender*. In either case, it would be difficult to state that the tested emotional experiences were solely the product of either *sex* or *gender*. It may be more accurate to assume that all the hypotheses examined a combined influence of both *sex* and *gender*.

Not separating these two important variables, however, has not hindered the ability to find consistent results in studies comparing men's and women's differences in cognitive functioning. There appears to be slippage between the cognitive literature and the emotion literature where sex-related differences are concerned. As previously noted, the literature on cognitive differences consistently reports small but statistically significant sex-related differences. That is, males typically perform at a higher level than females on tasks with a strong visuo-spatial component (right hemisphere dominant tasks) and females typically perform at higher levels than males on tests of perceptual speed, memory for location of common objects, verbal fluency, and fine motor skills (left hemisphere dominated tasks). Perhaps where the emotion literature is concerned, the tasks used to examine these issues are not sensitive enough to detect differences. Or, there may not be sex-related differences for emotion even though there are differences in cognitive abilities.

As a final possibility, if one could clearly separate which responses were derived from biological mechanisms and which were derived from socio-psychological mechanisms, and examine them individually, perhaps studies comparing men's and women's affective differences would produce more consistent results. Whatever the reason for the different findings, the gap that exists between these areas of study is clearly defined and hopefully, one day, will be narrowed.

POMS-BI. The third prediction was that the interaction between the side of the face manipulated last and the sex of the subject would guide the intensity of responses on the POMS-BI. This prediction was not supported. That is, regardless of the side of the face manipulated last, the POMS-BI did not discriminate the subjects' emotion as being more intensely positive or negative, and it also failed to disclose differences between men and women.

As with any measure, the POMS-BI has both strengths and weaknesses. In choosing this measure as a dependent variable, it was decided that its strengths outweighed its weaknesses. The next section will describe these strengths and weaknesses.

On the positive side, the POMS-BI took between three and five minutes to complete, making it easy to administer, and it is easily scored with scoring keys. Also, since the responses are coded on a Likert Scale, information about the intensity of the subjects' feelings is available. These features allowed much information to be gathered in a short time.

There are also important limits to the POMS-BI that must be examined. For instance, the manual for test administration and scoring does not provide clear validity and reliability scores (aside from test-retest scores) from standardized samples. Also, although the six bi-polar scales are given in the manual, no data verifying these six bi-polar scales are presented. It was necessary, therefore, to verify the assumptions discussed above by completing a Principles Component Factor Analysis before any strong conclusions could be stated. The six-factor prediction presented by its authors was not supported, so a more reliable factor structure had to be determined in order to test hypotheses generated from use of the POMS-BI.

Unfortunately, data gathered from the POMS-BI are of questionable value because the POMS-BI was not found to have the structural stability reported by its developers, Lorr and McNair (1988). Although attempts were made to modify this test, trying to create a valid tool to measure the intensity of emotional responses in the current study has dramatic limitations. These limitations hinge on the problem of having only a small sample for testing the validity and reliability of the modified measure. In the end, any results generated from this measure must be viewed with great caution.

Sex-Related Response Patterns. This prediction supposed that women would report more overall emotion than men. In other words, even after a specific manipulation, women would produce more emotional responses, both positive and negative, than men. This prediction was not supported. Instead, just the opposite was found; the average DACL scores following the last manipulation showed that, regardless of condition, men reported more overall emotion than did women. The phenomena explained by the *response-bias* theory discussed earlier were, therefore, not supported in these findings. To repeat, that theory suggests that women view the expression of emotion as a positive symbol of connectedness between individuals, whereas men view it as a symbol of weakness. Thus, the theory supports the notion that women express emotions or feelings to others, including interviewers, more readily than men (Mirowsky & Ross, 1986), which may also suggest that men actively *inhibit* the expression of emotion. There are data supporting sex-related differences whereby men were thought to actively inhibit emotional processes (Burton & Levy, 1989). The issue regarding men actively inhibiting emotion will be considered in more detail below.

Discussion of Secondary Predictions

Timing of manipulation (part 1 and 2)[10]. In the next predictions, it was thought that the effects of the manipulations would become more apparent after the subject manipulated both sides of the face than after only the first manipulation. These predictions were not supported.

In an attempt to explain the lack of agreement between the current results and those reported by Schiff and Lamon (1989), Kop, Merckelbach, and Muris (1991), we return to the original rationale for these predictions. First, a restatement is made regarding both Schiff and Lamon's (1989, 1993) reasoning for this procedure and these predictions, as well as the criticism brought against them by Kop et al., (1991) for using this approach. After that, the current study's rationale for following Schiff and Lamons' procedure is discussed and possible reasons for incongruent findings are given.

Recall that two opposing theories have been suggested regarding these predictions. First, Schiff and Lamon (1993) proposed that the effect of the manipulations would become more apparent after the subject manipulated both sides of the face than after only

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[10]The underlying assumptions are the same for both "timing of manipulation" predictions and, therefore, they are discussed together.

the first manipulation. They drew on this assumption as support for using an alternating manipulation sequence (e.g., RLRL and LRLR) as their method of mood induction.

In contrast, Kop et al., (1991) argued that the effect of the manipulation should not change depending on whether alternating contractions or consecutive contractions (i.e., RRRLLL, LLLRRR) are used. In their reply to Kop et al. (1991), Schiff and Lamon (1993) stated: "We believe that alternation of contractions within subjects makes the induced states more salient through contrast, and thereby increases the probability that they [the feelings] are reported" (p. 550). What is not clear is why Schiff and Lamon (1989) believed that the contrast was important for producing reports of the emotional experience. This is especially unclear given their initial experience when three subjects wept following left-face manipulations (Schiff & Lamon, 1989, exp. 1). The act of weeping is a clear and strong emotional response and would not seem to require a contrast to bring it about or to make the underlying emotion salient.

As one possible explanation for these results, Schiff and Lamon (1989) pointed out that the subjects who wept were atypical in that they were ". . . acquaintances of the experimenter. They were selected because the experimenter considered that they would be sufficiently comfortable feeling unexplained emotions, they would not interfere with such experiences and would also be willing to report them" (p. 925, exp. 1). These characteristics presumably influenced the intensity of these subjects' responses. Had they not been acquainted with the examiners, however, they may have responded in a less dramatic way. Furthermore, had this not been the first time Schiff and Lamon used the manipulation, one could argue that other, less dramatic experiences would have led them to believe that the contrast produced by alternating the side of facial contractions was necessary to produce clear results. As it stands, however, the subjects' relationship to the experimenters, and the fact that this was the experimenters' first experience with the procedure, might lead one to believe that Schiff and Lamon's (1993) explanations were generated as a *post hoc* response to Kop et al. (1991).

