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Posed Emotional Expression in Brain-Damaged Patients
Across Three Channels of Communication

by

Elizabeth Canino

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

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THE CITY UNIVERSITY OF NEW YORK

Abstract

Posed Emotional Expression in Brain-Damaged Patients Across Three Channels of Communication

by

Elizabeth Canino

Chairperson: Joan C. Borod, Ph.D.

The ability to pose eight different emotional expressions across three channels of communication (i.e., facial, prosodic/intonational, and lexical/verbal) was examined in individuals with unilateral stroke and in neurologically-healthy adults. This study also determined whether there is a general or separate processors for emotional expression in multiple channels. Also of interest was replicating preliminary findings that interrater reliability could be established using previously developed (Canino et al., 1999) training and rating procedures.

Posers included 19 individuals with right-hemisphere brain damage (RBDs), 17 individuals with left-hemisphere brain damage (LBDs), and 18 normal controls (NCs). All groups were demographically matched, and patient groups were matched on lesion site (frontal, temporal, parietal, and/or occipital lobes). Measures of posed emotional expressions from the New York Emotion Battery (Borod, Welkowitz, & Obler, 1992) included facial emotional expressions, prosodically-intoned neutral-content sentences, and generated word lists for three positive and five negative emotions. Expressions were evaluated for category accuracy, emotional intensity, and rater confidence by a separate set of four raters for each channel. Overall, interrater reliability was high: median complete agreement for accuracy = 73%, and median intraclass correlation for intensity = .85.

Group comparisons for the rating parameters revealed Group-by-Channel interactions, such that prosodic emotional expressions of RBDs and LBDs, relative to those of NCs, were produced with significantly less accuracy and tended to be rated with less confidence. There were no group differences for intensity. Across posers, there were differences for channel (lexical > facial > prosodic) and valence (positive more accurate and more confident, and negative more intense). Exploratory analyses considered demographic variables, nonemotional control tasks, background affect in neutral poses, intrahemispheric lesion location, and language impairments. When correlations were computed among the three channels for each rating parameter, facial and prosodic expression were significantly related to each other but not to lexical expression. Further, when correlations were computed among the three rating parameters for each channel, a similar pattern occurred for face and prosody (i.e., significant correlations between intensity and confidence) as compared to the lexical channel (i.e., significant correlations among all parameters). These findings suggest a dissociation between nonverbal and verbal components of emotional processing.

Acknowledgments

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Introduction

Rationale and Overview of Methods

The focus of this research was to gain a better understanding of the role of specific brain regions in the expression of emotion. This project studied the impact of brain lesions caused by unilateral stroke in humans on their ability to pose 8 different emotions across three different communication channels. From this approach, we were able to infer the role of various brain regions for the expression of posed emotions in each of three channels, which are facial, prosodic/intonational, and lexical/verbal.

The role of brain regions in emotional expression has been of interest to researchers for many years. Early observations of Hughlings Jackson (1880), Mills (1912), and Papez (1937) each pointed to evidence that the brain had specialized anatomical sites for emotional processing. While subcortical structures were initially the focus of emotion research, studies in the past 25 years have also examined the role of the neocortex. The use of humans with unilateral brain damage has become one standard means of studying hemispheric and localized differences in the expression of emotion. Researchers in this area have primarily published studies which focused on one channel of communication only (for reviews, see Borod, 1993). For instance, highly detailed procedures have been developed for assessing facial emotional expressions based on measuring the involvement of the facial musculature (the Facial Action Coding System [FACS; Ekman & Friesen, 1978]), assessing prosodic emotional expressions based on measuring acoustical parameters (e.g., Scherer, 1986), and assessing lexical emotional expressions by measuring linguistic and pragmatic content (e.g., Bloom, Borod, Obler, & Gerstman, 1993). This has led to a better understanding of channel-specific mechanisms and to the development of several specialized means of measuring emotional expression. Unfortunately, the use of expression tasks, rating procedures, and techniques that have been customized for a single modality study prevents a systematic comparison of the findings across studies because the results are not comparable to the results of studies of other communication channels.

The current project attempted to address the need for more integrated findings by studying three communication channels, separately, in the same individuals and using comparable techniques across channels. Using three expression tasks, one for each of the three communication channels, we have isolated subjects' expressions in that channel. This allowed us to study specific channels as previous studies have done, but also allowed for comparison across channels within the same group of subjects because each subject provides comparable data for each channel. We were therefore also able to investigate relationships among the three channels and assess whether dissociations existed in subject performance across communication channels. Additionally, we were able to test for the presence of a central processor for emotional posed expression. Subjects with unilateral brain damage and matched normal controls allowed us to explore the impact of brain lesions on the ability to pose emotions in each channel. With data from three channels, were able to make comparisons within subjects and across subject groups to lead us to a more integrated understanding of how the brain expresses emotion.

It was essential to use expression tasks and rating techniques that are comparable across channels. In previous work which served as a pilot for this project (Canino, Borod, Madigan, Tabert, & Schmidt, 1999), rating procedures had been developed which were comparable across channels because they were all based on the premise of measuring the subjects' communicative ability (in that channel) as assessed by judges who were trained to perceive what is being communicated. The use of human judges to "receive" what is being conveyed has been discussed in the literature and deemed to be a reasonable way to assess human communicative abilities (e.g., Ekman, Friesen, & Ellsworth, 1972). Because the effectiveness of human communication is adequately judged by the ability of a rater to accurately identify the expression, this approach offers face validity and allows for direct interpretation of the findings in terms of the subjects' expressive communication abilities.

In this study, posed (i.e., to command, voluntary) expressions were elicited. This was done in order to focus on identifying brain regions responsible for emotional expression in each distinct communication channel. To do this, the emotional expressions needed to be isolated, i.e., limited to one channel at a time. This method prevented the use of more generalized or idiosyncratic communication strategies, such as strong use of prosody with limited use of emotion-laden vocabulary, on the part of subjects. This allowed us to meaningfully compare the performance of subjects across channels to determine differences in accuracy or intensity by channel. Also, because this study was interested in the role of the two cerebral hemispheres, particularly the neocortex, in emotional expression, a paradigm was needed that would access neocortical structures. For example, spontaneous (as opposed to volitional) facial movements rely on the extrapyramidal system which involves mostly subcortical nuclei (Rinn, 1984). Finally, the battery used for this project and for the larger project from which this study is derived, includes several control measures that allow us to adjust for the variance in performance that is due to nonemotional factors. The expressions derived from the control tasks were also elicited in a posed format, thereby serving as good control measures for a study of posed emotional expression.

Theories of Emotional Expression

As mentioned above, early emotion research was focused on the role of subcortical structures. But evidence for cortical involvement grew with studies by Mills (1912) which suggested a direct link between emotional processing and the right hemisphere. Gainotti's (1972) report of differential emotional reactions with right versus left sided cortical damage suggested hemispheric specialization for emotion. Two main theories regarding hemispheric specialization for emotional expression have been developed by researchers since. One, the right-hemisphere hypothesis, posits that the right hemisphere is specialized for processing all emotions, regardless of valence, that is, whether the emotion is positive or negative (Borod, 1992; Heilman, Bowers, & Valenstein, 1985; Liotti & Tucker, 1995). The other theory, the valence hypothesis, states that the right hemisphere is specialized for the expression of negative emotions while the left is specialized for the expression of positive emotions (Davidson, 1984; Ehrlichman, 1987). For example, if the right hemisphere hypothesis is correct, we would see in this study that subjects with lesions to the right cerebral hemisphere (RBDs) would express emotions less intensely and less accurately than subjects with lesions to the left cerebral hemisphere (LBDs). On the other hand, if the valence hypothesis is correct, we would expect to see that RBDs would have a selective deficit when expressing negative emotions while LBDs would demonstrate a selective deficit when expressing positive emotions. In the preliminary study that served as a pilot for this project (Canino et al., 1999), overall results in a small group of posers supported the right hemisphere hypothesis as the RBDs were rated as least accurate across all three channels of communication. This review will now discuss findings regarding these emotion theories, in relation to each of the three communication channels.