Be that as it may, in the current study, it was believed that the emotional experience would be subtle and in some instances might resist clear labeling, especially those experiences that followed right-face manipulations. It was predicted, therefore, that these subjects would require the contrasting emotions before they could clearly realize that their emotional experience had changed. These assumptions follow, in part, from the explanations just mentioned. Nevertheless, choosing to alternate facial-contractions was apparently insufficient in bringing about a significant emotional experience. As previously stated, another reason for not finding significant differences may be related the DACL's inability to detect differences between negative and *positive-like* emotional experiences.

Timing of manipulation and sex of subject. Finally, on the hypothesis that men are more clearly lateralized than women, it was predicted that men would produce more exaggerated DACL-D and DACL-G scores than women. The results did not confirm these predictions; the last two manipulations for men did not produce more exaggerated DACL responses than those for women.

Although these results do not support the predictions set forth above, they are consistent with the other results of the experiment. That is, none of the findings presented in this study showed significant sex-related differences. This may suggest that the methods used in this study to measure mood changes were reliable but perhaps had poor validity.

Clinical Implications

This research is thought to have implications that apply not only to neuropsychology but also to clinical psychology. It was mentioned earlier that clinicians could benefit greatly from a more thorough understanding of emotional systems and functioning. This is certainly true where sex-related differences exist. To restate, clinicians tend to see more women in psychotherapy than men. It was previously suggested that men may not be readily attracted to traditional talk-therapy (a left-hemisphere dominant approach) and may be more inclined toward using a visualization-type technique (arguably a more right-hemisphere dominant approach). The findings in this study, however, would not support implementing such techniques based on the sex of a client.

The lack of significant sex-related differences presented in the current study does not mean that no differences exist between men and women. After all, there have been a number of studies already discussed that found differences between men and women for other emotion-related processes (Bryden, et al., 1991; Ladavas et al., 1980; McKeever & Dixon, 1981; Rizzolatti & Buchtel, 1977). Additionally, differences between men and women in the prevalence of, and intensity of, various clinical problems like depression (Aneshensel, 1992; Klerman, Weissman, Rounsaville, & Chevron, 1984; Mirowsky & Ross, 1986) and anxiety (Aneshensel, 1992; Mirowsky & Ross, 1986) have also been covered in some detail. Since other studies have found important differences, one cannot discount the possibility of useful therapeutic techniques that would benefit men and women differently. In future research, therefore, therapeutic techniques specifically designed for men and women may be an important avenue to explore.

In other ways, some of the issues presented in the current experiment may still be helpful when *conceptualizing* clinical issues. For example, different clinical theories have their foundations in different approaches to understanding emotional processes. As previously noted, many of the techniques used to induce and examine emotional experiences are contaminated by unwanted cognitive influences on research manipulations (e.g., societal influences on watching movies). It is still assumed that the technique used here is less influenced by cognitive interference. Given this, two differing approaches to therapy will be discussed; 1) Cognitive-Behavioral Therapies (CBT) and 2) Affective Therapies (AT). Then, the ways in which these therapeutic approaches may benefit from this type of research will be discussed.

<u>Cognitive-Behavioral Approach</u>. As explained by Bloom (1992, section 3, pp. 158), a primary premise at the foundation of cognitive-behavioral therapy is that small changes in faulty cognitive processes and negative behaviors will produce significant changes that will reverberate throughout the personality and can bring about changes in many areas of functioning. The implicit message is that, where change in therapy is concerned, cognition and behaviors are the primary mechanisms and emotions are secondary mechanisms. Research that focuses primarily on emotion and secondarily on cognition, therefore, would likely hold opposing views to those espoused by theorists supporting a CBT approach.

<u>Affect Theory Approach</u>. Contrary to the Cognitive-Behavioral theorists, Affect theory, as presented by Tomkins (1987), assumes that the primary mechanism for successful therapy and therapeutic change is affect, not cognition. That is, affect is the blueprint for cognition, decision making, and actions. A therapist who is partial to using

affect theory to guide the therapeutic process, therefore, would focus on the affect a client is experiencing and assume that the cognitive and behavioral changes will follow.

Clearly, the foundation of these theories rests on the question, which comes first, the cognition or the affect? Currently, we have little concrete knowledge to answer this question. As Schiff and Lamon (1989) suggest, there is no clear answer to the dispute over whether emotion always has a secondary influence on the cognitive appraisal of events (Schacter & Singer, 1962; Lazarus, 1984) or whether emotions can come before cognition (James, 1884; cited in Schiff and Lamon, 1989; Zajonc, 1980).

The theory behind the current study supports the supposition that one can experience affect primarily and have cognition secondarily because, prior to the induced emotional change, subjects had no cognitive awareness of impending emotional changes. Although no concrete answers to these complex questions are generated by the current study, it offers another way to approach these questions.

Where clinical neuro-psychopharmacology is concerned, it was previously stated that the type of research presented in the current study may help explain how various mood-altering medications may have different sites of action for men and women. The current study, however, did not offer results that would support sex-related differences but still may have offered helpful information in this research area. These results may guide one away from certain investigations, since, for instance, no sex-related differences in lateralization for the experience of emotion were found or it may guide changes in one's approach to future investigations. For instance, instead of using only male rats in pharmacology laboratory studies, a common practice because of less predictable female-rat hormone cycles, use both male and female rats in laboratory studies of drugs known to alter emotional experiences. This may help to elucidate the current discrepancies found in the literature on sex-related differences in emotion.

Although this study has raised questions that, if studied in the future, could move us closer to understanding the lateralization of emotion in general, as well as possible sex-related differences in lateralization of emotion, there are many other ways to approach these questions as well. Some of these other ways are discussed below.

Future Research Directions

As stated above, the dependent measure used in the current study has received support in the literature as a statistically valid and reliable measure. For this study, however, it may have lacked the sensitivity needed to detect subtle emotional changes. It is possible that a projective measure such as the TAT would be better at detecting these subtleties. A study comparing results from the DACL with those from the TAT may resolve this question and would begin to establish a consistent replication procedure, offering a guide for future researchers to know which tools provide the richest information.

Also, the question was raised whether the subjects would report more changes in emotion if the experimenter and subjects became acquainted prior to the experiment. Meeting with subjects ahead of time and becoming somewhat acquainted perhaps would enhance the subjects' willingness to reveal their true range of feelings. Of course, experimenters should take care to control for experimental biases, since they will not be blind to their subjects prior to the experiment.

Another way to enhance the probability of revealing emotional responses would be to include a pre-test scenario wherein an emotional experience is shared by potential subjects and the examiner. By sharing an emotional experience, subjects may feel more connected to the examiner, which would establish an atmosphere that would permit subjects to report their feelings more freely.

Next, using both male and female examiners in future research will be vitally important, especially where possible sex-related differences are concerned. In order to establish appropriate control over all possible conditions, both male and female subjects should be tested by both male and female examiners. This design would let experimenters determine whether the sex of the examiner plays a role in the subjects' performance.