Facial Channel

To examine the neuroanatomical basis of emotional facial expression, much research has focused on the study of facial asymmetry, posed expressions to command or imitation, and recordings of spontaneous expressions. Both normal and brain-damaged subjects have been studied. Facial asymmetry provides a powerful paradigm as the lower two-thirds of the face are predominantly innervated by the contralateral cerebral hemisphere (DeJong, 1979; Rinn, 1984). In a review of the literature of facial asymmetries during emotional expression by normals (Borod, Santschi-Haywood, & Koff, 1997), it was concluded that the left hemiface, presumably with more connectivity to the right hemisphere, is more involved than the right hemiface during the facial expression of emotion. This conclusion was drawn from a review of 49 studies which led to 82 observations. The data showed some degree of left hemisphere involvement in positive emotion which the authors stated could potentially be consistent with the valence hypothesis. Two studies using different methodologies to study the expression of a smile resulted in differing conclusions. Cambell's (1978) study concluded that when posing a smile to command, normal posers tend to express more with their left than their right side of the face. This study used chimeric faces judged by naive raters. A later study (Gazzaniga & Smylie, 1990) evaluated the ability of 3 posers who had undergone commissurotomy to produce facial expressions to command. This study found that when the command to smile was presented to the left hemisphere, a significantly quicker response of the right hemiface was noted as compared to the left hemiface. None of the three patients were able to carry out the command when it was presented to the right hemisphere. These authors conclude that previous inferences that the right hemisphere controls voluntary or posed emotional expressions are inaccurate. The results though are complicated by the fact their study used nonemotional facial expressions (wink, blow), as well as a smile, yet reported that the sum total of their results reflect emotional processing. An important methodological issue arises when one considers that many researchers have determined that an intact left cerebral hemisphere is necessary for the ability to carry out complex motor commands (e.g., Borod, Koff, Lorch, & Nicholas, 1986; Geshwind, 1975). The current study therefore will control for the subjects' ability to pose nonemotional facial expressions (see Statistical Procedures).

Other studies have provided support for the right hemisphere hypothesis when studying posed or spontaneous facial expression. A study of the posed facial expressions of 90 normal adults (Moreno, Borod, Welkowitz, & Alpert, 1990) found that the left hemiface had more muscular involvement than the right with no overall support for valence effects. This finding was further supported by their study of brain-damaged posers. In another study (Kent, Borod, Koff, Welkowitz, & Alpert, 1988) facial expressions in 27 subjects with either unilateral left or right brain damage due to cerebral vascular lesions and 16 healthy matched controls were studied during tasks of posing emotional facial expressions to command and to imitation, and when responding spontaneously to emotionally-toned slides. Eight emotions were posed, and the authors found that the RBD subjects were more impaired in their ability to accurately express facial emotion. Buck and Duffy (1980) found male RBDs to have less sending accuracy than LBDs and NCs when their spontaneous facial responses to emotional slides were judged by raters. In another study of spontaneous facial emotional expression recorded while subjects produced monologues about two emotional experiences, RBDs (relative to NCs) were found to have significantly less intense facial expressions and to show significantly less positive emotion during both pleasant and unpleasant monologues (Martin, Borod, Alpert, Brozgold, & Welkowitz, 1990). RBDs have also been found to pose less accurately than LBDs and NCs, but on positive emotions only (Kent, Borod, Koff, Welkowitz, & Alpert, 1988; Weddell, Miller, & Trevarthen, 1990). Other studies have found no differences in performance based on side of neurologic lesion (Heilman, Watson, & Bowers, 1983; Mammucari et al., 1988). No consistent valence effects have been found despite differing performance by RBDs on positive or negative emotions in some studies (Blonder, Burns, Bowers, Moore, & Heilman, 1993; Mammucari et al., 1988).

Prosody

Early clinical observations by Hughlings Jackson (1880) that patients with severe expressive aphasia often had spared emotional expression intrigued many later researchers. Monrad-Krohn (1947) published a detailed case description of a woman with Broca's aphasia whose speech had intact melody and whose ability to sing was unaffected. These observations helped promote the distinction between propositional and non-propositional aspects of language. The importance of the non-propositional aspects, including such features as pitch, loudness, stress, melody, and affective content are now frequently referred to as the prosodic aspect of language (Ross, 1993). Two main methods of studying prosody have been developed (for a review of both methods, see Frick, 1985). One method examines the ability of an individual to use prosody to convey emotional meaning (without using words with emotional meanings) in posed or spontaneous speech (Borod et al.,1986; Cancelliere & Kertesz, 1990; Ross, 1981; Tucker, Watson, & Heilman, 1977). Another method is to analyze subjects' speech at the level of specific acoustical parameters, such as fundamental frequency (Bachorowski & Owren, 1995; Scherer, 1986).

Many of the research findings with brain-damaged subjects point to the right hemisphere as being dominant for the prosodic expression of emotion, regardless of measures used (Blonder, Pickering, Heath, Smith, & Butler, 1995; Borod, 1993; Gorelick & Ross, 1987; Ross, 1993; Tucker et al., 1977). These studies point to lesions of the right cerebral hemisphere, including the frontal operculum, perisylvian region, insula, and parietal cortex, as impairing the ability to accurately express emotional prosody. Gorelick and Ross (1987) suggested that the organization of affective prosody in the right hemisphere is comparable to the left hemisphere's organizational structure for propositional language. Their study led them to propose that damage to the right hemisphere can lead to aprosodias (e.g., motor aprosodia, conduction aprosodia, sensory aprosodia, and transcortical aprosodia) that parallel the aphasias seen after damage to the left hemisphere. Ross, Thompson, and Yenkosky (1997) present findings that suggest that lesions to the deep white matter below the supplemental motor area which impinge on the mid-rostral corpus collosum may be the cause of aprosidias seen in LBD patients. Merewether and Alpert (1990) summarize these types of findings by stating that the left hemisphere provides the "text" while the right hemisphere "plays the accompaniment" (p.333). The basal ganglia have also been implicated in prosodic expression (Cancelliere & Kertesz, 1990). These authors found that in 6 patients with global aprosodia, the largest area of overlap on CT was in basal ganglia structures regardless of the side of the hemispheric lesion, and that emotional expression did not vary as a function of intrahemispheric lesion location. They point to the role of the basal ganglia in motor control and suggest that the basal ganglia may work in conjunction with cortical structures to mediate the voluntary direction of complex motor programs, such as prosodic expression. In other words, the basal ganglia may be an "effector unit" which translates the prosodic intention into behavior (Cancelliere & Kertesz, 1990, p. 144).

While there have been no studies which presented systematic findings contrary to those described above, one earlier study (Weintraub, Mesulam, & Kramer, 1981) did question the focus of the conclusions. While this study acknowledged the role of the right hemisphere in the expression of affective prosody, the authors suggested that its role may be broader. In their study of 9 RBDs and 10 NCs, they found that the RBDs performed significantly worse than controls when asked to repeat emphatic stress and statement-question intonation, and to spontaneously place emphatic stress within sentences. The authors conclude that these findings suggest that the deficits seen after damage to the right hemisphere are not limited to expression of affective prosody. The issue of emotional valence has rarely been addressed. One study (Borod, Welkowitz et al., 1990) found that the performance of RBDs was more impaired on positive versus negative emotions as compared to normal controls.

Lexical

As is implied from the discussion on prosody, the notion that the left hemisphere is dominant for language functions does not strictly hold. The right cerebral hemisphere and specific subcortical structures have been implicated in several important aspects of language. Therefore, the role of the left cerebral hemisphere in emotional expression, specifically, needs to be clarified. Unfortunately, few studies of this type have been published, and none are known that have examined posed lexical expression. Therefore, this review will discuss findings from studies of spontaneous expression studies and other relevant information. A preliminary study (Bloom, Borod, Obler, & Koff, 1990) elicited spontaneous emotional responses from RBDs, LBDs, and NCs by showing subjects emotionally laden slides. This study measured the subjects' discourse for category and valence accuracy and the emotional intensity of the words used. It was found that LBDs, despite frank aphasia, were better at using words to accurately convey emotion. The RBDs used words that were rated lower for degree of pleasantness and emotional intensity as compared to LBDs and NCs. LBDs actually used words of higher emotional intensity than NCs, suggesting the use of a compensatory communication strategy. In a larger study (Bloom, Borod, Obler, & Gerstman, 1992), RBDs, LBDs, and NCs were studied for their discourse which was produced in response to the free-viewing of pictorial stimuli. The responses were rated for the presence of predetermined content elements. Three different stimuli were used, one with primarily emotional content, one with visual-spatial content, and one with neutral/procedural content. It was found that although the amount of speech produced was not significantly different across the groups, the brain-damaged subjects produced significantly less content elements than controls. Of particular interest is the finding that RBDs produced significantly less content for the emotional stimulus as compared to the other two stimuli, offering support to the notion that the right hemisphere plays a special role in emotional expression even through the lexical channel. Additional support comes from the study of the effect of emotional content on the pragmatic ability of aphasics during discourse (Bloom et al., 1993). In this follow-up study, the authors concluded that emotional content provided a facilitory effect on the ability of LBDs to produce discourse with appropriate pragmatic features such as topic maintenance, relevancy, and quantity of information. On the other hand, emotional content seemed to suppress the pragmatic performance of the RBDs, further supporting the role of the right hemisphere. Similarly, this faciliatory effect was found in a study of brain-damaged and normal control subjects who produced monologues while recollecting emotional and nonemotional experiences (Borod, Rorie, et al., 2000). Emotional content enhanced the pragmatic performance of LBDs and suppressed performance of RBDs.

As previously stated, no studies in the literature have utilized a posed lexical emotion task, similar to the type being used in this study. One Italian review (Zammuner, 1998) offered support for the premise underlying the use of our posed lexical task which asks subjects to generate single words that are related to individual emotions (e.g., “happy”, or “sad”). This review studied the ratings of 153 Italian emotion words by undergraduates for several dimensions including “emotionness”. Based on findings from regression analyses, the author concluded that judgments of the “emotionness” of single words reflect a summary of the emotional features communicated by the word. Therefore, our lexical task should be comparable to the facial and prosodic tasks, in that posed words will communicate emotion in a way that is similar to the isolated faces and prosodic expressions.

Study Objectives

The aims of the current study were as follows:

1. To test the two neuropsychological theories regarding hemispheric specialization of emotional expression.
2. To replicate and futher develop rating procedures for use across three different channels of communication.
3. To explore the relationships among communication channels.
4. To explore the relationships among parameters of emotion.

Methods

Participants

Overview. In this study, 54 individuals served as what would traditionally be called "subjects". These 54 individuals produced the posed emotional expressions under study and will therefore be referred to as "posers". These posers were a subset of brain-damaged and normal control subjects who had participated in a larger NIH-sponsored study (Joan C. Borod, Ph.D., Principal Investigator) at Mount Sinai Medical Center. Additionally, 15 individuals served to rate the posed expressions produced and will therefore be called "raters". To avoid confusion, the terms "poser" and "rater" will be used to distinguish these two groups of participants.

Posers. Of the 54 posers, 36 were individuals with unilateral brain damage (BDs), 17 of whom had damage to the left hemisphere (LBDs) and 19 to the right hemisphere (RBDs), and 18 were neurologically normal who served as normal controls (NCs). Brain-damaged posers had unilateral strokes as confirmed by CT and/or MRI. Right and left brain-damaged patients (RBDs and LBDs) were eligible for the study if they had a single-episode cerebrovascular accident that resulted in subsequent symptomotology. Prior to participation in the larger NIH study, verification of stroke, relevant neurological history, and lesion site were determined by the clinical medical record and the report of the neuroradiologist at the time of initial hospitalization. Before brain-damaged posers were selected for this study, all available scans, CT and/or MRI (39 in total), were read by the neurologist consulting to the larger project. This reading was done blind to the original site determination; acute clinical symptomatology, as reported by the initial treating neurologist, was provided to the project neurologist during his reading of the scan when necessary to determine the structures involved. The experimenter then compared the initial and subsequent readings. Where differences occurred (6 scans), a third opinion was obtained from a neurologist not connected with the study, and the consensus view was used. Copies of scans were not available for eleven subjects who were ultimately included as posers in this study (e.g., due to a failure of the treating hospital to send scan copies upon repeated requests). For these posers, lesion site was determined by staff on the larger NIH project, including the project PI, in conjunction with the project neurologist, based on the written description in the neuroradiological report, as well as associated clinical and neurological symptoms reported in the medical record.

In order to select which subjects would be included as posers in this study, data from all brain-damaged subjects were reviewed for completeness and quality of the tapes. That is, posers for this study were required to have completed all three experimental tasks under study and the related control measures. Subjects did not meet this criterion if they had not returned to complete the study or became ill during the course of their participation. Also, the audio and video tapes on which the posed expressions were recorded were reviewed. Subjects were not considered for this study if a meaningful portion of their data (tapes) was unrateable (e.g., audio clouded by static or video too dark to be viewed adequately).

As our goal here was to include as many posers as possible, all subjects from the larger study who had usable data as defined above were included in a table, categorized by lesion site based on caudality and verticality (22 LBD, 32 RBD in total). Subjects with lesions solely involving subcortical white matter structures were excluded; differences in performances of these posers would be hard to interpret due to the paucity of literature with respect to the effect of subcortical white matter lesions on emotional functioning. After those subjects were excluded, all remaining LBDs (n=17) were included. The RBDs were included if their lesion site, caudality, and verticality distinctions reasonably matched one of the LBDs (n=17). When more than one RBD was available for matching, a particular one was chosen based on specific lesion sites involved and their presumed role in emotional functioning. For example, of the 7 possible 'subcortical only' RBDs, the 4 chosen were posers with lesions involving specific structures that best matched the LBDs' basal ganglion and thalamic lesions - structures believed to be involved in emotional functioning. Secondarily, poser matching was also completed with an overall view of having groups similar in terms of number of brain structures involved/damaged, which was assessed after each matching combination was considered (Tables 1 and 2). Two additional RBDs with lesions in the right frontal cortex were selected. These individuals are of particular interest because of the right frontal lobe's demonstrated involvement in the expression of emotion (Borod, 1993). See Tables 1 and 2. It will clearly be indicated when these two posers are included in analyses. Tables 1 through 4 indicate the RBD group both without (n=17) and with (n=19) these two posers.

A group of normal control posers (n=18) was then matched based on relevant demographic factors. A process was carried out in which NC subjects were chosen from the overall group of 94 NC posers who had data for all posed expression tasks (the NC subjects from the larger NIH study at the time), based on the demographics that are considered relevant in studies of emotional expression, i.e., age, education, occupational status (as measured by the Hollingshead scale [Hollingshead, 1977]), gender, and ethnicity (based on NIH definitions). Next, normal control posers' data were checked for completeness and quality before being added to the final group from which NCs would be drawn. Then, a group of several possible NCs was chosen (with an eye toward maintaining the age, gender, and ethnicity balance present in the BD groups) and their overall demographics were calculated. Upon seeing the results of this process, we determined what changes were necessary to make the groups better mathced (e.g., the NCs were initially too old and had too many males). NCs were then added and deleted one-by-one until the groups were very well matched. Finally, a group of 18 NCs were chosen and their demographics were determined. See Table 3.