Furthermore, it would be interesting to see whether adding another set of contractions may intensify or enhance the emotional responses, especially if the environment were comfortable enough to permit greater expression. A RLRLRL condition may reveal more intense emotion than a RLRL condition. Similarly, a hand contraction, used as a priming mechanism prior to a facial contraction, may produce a clearer, more robust response than a facial contraction alone. There is already evidence suggesting that, by using various mood induction techniques and by priming either positive or negative emotions, subjects' social judgments change (Constans, 1993), visual recognition task responses change (Hermans, 1994), and ratings of emotional intensity become more congruent with the subjects' own emotional state (Hansen, 1995).

Based on the description of the facial sensory and motor pathways to the Central Nervous System (see p. 16), it is clear that the mood induction method used in this study stimulates primarily the contralateral hemisphere of the cerebral cortex. Yet, it is not clear where exactly the stimulation is taking place (beyond the motor strip), or what peripheral areas are being affected. Functional Magnetic Resonance Imaging (*f*MRI) or Positron

Emission Tomography (PET) could be used to better understand the neuronal mechanisms correlated with the manipulation and the subsequent emotional responses.

There are still other ways to use imaging techniques to examine sex-related differences. It would be an interesting but difficult task to test the notion, as presented as an extension of the *response-bias theory,* that men actively inhibit the expression of emotion. One possibility for testing this type of a question would be to use imaging techniques such as fMRI and to compare activation of regional areas of the brain. Given the roles played by the frontal and parietal regions for expression and perception, respectively, these regions also may serve as a likely starting point for the study of the experiencing of emotion. The difficulty with such a study would be trying to determine whether "activation" in a specific region represented excitation (increasing the likelihood of a response), or "inhibitory" (reducing the likelihood of a response). Presumably, a clear understanding of which neurotransmitters and receptors (excitatory or inhibitory) are involved in those regions and which are actually activated would be necessary.

Finally, even if these questions were answered, additional conceptual issues remain. For instance, if men were found to "actively inhibit" the expression of emotion, the active inhibition might reflect a socio-psychological influence whereby men are taught to inhibit the expression of emotion. Still, the questions remains whether men may be biologically predisposed (i. e. hard-wired) to actively inhibit the expression of emotion. These questions cannot be addressed in detail here, but they can be considered as future research questions.

In addition to the methodological issues discussed above, there are conceptual issues that have been raised by the current study. For instance, the importance of understanding the implications of the differences between the terms "sex" and "gender" cannot be over-emphasized. Although many people use these words interchangeably, the actual differences are significant and arguably should be considered pivotal in defining the goals of future research in the area of emotional experience. One example of future research that emphasizes this difference is presented here.

Finally, in an attempt to continue bridging the gap between research and clinical work, future studies should consider potential clinical implications. For instance, as previously stated, one question raised here was whether it was reasonable to expect a dramatic mood shift in a normal and healthy population. In individuals whose moods are more labile (e.g., individuals with bi-polar disorder or hysterical tendencies), more robust findings may develop that have implications for both the neuroscience and the clinical communities.

APPENDICES

APPENDIX A

APPENDIX A

INFORMED CONSENT FORM

This is a study of the effects of facial muscle contractions on mood in normal, healthy people. It is a "normative study", which means that we don't know how normal, healthy people will respond, and we want you to help us find out. There are no right or wrong ways to respond. For example, you may feel a change in your mood or you may feel no change at all. Either response is possible, and that is why there is no right or wrong way to respond. The study will take about one hour to complete. You will receive one hour of research credit for participating.

Your record will be kept completely confidential. To ensure this, you will be assigned a subject number, which will be the only way to identify you in any reports about the study. Only the experimenter will have access to files and lists that can be used to link a name with a subject number. Any publications resulting from this work will not identify you by name or in any way that would allow your identity to be discovered.

For this study, you will be asked to complete several tasks.

1. On the *Subject Identification Form*, you will be asked to write your name. This is the only form that can identify you by name and link you to the subject identification number that has been assigned to you. Only the experimenter and his designates will have access to your file. To ensure confidentiality, all other documents you fill out will have only your subject identification number.

2. On the *Medical History Questionnaire*, you will be asked whether you have a history (either past or present) of clinical depression, bipolar episodes, substance abuse, anxiety disorders, hypertension, and facial paralysis. This form is a screening measure which will be used to identify and exclude individuals with any of the above-mentioned histories. For this study, such individuals cannot be included.

3. On the *Personal Information and Background Questionnaire*, you will be asked to provide your age, sex, ethnicity, religion, years of education, and academic major.

4. On the *Laterality Questionnaire*, you be asked to identify which hand you prefer to use for a variety of common tasks. You will be asked whether anyone (including yourself) has tried to change your hand preference.

APPENDIX A (cont'd).

5. On the *Profile of Mood States-Bipolar* form, you will be asked to check off adjectives on a list that describe how you feel at a given time.

6. After completing these questionnaires, you will be asked to perform four *facial manipulations*, specifically, to move the lower part of your face into a certain position and then to hold that position for 45 seconds.

7. After each facial manipulation, you will be asked to complete another mood check list. For this measure you again will be asked to check off adjectives describing how you feel.

8. Lastly, you will be asked to complete a different *Profile of Mood State-Bipolar* check list.

A debriefing period will follow your participation in the experiment. You will receive one hour of research credit for your participation. You have the right to discontinue your participation at any time and for any reason, and to do so without explanation or penalty. There is also an alternative method of earning extra course credit if you do not wish to participate in this or other experiments. If you wish to seek this alternative, speak with your Introductory Psychology professor for specifics. The assignment may vary from professor to professor, but it is usually to write a short paper.

If you would like further information regarding your rights as a research subject, you may contact the Office of the UCRIHS at Michigan State University by telephoning (517) 355-2180.

After the entire study is completed, if you have any questions or if you want a written summary of the general results, you may contact the investigators at their university offices.

I have read this consent form, I understand the conditions, and I voluntarily agree to participate in this study.

____________________________ __________

Subject's Signature Date

____________________________ __________

Investigator's Signature Date

APPENDIX B

APPENDIX B

SUBJECT IDENTIFICATION FORM

This is the only form that can identify you by name and link you to the subject identification number that has been assigned to you. Only the investigators and their designates will have access to your file. All other documents you fill out will have only your subject identification number in order to ensure confidentiality.

Please print your full name.