In order to compare demographic characteristics of the three poser groups, we conducted one way analyses of variance (ANOVAs) for Group (RBD, LBD, and NC). No significant group differences were found for age, $\underline{F}$ (2, 49) = 0.15, $\underline{p}$ = .862; years of education, F (2, 49) = 0.01, p = .991; occupational status as measured by the Hollingshead scale, F (2, 49)= 0.43, p = .651. There were also no significant group differences when the two RBDs with frontal lobe lesions were included (df = 2, 51, p values: .958, .992, .696, respectively). There was no significant difference in months post onset of stroke between the two brain-damaged poser groups with the 2 additional RBDs, t (34)= 0.43, p = .510, or without them, t(32)=0.60, p= ..445. There were no significant differences in gender across the three groups with the 2 additional RBDs, Chi Square (1, 54)=0.18, p=.913, or without them, Chi Square (1, 52)=0.06, p=.969, nor differences in ethnicity, Chi Square (1,54)=0.00, p=1.000, Chi Square (1,52)=0.06, p=.969.

All posers were right-handed by self report and by the Coren, Porac, and Duncan (1979) lateral preference inventory, without history of being forced to switch from left-handedness. All posers were native English-speakers or had begun using English by age 7. Prior to being entered into the study, all posers had been subjected to careful phone screening to eliminate those with any history of prior neurological insult or disease, psychiatric disorder, mental retardation, or learning disability. Upon beginning the study, all posers were interviewed with the Schedule for Affective Disorders and Schizophrenia-Lifetime Version (SADS-L; Endicott & Spitzer, 1978) to exclude any participants with significant premorbid psychiatric disorders or any history of significant substance abuse.

All posers also met established entry criterion based on screening tasks that measured general cognitive ability to ensure that they possessed the basic cognitive ability to complete the experimental tasks. See Table 4. Selected subtests of the Wechsler Adult Intelligence Scale - Revised (WAIS-R; Wechsler, 1981) were administered to assess basic cognitive skills that would be necessary for adequate participation in the experimental tasks. The Block Design subtest was administered to the NCs and the LBDs to test intelligence in a non-verbal modality and the Information subtest administered to the NCs and RBDs to test intelligence in a verbal modality. Two subtests (Attention and Memory) of the Mattis Dementia Rating Scale (MDRS; Mattis, 1988) were administered to all posers to assess basic memory and attention skills. One subtest (Complex Ideational Material) of the Boston Diagnostic Aphasia Examination (BDAE; Goodglass and Kaplan, 1983) was administered to ensure that all posers would be able to handle the basic cognitive and linguistic requirements of the experimental tasks (e.g., understanding instructions). Although not used as a screening measure (the SADS-L served as the screening measure for mood), the Beck Depression Inventory was used to assess current mood in all posers with no preset cutoff point. The cutoff scores used for the screening measures in this study were generally 1-2 standard deviations (Sds) below the normal mean. Although all posers met preestablished criteria for entry to the study, we ran one-way ANOVAs on each task to determine if there were group differences in performance on these tasks. The only significant difference was for the DRS Attention task, F (2,49)=4.73, p=.013. Follow-up with an LSD procedure revealed that the RBDs performed worse on this task than both the NCs and LBDs who did not differ from one another. However, this group difference was not deemed to be clinically significant as the group means differed by less than 1 point (Means: RBD=35.47, NC=36.28, LBD=36.53; in all groups the highest score by any poser was 37/37). All LBD posers also completed the Boston Diagnostic Aphasia Examination (BDAE; Goodglass and Kaplan, 1983), which was administered by a doctoral student in Speech and Hearing Sciences. Based on BDAE performance and medical record information regarding language functioning at the time of stroke, as well as the examiner's evaluation of spontaneous speech and posers' subjective views, expressive language functioning was coded as follows: 0=no aphasia present or past, 1=history of aphasia with no current deficit, 2=mild residual aphasia, 3= frank aphasia in past and at present, 4= language deficit yet no aphasia history. Posers in the current study received codes of 0, 1, or 2 and were grouped accordingly for analyses related to the effects of emotion in posers with language impairment. That is, posers with no language impairment (codes of 0 or 1) were grouped seperately from posers with language impairment (code of 2) in some analyses. All posers were told that the purpose of the research was to study emotional processing, and that they would be video and audio taped during the course of the study. Informed consent was obtained before the start of testing. All posers were paid for their time and travel expenses.

Raters. As previously stated, the individuals who completed the rating procedures to "score" the experimental and control data are called "raters". Raters were undergraduate students at Queens College who responded to posted advertisements and/or classroom presentations by the experimenter describing the responsibilities of a rater. All were paid the same hourly wage for their time. Raters were subjected to screening procedures, similar to those used with posers, to ensure that they had no history of neurological insult, significant substance abuse, major psychiatric disorder, or learning disability. All raters were native English speakers or had begun to use English by age 7. It was determined prior to advertising, that 15 raters would be needed in total. Separate groups were deemed necessary to rate each channel of experimental data and another group to rate control data in order to prevent carry-over effects, primarily becoming overly exposed to the 8 emotions. With a goal of balancing the need for good interrater reliability with the need to find appropriate raters whose schedules matched, it was determined that four raters were needed for the experimental ratings in each channel (for a total of 12 raters) and three would be adequate to rate the control data. It was expected that the control data would be less variable and more easily rated, therefore fewer raters were appropriate. Also, no carryover effects were expected when rating the nonemotional control data so the three raters rated control data for each channel of experimental data. The four groups therefore needed to be matched on age, gender, and education. Of all respondents who could be reached for screening, the 15 were selected based on a process which accounted for demographics (in order to have 4 matched groups), and availability (individual raters had to have free time that allowed for group training and rating sessions). One-way ANOVAs were conducted for each demographic variable to ensure that the groups of raters did not differ. Once 4 groups were established, advertising ceased and rating groups were finalized. Demographic characteristics of the raters, by group, are presented in Table 5 with results of ANOVAs.

Collection of Expressive Data from Posers

Experimental Tasks

The posers produced expressions during facial, prosodic, and lexical tasks of posed emotional expression from the New York Emotion Battery (NYEB; Borod, Welkowitz, & Obler, 1992). Posers were informed that the purpose of the research was to study emotional communication and were aware that they were being video/audiotaped. For each task, the eight emotions studied were three positive/pleasant (i.e., happiness, pleasant surprise, and interest) and five negative/unpleasant (i.e., sadness, disgust, unpleasant surprise, fear, and anger). These emotions were derived from those described by Ekman and Friesen (1975) and Izard (1977). The order of emotions was completely randomized across trials.

The facial and prosodic expression tasks required a poser to express, with as much emotion as possible, each of the eight target emotions, randomly presented. The prosodic task utilized neutral-content sentences (e.g., "They found it in the room"). The first trial in each task was a practice trial, using one of the eight emotions, which had been randomly selected. On the eight subsequent trials, posers were given an opportunity to practice the expression once and then to repeat it. The procedures followed were based on those described in Borod et al., (1986) and in Borod, Welkowitz, et al. (1990) and appear in the NYEB (Borod et al., 1992).

The lexical expression task required a poser to generate as many words as possible that were related to one of the emotion categories (e.g., happiness); each of the eight emotions was presented one time. Posers were asked to use only single words, and to avoid proper names and repetitive responses. One minute was provided for each emotion, and the entire task was audiotaped to ensure accurate transcription for scoring purposes. There is no neutral category for the lexical channel.

Neutral Poses. In the facial and prosodic channels, posers also produced a "neutral" expression; they were asked to pose a face/voice that did not express any emotion. This pose was the last of all poses, coming only after all 8 emotional poses were completed. This pose was included in the intensity ratings for each poser and in a separate rating described later.

Nonemotional Control Tasks

Facial Channel. To control for aspects of facial expression that are not related to emotional communication, posers completed tasks to measure facial paralysis and facial praxis. Based on methods from previous work (Borod et al., 1988), to examine facial paralysis, the posers were videotaped for one minute while they were presenting their "neutral" face. Posers were told to relax and to try to not show any emotion with their face. To examine bucco-facial praxis, a task was used which asked the poser to make six non-emotional movements with their face which was adapted from a standard clinical test of facial apraxia (Goodglass & Kaplan, 1972). The subjects were asked to (pretend to) sniff a flower, blow out a match, puff out the cheeks, lick the lips, suck through a straw, and cough. Because posers had successfully completed screening tasks, any impairment on this test of apraxia was not due to receptive aphasia.

Prosodic Channel. To control for aspects of prosodic expression that are not related to emotional communication, posers completed a task that measured their ability to use their voice to indicate a specified type of communication while speaking nonsense syllable-sentences (e.g., "Ba-ta-ga"). The task, Intonation Contours (Borod, Welkowitz, & Obler, 1992), demanded that a poser read syllables using a tone of voice that indicates either a question, a statement, or a command.

Lexical Channel. To control for aspects of lexical expression that are not related to emotional communication, posers competed a standard verbal fluency task, Controlled Oral Word Association Test using the letters: F,A,S (Benton, des Hamsher, Varney, & Spreen, 1983) and Animal Naming (Goodglass & Kaplan, 1972). Posers were asked to produce words that began with the specified letter of the alphabet, or names of animals, for one minute. Standard instructions and scoring procedures were used.

Preparation of the Data for Rating

Experimental Tasks

Facial Channel. For the facial channel, it was decided to use a single frame from the entire trial which represented the peak of emotional expression, as opposed to several seconds of tape. Use of a single frame allowed the "data" to be comparable across channels in that each item presented to raters across channels was only that which contained the most emotional aspects of the posers' expression as opposed to the early and late motoric aspects of the expression. The peak frame also prevented exposure to any movements that could provide information about the poser's group membership (e.g., neurological status) and that could distract from the rating of the expression itself.

Prior to ratings, one of the experimenters and a volunteer (who was naive to the aims of this study) selected the single frame which represented the peak of the emotional expression from the second expression in each trial for every poser. The practice trial was not used for ratings unless a technical error had occurred which made the second expression not clearly visible. To select the frame to be rated, the entire trial was first reviewed. The few seconds containing the height of the expression were easily identified. This section of the trial was then reviewed frame-by-frame. Discussion was held regarding the qualities that indicated the peak of the expression. Agreement was reached about the peak frame in 90% of the trials; a third individual naive to the study's aims was consulted in the remaining 10% of the trials in order to reach consensus.

The peak frame was then copied onto the rating tape for a 10-second exposure, with a 4-second interval of blank tape between trials, allowing time for the raters to complete their ratings. The order of expressions on each tape to be rated was quasi-randomized in the following way. The order of posers was completely randomized (i.e., across poser group). The order of emotions was predetermined by the order in which the poser had produced the expressions. In this study, complete randomization by emotion was not deemed necessary as the posers produced the emotional expressions in random order based on one of four test battery orders to which they had been consecutively assigned upon enrollment in the study. Since each of the four battery orders had already been randomized by emotion, this order was used here to prevent the dramatic increase in preparation time that would be necessitated if we had done a complete randomization by subject and emotion.

Because a left visual-field perceiver bias has been demonstrated in studies of free-field viewing of facial expressions (Borod, St. Clair, Koff, & Alpert, 1990; Jaeger, Borod, & Peselow, 1987; Levy, Heller, Banich, & Burton, 1983; Moreno et al., 1990; Sackeim & Grega, 1987), facial expressions were viewed by the raters on two television monitors to control for this bias; one that displayed the image in the original orientation and one that automatically displayed the mirror-reversed orientation. Of the total 486 expressions (54 posers x 9 expressions), 243 were viewed in original orientation and 243 in mirror-reversed. This was accomplished by switching between which video monitor was used to show the expressions. The monitor used was switched every 54 expressions. This number was used as it provided an adequate balance between preventing raters from becoming used to one monitor and avoiding too many switches. Raters were not told why two monitors were used and were able to view each monitor equally well.

Prosodic Channel. As with the facial data, the practice response from the poser was not used unless a technical error had occurred during taping, making the second expression inaudible. The sentences were then edited onto an audiotape using the randomizing procedure discussed for the facial channel. Each prosodic expression was duplicated and presented twice in succession prior to rating. Two exposures to the expression were necessary based on previous findings that rating prosodic expressions is frequently the most difficult, and because the stimulus itself (e.g., the sentence being said in an emotional tone of voice) is quite short, lasting approximately, three seconds. The time between the two presentations of the same sentence was three seconds, and the inter-trial interval was five seconds. A five second inter-trial interval was used, instead of the four-second interval used in the facial channel, because additional time was needed so raters could distinguish between the inter-stimulus interval (of three seconds) and the inter-trial interval. Differences in these intervals were acceptable as the measures had been developed to allow optimal rating conditions appropriate for each channel.

Lexical Channel. All words generated by each poser for each category were subjected to a detailed scoring procedure (Tabert et al., 1997) to eliminate any production errors (i.e., repetitions, proper names, or phrases) from the rating sessions. These words were then completely randomized and presented via computer. All of the unique words were presented for Intensity and Category Accuracy ratings. The rater responses were then automatically recorded and stored for analysis. Although this procedure is somewhat different from the rating procedures in the other two channels, the volume of lexical data precluded handwritten ratings. And, training ensured that raters were comfortable with the computerized system. A total of 2245 words was presented.

An additional rating was completed for the words which had been produced for more than one emotion category by at least one poser. For this rating, 361 words were presented in a separate rating session, which was conducted after the Accuracy ratings for all the words had been completed. These words were presented in a format similar to the Accuracy ratings.

Neutral Poses. The neutral poses were included in the Intensity rating tapes for the facial and prosodic channels and rated for Intensity, similar to the other 8 poses. Additionally, a separate audio and video tape of neutral poses was created. For the facial channel, neutral poses were completely randomized and edited onto the rating tape for 10 seconds. Neutral prosodic poses were also completely randomized and presented twice, with a 3-second inter-stimulus interval and a 10-second inter-trial interval. The 10-second inter-trial interval was necessary because raters were asked to determine "how much" of each of the 8 emotions were present in the pose, on a scale of 1-7. This rating was conducted to assess the degree of "background" emotion present, i.e., the degree of emotion present even when posers were not attempting to produce emotional expressions.

Nonemotional Control Tasks

Facial Channel. A single frame from the video tape of each posers' neutral face was used to rate facial paralysis. The frame for rating was decided upon by the experimenter and a naive judge who selected the most representative frame in a consensus judgment process similar to that described for the preparation of the experimental facial data. The single frame selected was copied to a rating tape allowing for a 10-second exposure. Again, a 4-second intertrial interval of blank tape was provided. The rating tape for facial paralysis was randomized by poser. For bucco-facial apraxia, the several frames of tape that showed the posers' movement in its entirety were similarly selected and edited onto a rating tape. Several frames were necessary for the rating of this task as each movement involved more than a single pose. This rating tape was also randomized by poser.

Prosodic Channel. The Intonation Contours expressions were prepared in a similar manner as the experimental task. The expressions were presented twice with three seconds between each presentation, and an inter-trial interval of six seconds. The tape was randomized by poser.