Subject Name: ______________________ Identification Number: __________

APPENDIX C

APPENDIX C

MEDICAL HISTORY QUESTIONNAIRE

Please check whether you have, or at some time in the past have had, any of the following conditions:

	CURRENT		PAST	
	Yes	**No**	**Yes**	**No**
Major Depression	___	___	___	___
Bipolar Disorder	___	___	___	___
Generalized Anxiety	___	___	___	___
Panic Disorder	___	___	___	___
Post Traumatic Stress Disorder	___	___	___	___
Substance Abuse	___	___	___	___
Hypertension	___	___	___	___
Schizophrenia	___	___	___	___
Other: ________________	___	___	___	___
Have you ever suffered from any type of facial paralysis?	___	___	___	___

If yes, please describe:

____
____
____
____
____
____

APPENDIX D

APPENDIX D

PERSONAL INFORMATION AND BACKGROUND QUESTIONNAIRE

1. What is your age? _______

2. Are you? Male: ___ Female: ___

3. What year in school are you in now? _____________

4. What is your academic major? _____________

5. Which ethnic/race category best fits you?

Caucasian:	___	Asian:	___		
African-American:	___	Hispanic:	___		
Native American:.	___	Other:	___	Define:	____________

APPENDIX E

APPENDIX E

LATERALITY QUESTIONNAIRE

A. General Handedness

Circle the description that best applies to you:

a. Strongly left-handed

b. Moderately left-handed

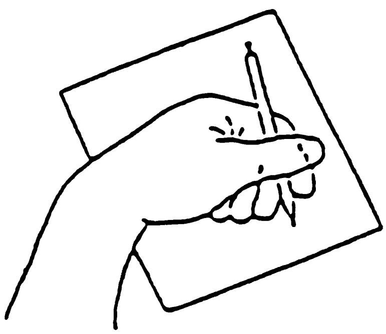
c. Ambidextrous (either-handed)

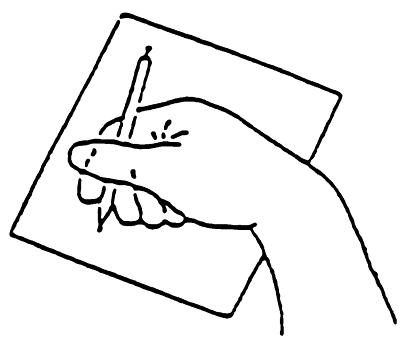
d. Moderately right-handed

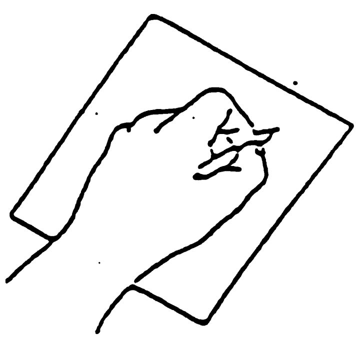
e. Strongly right-handed

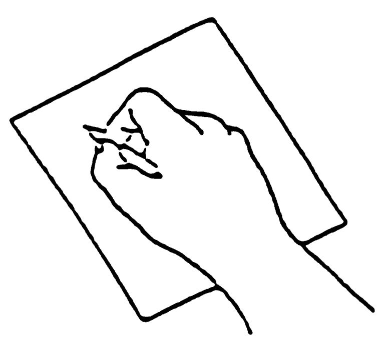
Circle the picture which best depicts how you hold a pencil when writing.

Left-Handed Writers | **Right-Handed Writers**









B. Hand Use for Specific Tasks

For each of the tasks listed below, check the column that corresponds to the hand you would use to perform that task.

Hand Use	Always Left 1	Usually Left 2	Both 3	Usually Right 4	Always Right 5
1. Write a letter	___	___	___	___	___
2. Hammer a nail	___	___	___	___	___
3. Throw a ball at a target	___	___	___	___	___
4. Unscrew lid of a jar	___	___	___	___	___
5. Use knife to cut bread	___	___	___	___	___
6. Use tooth brush	___	___	___	___	___
7. Hold a match while striking it	___	___	___	___	___
8. Hold a tennis racket	___	___	___	___	___

Has anyone (including yourself) tried to change what hand you use to perform any of the tasks listed above or any other tasks? No____ Yes____

If your answer was yes, please identify the task(s) and describe the circumstances.

____
____
____
____
____

APPENDIX F

APPENDIX F

POMS-BI

NAME ____________________ DATE ____________

IDENTIFICATION

Below are words that describe feelings and moods people have. Please read EVERY word carefully. Then fill in ONE space under the answer which best describes how you have been feeling DURING THE PAST WEEK INCLUDING TODAY.

Suppose the word is *happy*. Mark the one answer which is closest to how you have been feeling DURING THE PAST WEEK INCLUDING TODAY.

The numbers refer to these phrases:

- 0 = Much unlike this
- 1 = Slightly unlike this
- 2 = Slightly like this
- 3 = Much like this

MARKING DIRECTIONS

- USE A NO. 2 PENCIL ONLY.
- MAKE NO STRAY MARKS.
- ERASE CLEANLY.

CORRECT MARK INCORRECT MARK

MUCH UNLIKE THIS / SLIGHTLY UNLIKE THIS / SLIGHTLY LIKE THIS / MUCH LIKE THIS

1. Composed
2. Angry
3. Cheerful
4. Weak
5. Tense
6. Confused
7. Lively
8. Sad
9. Friendly
10. Tired
11. Strong
12. Clearheaded
13. Untroubled
14. Grouchy
15. Playful
16. Timid
17. Nervous
18. Mixed-up
19. Vigorous
20. Dejected
21. Kindly
22. Fatigued
23. Bold
24. Efficient
25. Peaceful
26. Furious
27. Lighthearted
28. Unsure
29. Jittery
30. Bewildered
31. Energetic
32. Lonely
33. Sympathetic
34. Exhausted
35. Powerful
36. Attentive
37. Serene
38. Bad tempered
39. Joyful
40. Self-doubting
41. Shaky
42. Perplexed
43. Active
44. Downhearted
45. Agreeable
46. Sluggish
47. Forceful
48. Able to concentrate
49. Calm
50. Mad
51. Jolly
52. Uncertain
53. Anxious
54. Muddled
55. Ready-to-go
56. Discouraged
57. Good-natured
58. Weary
59. Confident
60. Businesslike
61. Relaxed
62. Annoyed
63. Elated
64. Inadequate
65. Uneasy
66. Dazed
67. Full of pep
68. Gloomy
69. Affectionate
70. Drowsy
71. Self-assured
72. Mentally alert

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BE SURE YOU HAVE ANSWERED EVERY ITEM

APPENDIX G

APPENDIX G

ST-DACL
Form A

Directions: Below you will find some words that describe different kinds of moods and feelings. Check the words that describe **how you feel right now - at this moment.** Some of the words may sound alike, but we want you to check all of the words that describe your feelings. Work rapidly and check all of the words that describe how you feel right now. If you need to change an answer, clearly erase the incorrect the answer.