Lexical Channel. The words produced in the F,A,S, and animal naming tasks were scored (i.e., counted as correct) according to standard scoring procedures. All words scored as correct were included in a total score for that poser.

Rating Procedures

Experimental Data

In order to evaluate the expressions produced by these three groups of posers, three separate ratings were carried out (i.e., three parameters were rated). Of particular interest were the parameters of intensity and category accuracy. Intensity was rated to capture the degree of expressiveness and emotionality with which the pose was produced. Category accuracy was rated to capture the poser's ability to pose discrete emotions in an identifiable manner. Additionally, a measure of the rater's confidence was included as a means to qualitatively assess posers' errors. In other words, low accuracy scores could result for two basic reasons: posers produced good poses for the wrong target emotion or posers' produced ambiguous, difficult to judge poses. In the first case, we would see low accuracy but high confidence and in the latter, low accuracy and low confidence.

Intensity. Emotional intensity was defined as how much feeling or emotion the expression conveyed. The following 7-point Likert scale for measuring intensity was used for all three channels:

1	2	3	4	5	6	7
minimally intense	slightly intense	mildly intense	moderately intense	quite intense	very intense	extremely intense

For the facial and prosodic channels, raters were presented with the rating tapes described above along with a printed version of the intensity scale, and a response booklet. They were asked to mark their responses, a number from the intensity scale, in the booklet. For the lexical channel, the list of words to be rated was presented by a computer program and raters were shown how to mark their responses using the keyboard. All raters were trained to determine the overall emotional intensity of the expression and to utilize modality-specific characteristics. For the facial channel, the focus was on the degree of muscular involvement. For the prosodic channel, the focus was on varying degrees of amplitude and pitch in the voice. For the lexical channel, the focus was a linguistic/semantic judgment regarding the most widely used meaning of the word.

Category Accuracy and Confidence. Ratings of category accuracy were completed to assess how accurately posers were able to express the target emotion, using the specified communication channel. The task of the raters across channels was to determine how well the poser communicated the target emotion. To do this, raters were asked to determine which emotion category the expression fit into best. In each channel, the expressions were presented to raters in the same way as they had been for the rating of intensity. Because ratings for category accuracy took place on a separate day, there was no risk of raters becoming too familiar with the order of the stimuli. Raters were also presented with a randomized list of the eight emotions from which they were to choose their response. After being presented with the stimulus, raters selected the emotion they thought most accurately identified the expression posed. Raters also indicated how confident they were of their choice, on a scale of 0-4:

0	1	2	3	4
not at all confident	somewhat confident	moderately confident	very confident	extremely confident

As mentioned, an additional Lexical rating was conducted for 361 words produced in more than one emotion category. Because the primary Accuracy rating forced raters to choose only one emotion category, despite several categories possibly being appropriate for a word (e.g., the word "death" was produced by several posers for the categories of 'Fear', 'Sad', and 'Unpleasant Surprise'), we used this third lexical rating (referred to as Lexical Accuracy II) to account for these productions. Ratings were conducted in a similar manner to the primary Accuracy measure except that raters were asked to choose all the emotion categories into which the word could reasonably fit. Confidence ratings were not collected for this measure.

Nonemotional Control Data

The control data was rated to determine how well the subject could perform an expression task that is comparable to our experimental task, but does not involve an emotional component. In the facial channel, because facial characteristics could influence ratings, facial paralysis (Borod et al., 1988): was rated for the presence and degree of asymmetry of six facial features: wrinkles on the forehead, position of the eyebrow, size of the eyelid, position of the corners of the mouth, depth of the nasolabial fold, and direction of the middle of the mouth. Asymmetry ratings were done using a 5 point Likert-type scale (e.g., "-2" a lot more wrinkled on the left, to "0" no difference, to "+2" a lot more wrinkled on the right). For bucco-facial apraxia (Borod et al., 1987), the movements were first rated for correctness (1=correct, 0=incorrect). Then, a 3-point scale was used to judge how the facial movement was executed (1=poorly executed to 3=well executed). In the prosodic channel, the raters selected which intonation they thought was posed. Expressions were then scored as "correct" if the rating matched the target intonation, and as "incorrect" if it did not (1=correct, 0=incorrect). For the lexical channel, words produced were also scored for correctness based on whether or not they were correct based on standard scoring procedures(1=correct, 0=incorrect).

Training the raters.

Experimental Data

Training procedures to prepare raters for rating the experimental data were based on a pilot study which developed a system of training that would be comparable across the three channels. The procedures in each channel are based on analogous properties and focus raters on features of the expressions that are conceptually similar. The pilot study demonstrated that use of these procedures allowed for sufficient interrater reliability

(Canino et al., 1999). Formal training was not conducted for the Confidence ratings. Extensive training was not deemed appropriate as the Confidence rating was meant to be a personal, subjective assessment. Unlike the Intensity and Accuracy ratings in which raters were trained to rate as others would likely rate, the Confidence rating asked them to determine their individualized perception. Therefore, group consensus was not necessary.

A system was developed which involved three levels of training. This system was maintained across the three channels and the two parameters. The three levels of training were: (a) Introduction and Definition, (b) Presentation of Exemplars, and (c) Conferencing. After training was accomplished, inter-rater reliability (IRR) was evaluated. The four raters evaluating expressions from each channel were trained together. See Appendix A for an example (for Lexical Category Accuracy ratings) of the instructions used to train the raters.

Introduction and Definition. The first level of training provided an explanation to the raters of what they would be asked to do during the rating sessions. This level defined the relevant terms, such as "emotional intensity", provided a description of the eight emotions, and explained the rating to be completed. Once raters had a framework for understanding what they would be asked to do, exemplars were presented.

Presentation of Exemplars. The materials to be used as exemplars were those that clearly represented each scale point. In each of the six rating sessions (3 channels x 2 parameters), two to four exemplars were presented for each possible response. The exemplar materials consisted of posed expressions produced by trained actors and actresses for the facial and prosodic channels (Borod, Cicero, et al., 1998). The lexical exemplars were derived from the literature (Brown & Ure, 1969) and from word lists previously developed in our laboratory (Andelman, 1990; Borod et al., 1994, 1998). The materials for these three channels had been evaluated for each parameter by five naive judges, and only items that demonstrated very high agreement among the judges were selected to be exemplars. For example, 100 photos of facial emotional expressions produced by trained posers were rated for intensity. Of these, 14 photos representing all 8 emotions, balanced for positive/negative, were chosen, providing two exemplars for each of the seven scale points for intensity. When presented in experimental rating sessions, each exemplar was discussed in order to point out the characteristics that the raters should attend to (e.g., for facial intensity, the extent to which the muscles around the eyes and mouth are tightened or the degree of widening/narrowing of the eyes.).

Conferencing. The third level of training occurred after all the exemplars had been reviewed. This was called the "conferencing stage", and it allowed for practice ratings, discussion, and review. Conferencing materials were derived from data collected from brain-damaged and normal posers who had participated in a larger NIH project. The decision to use these posers, as opposed to trained actors and actresses, for conferencing was based on the need to ensure that the raters would be adequately prepared for rating more difficult and potentially ambiguous stimuli. In contrast, posed expressions from trained actors and actresses were used in the exemplar stage to provide stimuli that were relatively clear and unambiguous. It was believed that practicing and conferencing with such "ideal" stimuli would lead to high interrater reliability but would not necessarily prepare the raters to assess stimuli that were more ambiguous. Therefore, it was decided to practice with materials that would more closely resemble the expressions of the posers in the current study.

To create the conferencing materials, poses were taken from the larger data set to be representative of the three poser groups equally, and to reflect the gender, age, and ethnicity of the experimental posers. The same posers were used for each of the three channels of conferencing training. Sixteen conferencing items (8 emotions x 2 times) for each of the six training sessions were presented in a randomized order with respect to emotion and poser. A backup set of materials was available for each channel in case raters did not achieve the conferencing criterion.