List A

O 1. Wilted
O 2. Safe
O 3. Miserable
O 4. Gloomy
O 5. Dull
O 6. Lively
O 7. Low-spirited
O 8. Sad
O 9. Unwanted
O 10. Fine
O 11. Brokenhearted
O 12. Downcast
O 13. Enthusiastic
O 14. Failure
O 15. Afflicted
O 16. Active
O 17. Strong
O 18. Tortured
O 19. Listless
O 20. Sunny
O 21. Destroyed
O 22. Wretched
O 23. Broken
O 24. Lighthearted
O 25. Criticized
O 26. Grieved
O 27. Dreamy
O 28. Hopeless
O 29. Oppressed
O 30. Joyous
O 31. Weary
O 32. Droopy

ST-DACL
Form D

Directions: Below you will find some words that describe different kinds of moods and feelings. Check the words that describe **how you feel right now - at this moment.** Some of the words may sound alike, but we want you to check all of the words that describe your feelings. Work rapidly and check all of the words that describe how you feel right now. If you need to change an answer, clearly erase the incorrect the answer.

List D

O 1. Depressed
O 2. Elated
O 3. Awful
O 4. Lifeless
O 5. Grief stricken
O 6. Inspired
O 7. Woeful
O 8. Lonely
O 9. Suffering
O 10. Mellow
O 11. Drooping
O 12. Rejected
O 13. Fortunate
O 14. Dreary
O 15. Lousy
O 16. Good
O 17. Fit
O 18. Lonesome
O 19. Unloved
O 20. Glad
O 21. Grave
O 22. Sunk
O 23. Shot
O 24. Merry
O 25. Wasted
O 26. Washed out
O 27. Clear
O 28. Gruesome
O 29. Tired
O 30. High
O 31. Worse
O 32. Drained

ST-DACL
Form G

Directions: Below you will find some words that describe different kinds of moods and feelings. Check the words that describe **how you feel right now - at this moment.** Some of the words may sound alike, but we want you to check all of the words that describe your feelings. Work rapidly and check all of the words that describe how you feel right now. If you need to change an answer, clearly erase the incorrect the answer.

List G

O 1. Heartsick
O 2. Healthy
O 3. Sad
O 4. Afflicted
O 5. Lonesome
O 6. Fine
O 7. Alone
O 8. Gloomy
O 9. Depressed
O 10. Alive
O 11. Heavyhearted
O 12. Failure
O 13. Glad
O 14. Despondent
O 15. Sunk
O 16. Optimistic
O 17. Jovial
O 18. Enthusiastic
O 19. Bleak
O 20. Grief stricken
O 21. Eager
O 22. Drained
O 23. Desolate
O 24. Miserable
O 25. Merry
O 26. Dull
O 27. Melancholy
O 28. Interested
O 29. Unwanted
O 30. Gruesome
O 31. Whole
O 32. Oppressed
O 33. Lifeless
O 34. Elated

Table 1a: Right Hemisphere Hypothesis

	Left Hemisphere		Right Hemisphere	
	Positive	Negative	Positive	Negative
Perception			+	+
Expression			+	+
Experience			+	+

Table 1b: Valence Hypothesis

	Left Hemisphere		Right Hemisphere	
	Positive	Negative	Positive	Negative
Perception			+	+
Expression	+			+
Experience	+			+

Table 2. Correlations among five state lists for male and female normals (N=86).

	DACL-A	DACL-B	DACL-C	DACL-D	DACL-G
DACL-A	——	0.88	0.86	0.88	0.88
DACL-B	0.91	——	0.88	0.90	0.90
DACL-C	0.85	0.89	——	0.91	0.90
DACL-D	0.91	0.92	0.89	——	0.93
DACL-G	0.90	0.91	0.86	0.92	——

Note: Correlations for males (n=51) are below the diagonal; those for females (n=35) are above the diagonal.

Table 3. Correlations among mood scales for Profile of Mood States-Bipolar (Lorr & McNair, 1988).

		1	2	3	4	5	6
Composed	1	——	——	——	——	——	——
Agreeable	2	0.59	——	——	——	——	——
Elated	3	0.62	0.78	——	——	——	——
Confident	4	0.59	0.46	0.67	——	——	——
Energetic	5	0.40	0.49	0.68	0.64	——	——
Clearheaded	6	0.68	0.58	0.64	0.74	0.57	——

Table 4. POMS-BI retest correlations and mean scores (Lorr & McNair, 1988) (N=66).

	r	1st Mean	2nd Mean
Composed	0.55	24.26	23.91
Agreeable	0.33	28.70	29.55
Elated	0.59	23.76	24.77
Confident	0.57	23.80	23.73
Energetic	0.60	21.59	20.91
Clearheaded	0.72	27.53	26.64

Table 5. Results of Confirmatory Factor Analysis for a six-factor model of the POMS-BI (N=120).

Variable	Eigenvalue	Percent of Variance
1	19.43	27.00
2	6.31	8.80
3	3.85	5.30
4	2.88	4.00
5	2.67	3.70
6	2.39	3.30
7	2.00	2.80
8	1.63	2.30
9	1.59	2.20
10	1.52	2.10
11	1.45	2.00
12	1.39	1.90
13	1.35	1.90
14	1.25	1.70
15	1.16	1.60
16	1.12	1.60
17	1.02	1.40
18	1.01	1.40

Table 6. Correlation matrix for positive and negative adjectives selected for the Factor Analysis on the POMS-BI (n=120).

subscale: Positive	1	2	3	4	5	6	7	8	9	10	11	12
1. Full of Pep	1.00											
2. Kindly	0.48	1.00										
3. Peacefull	0.40	0.49	1.00									
4. Confident	0.51	0.37	0.44	1.00								
5. Jolly	0.58	0.49	0.36	0.36	1.00							
6. Agreeable	0.36	0.53	0.56	0.36	0.46	1.00						
7. Playfull	0.48	0.51	0.36	0.16	0.58	0.36	1.00					
8. Lively	0.63	0.56	0.43	0.39	0.60	0.42	0.59	1.00				
9. Good Natured	0.36	0.32	0.44	0.31	0.37	0.50	0.22	0.44	1.00			
10. Joyful	0.68	0.49	0.48	0.44	0.61	0.37	0.54	0.67	0.37	1.00		
11. Energetic	0.71	0.53	0.36	0.34	0.66	0.43	0.60	0.76	0.36	0.67	1.00	
12. Relaxed	0.40	0.40	0.52	0.43	0.39	0.40	0.40	0.40	0.14	0.39	0.33	1.00

subscale: Negative	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Sluggish	1.00														
2. Drowsy	0.67	1.00													
3. Tired	0.58	0.61	1.00												
4. Downhearted	0.44	0.31	0.24	1.00											
5. Sad	0.45	0.42	0.34	0.67	1.00										
6. Tense	0.31	0.23	0.16	0.37	0.38	1.00									
7. Exhausted	0.64	0.71	0.63	0.26	0.37	0.23	1.00								
8. Annoyed	0.36	0.23	0.24	0.45	0.41	0.30	0.31	1.00							
9. Grouchy	0.61	0.43	0.40	0.44	0.44	0.27	0.34	0.37	1.00						
10. Fatigued	0.63	0.72	0.67	0.37	0.42	0.26	0.73	0.25	0.33	1.00					
11. Weary	0.63	0.56	0.57	0.43	0.42	0.39	0.52	0.28	0.42	0.63	1.00				
12. Gloomy	0.41	0.41	0.18	0.61	0.66	0.32	0.34	0.35	0.57	0.40	0.41	1.00			
13. Bad Tempered	0.29	0.35	0.23	0.36	0.54	0.20	0.30	0.54	0.34	0.23	0.11	0.43	1.00		
14. Discouraged	0.42	0.38	0.35	0.61	0.67	0.51	0.35	0.57	0.48	0.44	0.50	0.55	0.44	1.00	
15. Uneasy	0.40	0.25	0.28	0.55	0.47	0.49	0.38	0.43	0.24	0.40	0.44	0.43	0.21	0.55	1.00

Table 7. Factor loadings, reliability analyses, and alpha variance if items deleted for positive and negative factors on the POMS-BI (N=120).

Factor 1 (positive)	Loadings Factor 1	Loadings Factor 2	Alpha if Item Deleted
Full of Pep	-0.76	0.21	0.90
Kindly	-0.62	0.10	0.90
Peaceful	-0.56	-0.21	0.90
Confident	-0.64	-0.26	0.91
Jolly	-0.71	0.27	0.90
Agreeable	-0.60	0.05	0.90
Playful	-0.60	0.34	0.90
Lively	-0.75	0.27	0.90
Good-Natured	-0.53	0.17	0.90
Joyful	-0.73	0.19	0.90
Energetic	-0.74	0.31	0.90
Relaxed	-0.50	0.78	0.91
Reliability Coefficient	**Alpha 0.91**		

Factor 2 (negative)	Loadings Factor 1	Loadings Factor 2	Alpha if Item Deleted
Sluggish	0.75	-0.11	0.90
Drowsy	0.71	-0.24	0.90
Tired	0.62	-0.27	0.91
Downhearted	0.52	0.48	0.91
Tense	0.47	0.22	0.91
Exhausted	0.71	-0.30	0.91
Annoyed	0.39	0.50	0.91
Grouchy	0.56	0.33	0.91
Fatigued	0.73	-0.28	0.91
Weary	0.70	-0.15	0.91
Gloomy	0.57	0.40	0.91
Bad Tempered	0.52	0.42	0.91
Discouraged	0.61	0.47	0.91
Uneasy	0.50	0.42	0.91
Reliability Coefficient	**Alpha 0.91**		

Table 8. Results of Repeated Measures Analysis of Co-Variance for Condition (RLRL, LRLR), Time (DACL B, C, D, G), and Sex (male, female) (N=80).

	SS	df	F	p
Condition	18.46	1, 77	0.14	0.71
Time	859.95	3, 234	14.43	0.00
Sex	373.13	1, 75	2.95	0.09
Condition x Time	176.25	3, 234	2.96	0.03
Condition x Sex	22.42	1, 75	0.18	0.68
Time x Sex	63.36	3, 228	1.06	0.37
Condition x Time x Sex	53.10	3, 228	0.89	0.45

Table 9. Mean DACL scores and SD for men and women in the RLRL and LRLR conditions (N=80).

	DACL-A		DACL-B		DACL-C		DACL-D		DACL-G	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Men-RLRL	47.70	5.67	50.20	6.34	55.00	6.27	54.40	7.72	55.80	6.98
Women-RLRL	45.14	5.65	49.57	6.78	52.66	7.10	49.23	7.02	53.42	8.48
Men-LRLR	48.60	9.30	52.50	8.25	52.60	7.36	55.10	8.17	56.70	8.29
Women-LRLR	47.57	6.45	48.84	5.25	50.31	5.82	51.42	6.29	53.84	8.82

Table 10. Results of Simple Factorial ANOVAs on the second administration of the POMS-BI, using negative and positive adjectives, and co-varying the first administration (N=80).

Negative Adjectives	**SS**	**df**	**F**	**p**
Sex	104.83	1, 78	3.58	0.06
Condition	50.27	1, 78	1.72	0.19
Sex x Condition	3.41	1, 78	0.12	0.73

Positive Adjectives	**SS**	**df**	**F**	**p**
Sex	59.33	1, 78	1.33	0.77
Condition	0.88	1, 78	0.02	0.89
Sex x Condition	3.99	1, 78	0.09	0.77

Table 11. Mean number of adjectives endorsed on each DACL (A, B, C, D, G) and results from a Simple Factorial ANOVA comparing responses rates on each DACL (A, B, C, D, G) for men and women (N=80).

	Men		Women					
	Mean	**SD**	**Mean**	**SD**	**SS**	**df**	**F**	**p**
DACL-A	6.76	3.92	6.20	3.47	6.61	1, 78	0.48	0.49
DACL-B	8.75	4.15	7.43	3.59	35.11	1, 78	2.33	0.13
DACL-C	9.83	3.54	9.35	3.64	5.00	1, 78	0.39	0.54
DACL-D	10.85	4.25	9.53	3.96	35.11	1, 78	2.08	0.15
DACL-G	11.73	4.19	11.15	4.19	6.61	1, 78	0.38	0.54
TOTAL DACL	N/A		N/A		369.8	1, 78	1.62	0.21

Table 12. Mean and SD of absolute differences scores for all subjects in either RLRL or LRLR condition (N=80).

	RLRL		LRLR	
	Mean	SD	Mean	SD
DACL B minus A	4.95	4.97	6.15	5.44
DACL C minus B	5.49	4.51	4.92	4.23
DACL D minus C	4.51	4.91	4.31	4.40
DACL G minus D	4.90	3.81	4.41	4.04

Figure 1. Percent of male and female subjects in each age category, year in school, and ethnicity\race category (N=80).

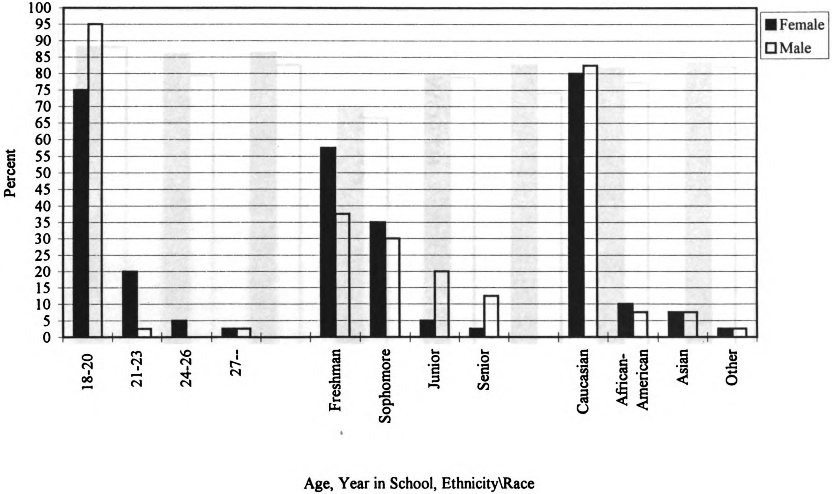


Figure 2. Mean responses from men and women for hand-preferences on eight tasks (N=80).