The process of conferencing began by having each rater independently rate the same item. Each rater then shared their opinion, and the experimenter led a discussion to focus on rating techniques to encourage group consensus. Techniques that were consistent with the training instructions were reinforced, and others were discouraged, particularly idiosyncratic methods (e.g., ones based on highly personal experiences or individual cognitive styles). This process allowed raters to learn how they were rating in comparison to the other raters and to share techniques for evaluating the stimuli. The raters were then given another opportunity to rate the item, as the discussion may have helped them make a different determination. A tally of the ratings from each rater before and after discussion was kept by the experimenter. It was previously determined that training would not end until the group had obtained at least 70% agreement for the ratings made after the discussion.

Assessing Interrater Reliability

After conferencing criteria had been met, interrater reliability (IRR) was assessed using intraclass correlations, separately, in each of the rating sessions. Similar to the development of conferencing materials, items for IRR were derived from actual poses from the larger NIH study. To assess IRR in all channels, 30 poses were used. The 30 trials were created to reflect as equally as possible the three poser groups and the discrete emotion categories; these trials were produced by 30 different individuals, who were chosen to reflect the gender and ethnic makeup of the larger database. IRR was assessed in each of the rating sessions by having the raters evaluate each trial individually.

Additionally, for the lexical channel, an additional 30 items were used to assess IRR using the computerized format. These 30 items were derived by taking one additional word from the same subjects described above. Raters were then introduced to the computerized rating system and allowed to practice on three trial items that were actually previously used conferencing items. Then, they were asked to complete ratings on 30 new IRR items and the group had to meet the same criterion on the computer before experimental rating sessions would be conducted. Criterion IRR was met in the first attempt in all rating sessions.

Experimental Rating Sessions

The raters proceeded to evaluate the experimental data for the parameters. Within each channel, the data were first evaluated for the parameter of intensity, then for category accuracy and confidence (together). Using this order, intensity was evaluated before individual emotions were discussed, therefore the raters were not aware of specific emotions during the intensity ratings. Across all channels, raters were not trained in the category accuracy ratings until experimental ratings for intensity had been completed.

For the facial and prosodic channels, raters were required to evaluate 486 poses (54 posers x 8 emotions plus Neutral) for the Intensity measure and 432 poses for the Category Accuracy measure (54 posers x 8 expressions). For both Intensity and Category Accuracy in the lexical channel, the raters were required to evaluate 2245 words.

Summary

Training sessions lasted, on average, 2 hours per parameter. Time to complete experimental ratings varied, depending upon the amount of material being rated, e.g., because the Lexical experimental task generated far more expressions than the Facial or Prosodic channels, ratings of the Lexical data took somewhat longer. Once training was completed and adequate IRR attained, raters were allowed to complete the experimental ratings in sessions of varying length, depending upon their individual schedules and preferences. This helped to ensure that raters were not fatigued or rushed during experimental ratings.

Nonemotional Control Tasks

The three raters for the control data were trained together and rated data from one channel per rating session.

Facial Channel. For the facial paralysis data, raters were trained (Madigan, 1998) to use a Likert-type scale that incorporates ratings of the upper and lower face to determine an asymmetry score, i.e., presence and degree of asymmetry. The six facial features to be rated were reviewed and then three samples were presented and discussed. Next, 18 trials were presented for conferencing and discussion. Finally, interrater reliability was tested using 12 subject trials. IRR was tested with intraclass correlations before raters were able to move on to rating the experimental subjects. For bucco-facial apraxia, raters were trained on the six facial movements and typical correct and incorrect samples. Two samples of each movement were then presented, one sample being correct, the other incorrect. The same 12 subject trials were shown again to allow practice ratings of how the facial movement was executed using a 3 point scale (1=poorly executed to 3=well executed). Next, 18 trials were presented for conferencing. Finally, IRR was assessed by presenting each of the six movements from 12 subjects and having raters complete bucco-facial ratings. The orientation of the facial stimuli was balanced across all facial ratings by presenting half of the stimuli to be rated in any given block in the original orientation, and the other half in mirror-reversed orientation.

Prosodic Channel. For the Intonation Contours data, raters were trained by having them complete the Intonation Contours perception task from the larger battery. This task presents three samples and then 24 trials. Raters needed to meet preestablished criterion on this task before rating the Intonation Contours expressions of the experimental subjects. For the experimental ratings, raters were shown a list of the three targets and were asked to judge which one best represented the expression presented. The poser's expression was later given a score of 1 (correct) or 0 (incorrect) based on whether or not the majority opinion of the raters agreed with what the poser had been asked to express.

Lexical Channel. Because the F, A, S, and animal naming tasks produced data that could be judged objectively as correct or incorrect, this experimenter and another staff person working in the laboratory, scored the data from this channel. Scoring was completed blind to the poser's identity or group classification. A total number correct was obtained for each poser.

Statistical Procedures

Statistical Analyses

Overview. There were several primary components to the analyses, and additional secondary analyses. The primary analyses included assessment of Interrater Reliability, measurement of differences between poser groups on the control tasks, testing the Emotion Hypotheses, and determining the degree of correlation among channels in an effort to test for the presence of a central processor for emotional posed expression. In addition to these, other analyses were conducted to explore more discrete issues. These include analyses to understand the impact of anterior lesions on performance; determine the effect of "background emotion" on posed emotional performance by testing differences in posers' neutral face and voice; and test whether emotion facilitates lexical expression in LBD posers. Each of these analyses will be discussed separately below.

Interrater Reliability. Reliability of ratings across each of the three groups of raters rating the experimental tasks was determined for the intensity and accuracy parameters, in each channel, for both the training and experimental ratings. Control data were also tested for IRR. Ratings of Confidence were also tested although training had not been done to ensure reliability across raters on this measure. An intraclass correlation statistic was used to test IRR for tasks that generated scale data (i.e., Bucco-facial Execution, Intensity, and Confidence), and percent complete agreement was used for those tasks that generated categorical data (i.e., Bucco-facial Accuracy, Intonation Contours, and Accuracy).

Collapsing of Data

Because IRR was sufficiently high on all tasks, experimental and control, it was appropriate to collapse the ratings across the group of raters to create the data used in the following analyses. For the bucco-facial execution, facial paralysis, intensity, and confidence ratings (all scale data), an overall average of the ratings was determined for each subject. For the bucco-facial execution, intonation contours, and accuracy ratings (all non-scale data), the rater's response was coded as either a '1' if it matched the poser's target, or '0' if it did not match the target, and an average was taken across the raters. Therefore, for each trial in these tasks, the raters' scores were converted to data with a range from 0 to 1.

Control Data. Before conducting analyses on the experimental data, the performances of the groups on the control tasks were tested for significant differences. This was done in order to determine whether it would be necessary to control for these factors in the analyses of the experimental data. One-way ANOVAs on Group were conducted for each task. It had been previously determined that significant differences found on the non-emotional control tasks would be followed up by determining the degree to which performance on that control task correlates with performance on the related experimental task. We did not automatically use them as covariates because it has not been proven that these control tasks, which were chosen based on presumed non-emotional skills underlying emotional posed expression, are highly correlated with the experimental tasks used here. When both significant differences between groups on the control measure and significant correlations were found, then that control task was used as a covariate in analyses of the experimental data.

Testing the Emotion Hypotheses.

Right Hemisphere Hypothesis. As previously stated (i.e., in the Introduction), the right hemisphere hypothesis of emotional processing posits that the right hemisphere is specialized for processing all emotions, regardless of valence. If this is operative, we would see that RBDs would express emotion significantly less intensely and with significantly less accuracy than LBDs and NCs. Because the relationships among emotional Intensity, Accuracy, and rater Confidence are not currently known, we tested this hypothesis for each parameter separately. Therefore, factorial ANOVAs were conducted for Group x Channel.