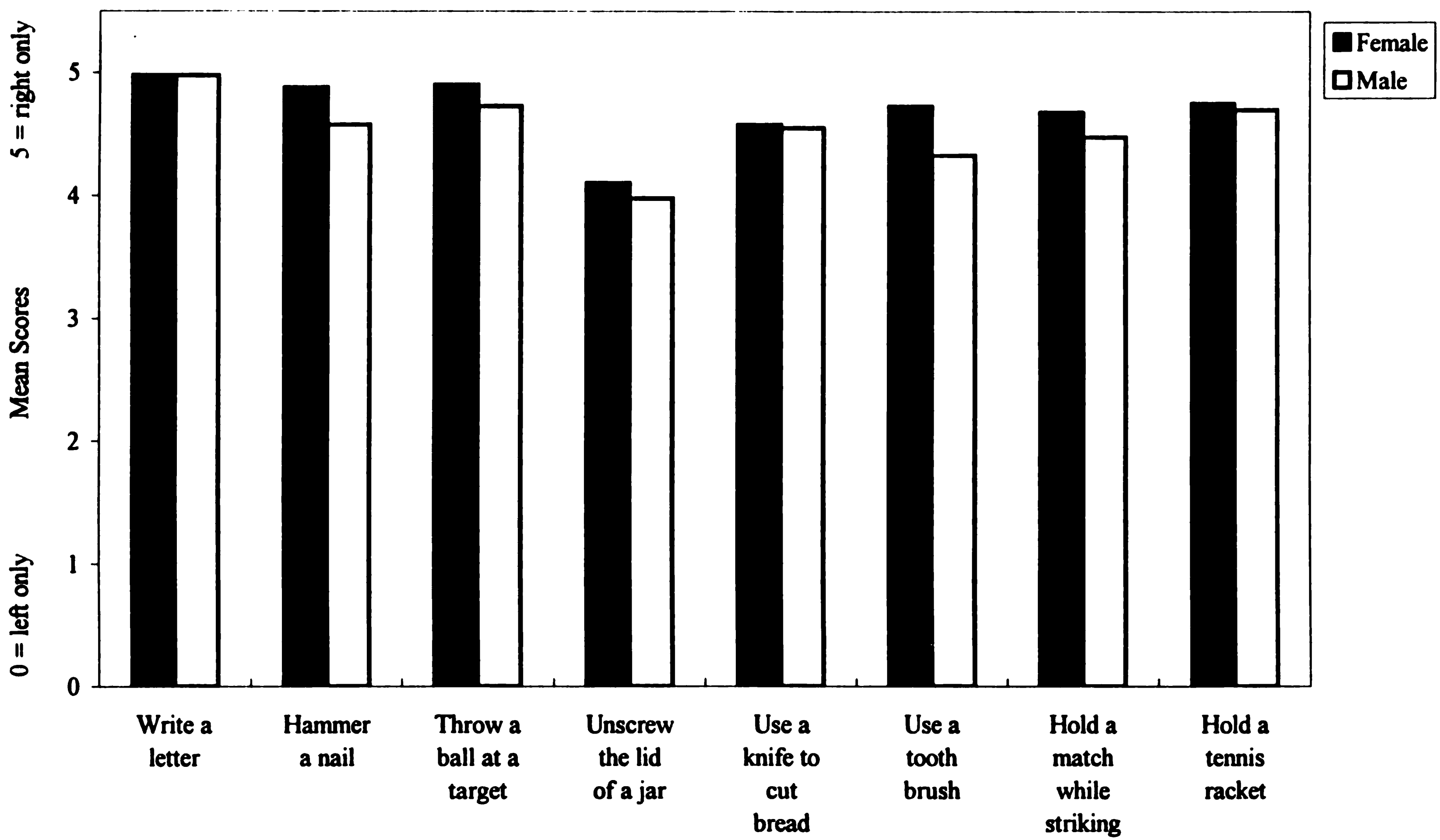


Figure 3. Interaction between Time (DACL B, C, D, G) and Condition (RLRL, LRLR), co-varying pre-measure DACL-A (N=80).

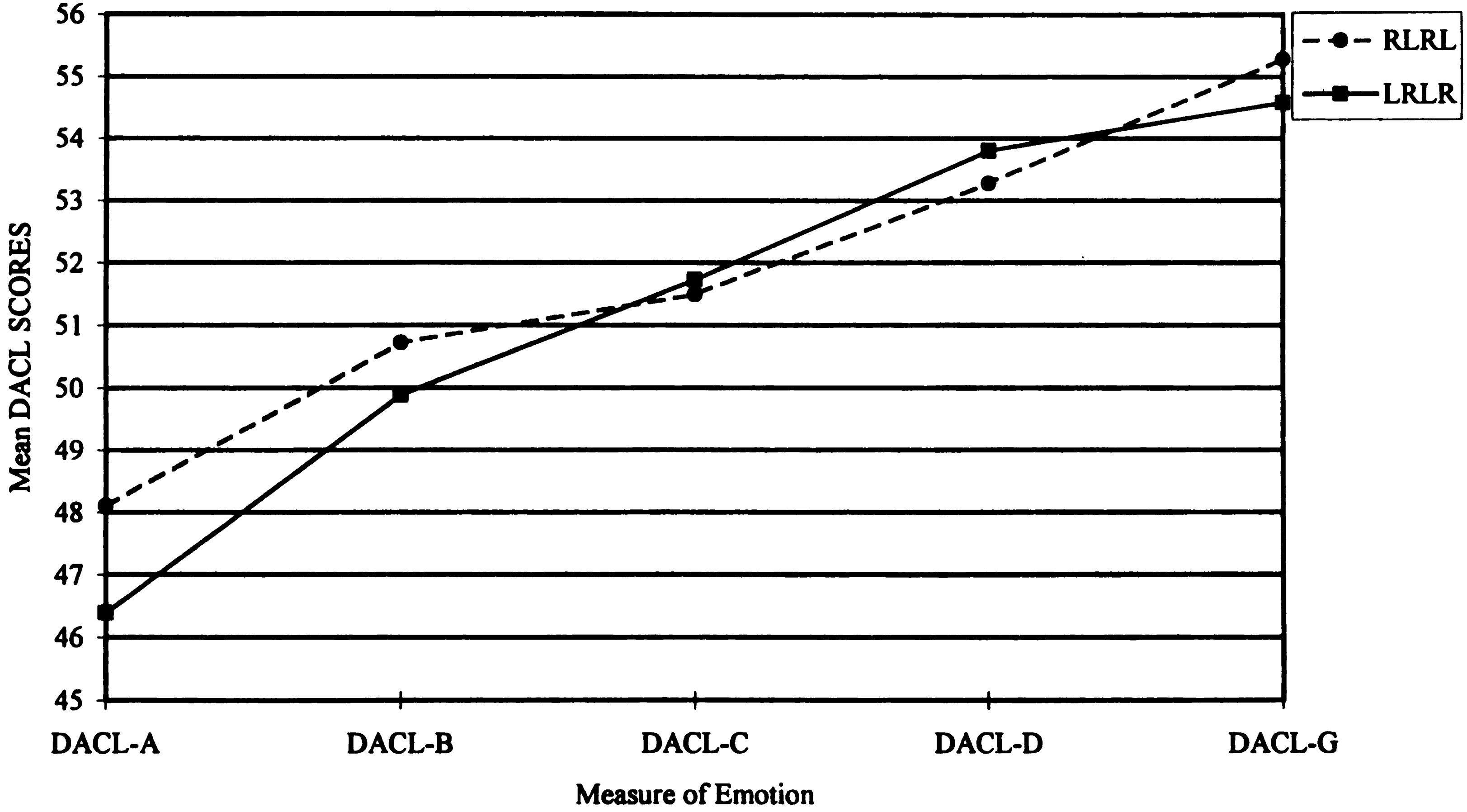


Figure 4. Mean DACL scores for left-face manipulations summed across conditions and mean DACL scores for right-face manipulations summed across conditions for both men and women (N=80).

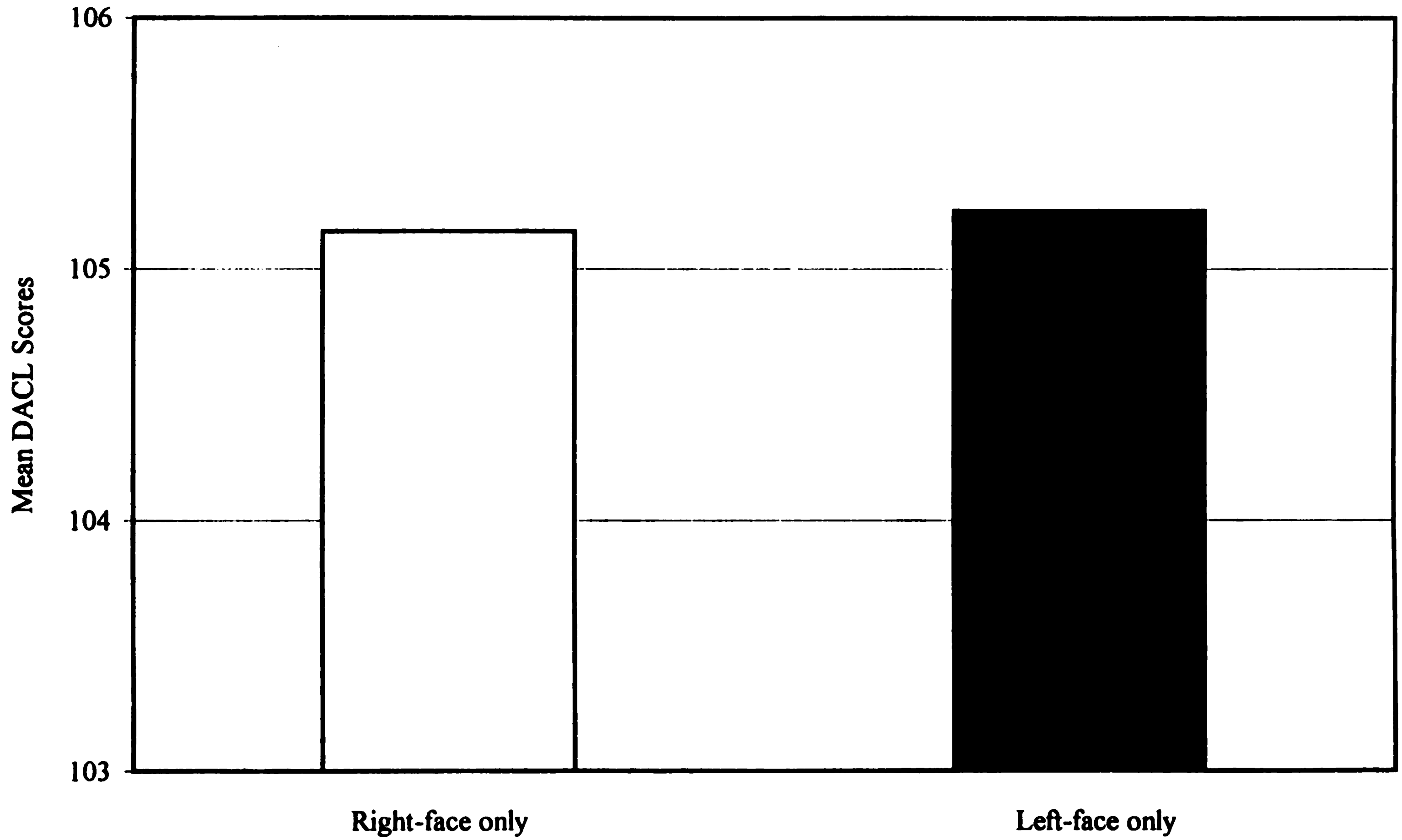
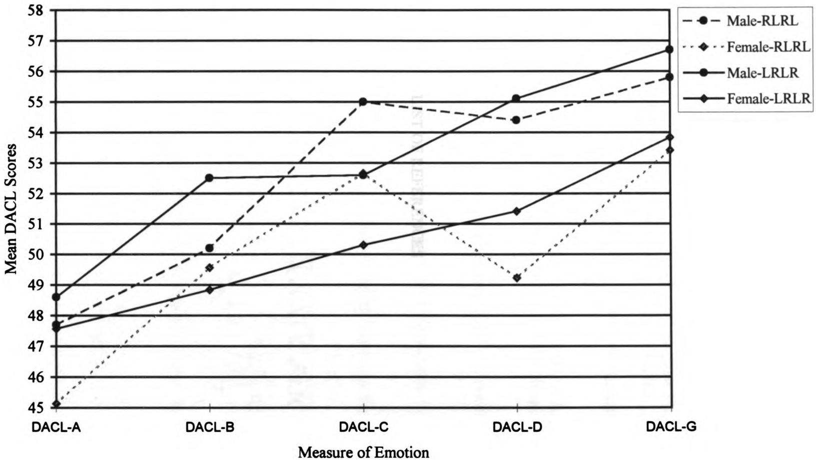


Figure 5. Mean DACL scores (DACL A, B, C, D, G) for men and women in the RLRL and LRLR conditions (N=80).



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