All significant F-values (p< .05) were followed up with pairwise tests using the Hayter-Fisher LSD procedure.

Valence Hypothesis. As previously stated (i.e., in the Introduction), the valence hypothesis posits that the right hemisphere is specialized for processing negative emotion while the left hemisphere is specialized for processing positive emotion. If this is correct, we would see that RBDs have a selective deficit in Intensity, Accuracy, and rater Confidence in the expression of negative emotion while the LBDs would have a selective deficit in Intensity, Accuracy, and rater Confidence in the expression of positive emotion. Therefore, mixed ANOVAs were conducted for Group (3) x Channel (3) x Valence (2) for Intensity, Accuracy, and Confidence, with Group being the between-subjects factor and Channel and Valence being the within-subjects factors. The Valence variable had 2 levels, Positive Emotion and Negative Emotion. The values used here were the average Intensity Rating or Average % Correct for the 3 positive emotions and for the 5 negative emotions. Significant F-values were followed up with multiple comparisons using the LSD procedure.

Channel Interrelationships

Based on previous work (Borod, Pick et al., 2000; Borod et al., 1990) which found evidence for a general processor for emotional perceptual identification in normal adults and in work that looked for a general processor of emotional expression (Borod, Welkowitz et al., 1990; Borod et al., 1985), we decided to examine the relationships among channels of emotional expression. Average values across all subjects for each parameter (Accuracy, Intensity, and Confidence) were intercorrelated using Pearson product-moment correlation for each of the three channels.

Also of interest was whether or not a group's performance in one channel correlated with its performance in the other channels. Therefore, we correlated each group's performance in all three channel, for each parameter separately using Pearson product-moment correlations.

Lexical Accuracy II

Because a substantial number of words was produced in more than one emotion category, an analysis of all these words was deemed necessary. To do this, each word was first assigned a "score" for each emotion category. A '1' was assigned for each category if a rater had assigned that word to that category, and a '0' if not, and the average across the raters was taken, i.e., a word could get a range of 0 (if no rater selected that category) to a 1 (if all raters selected that category) for each category. Once these scores were obtained for each word for all emotion categories, the scores were then assigned back to the subjects based on their productions (e.g., a subject who produced the word "birthday" for two categories was assigned the 2 scores corresponding to the categories for which they produced the word). This system corresponds to the primary Lexical Accuracy scoring system and accounts for the fact that many words may have reasonably been produced in more than one category. A one-way ANOVA for Group was then conducted on these data to see if there were differences between the three groups. If group differences were significant, a correlation would be run to determine if the two measures were significantly related. If both the group differences and correlation were significant, it was decided that the Lexical Accuracy II scores would be substituted for the corresponding words in the primary Lexical Accuracy x Group ANOVA, effectively adding additional data points to the primary analysis. However, there were no significant group differences on the Lexical Accuracy II measure, $F(2, 51)=.137$, $p=.872$. Therefore, this measure was not included in the results for the Lexical channel presented in the Results section. Of note, the correlation between the Lexical Accuracy II measure and primary Lexical Accuracy was significant, $r=.74$, $p<.01$.

Impact of Anterior Lesions on Performance

In order to evaluate the effect of an anterior brain lesion (with or without subcortical white matter lesions) on posed emotional expression, the LBDs and RBDs were combined and assigned to one of three groups based on lesion site: those with Anterior only (2 and 4), Anterior plus Posterior (7 and 7), and Posterior only lesions (5 and 4). Group (2) x Lesion Site (3) x Channel (3) ANOVAs were conducted for Intensity, Accuracy, and Confidence separately.

Background Emotion

As discussed in the Methods section, posers produced a "neutral" pose for both the facial and prosodic channels. The lexical channel expression task did not lend itself to a neutral pose. These neutral poses were assessed in two ways. First, because raters had rated the Neutral pose for Intensity, an average Intensity rating of the Neutral poses was determined for each group. This average was then correlated to the overall Intensity average of the emotion poses for the respective group, in both channels. This allowed us to examine the degree to which the Intensity of emotion poses was related to the degree of emotional intensity present in the posers' neutral pose across groups.

Secondly, raters had decided "how much" of each emotion type was present in these poses, on a scale of 1-7. The average rating across the 4 raters was taken and became the "score" for that subject's pose, for that emotion. We were then able to assess whether there were group differences in type of emotion, or valence of emotion, that were present in the neutral poses by conducting Group (3) x Emotion (8) ANOVAs for the Facial and Prosodic channels separately. Significant F tests for Group were followed up with univariate F tests on each emotion.

Facilitation

Recent studies have shown that the presence of emotional content facilitates the language capabilities of LBD subjects with aphasia (e.g., Borod, Rorie, et al., 2000). In order to test this facilitation effect here, the performances of the 7 LBD posers with confirmed language impairment (coded as "2" based on BDAE and other results described earlier), the 10 LBDs without language impairment (coded as "0" or "1"), the RBDs, and the NCs were compared on 4 measures of fluency, 2 emotional and 2 non-emotional. The dependent variable was the average number of correct words that were produced by each subject for the 3 positive emotion categories, the 5 negative emotion categories, the Controlled Oral Word Association task (F,A,S), and Animal Naming task. Because all tasks measure the same linguistic ability, i.e., naming single words to a given category, the difference in performance would be due to the emotional component. A Group (4) x Task (4) ANOVA was performed on the average number of words per category.

Working Hypotheses

Based on the current literature, it was expected that the right hemisphere hypothesis would be operative for all three channels. We also expected, based on pilot work, that relationships among channels would be found which show high correlation among performance in all channels for the NCs. Conversely, we expected that the RBDs would show the least correlation among performance across channels. In terms of the influence of lesion site on performance, we expected that subjects with more anterior lesions would have greater impairment on facial expression tasks. Based on the notion that emotional content can facilitate verbal abilities in individuals with left brain damage, we would expect that LBDs show greater intensity of expression in the lexical channel despite the decreased output that could be expected with aphasic difficulties. Independent of whether or not there are group differences in the ability of groups to accurately convey specific emotions, we hypothesize that the RBDs will evoke the least confidence in raters.

Results

Interrater Reliability

NonEmotional Control Data

As described in the Methods section which addressed Training of the Raters, no ratings were done of the Lexical control measure. This measure was scored based on standard scoring criteria to determine 'correct' vs. 'incorrect' responses. Scoring was done by the experimenter and another lab staff person, blind to the poser's group.

Training in the Prosodic channel was completed in order for the raters to meet the preestablished criterion.

Training for the Facial control tasks were done using previously developed training procedures adapted from Madigan (1998).

IRR for the posers' experimental data was determined after all ratings were completed, using intraclass correlation for the tasks that produced scale data (Bucco-facial Execution, Facial Paralysis), and % complete agreement for the tasks that produced categorical data (Bucco-facial Accuracy, Intonation Contours). See Table 6 for results. Additionally, to ensure that the overall IRR was not masking the undue influence of one or more raters in particular, the IRR was determined with each rater removed, in turn, from the overall analysis. See Table 7 for these results. The goal here was to include as many raters as possible to better stabilize the ratings. Although IRR differed from the overall in all tasks when a rater was removed, there was no evidence that one rater was rating in a strikingly different manner than the others. Therefore, no raters were eliminated.

Emotional Experimental Data

As described in the Methods section, IRR for the experimental tasks was assessed in two phases, first, at the end of the training phase, and second, after all ratings of the experimental data were completed. Although raters were not trained on the Confidence ratings, IRR was determined following the training for the accuracy parameter, when raters were first introduced to the confidence measure. At that point, Confidence IRR (assessed with intraclass correlation) was as follows: facial channel = 0.56, lexical channel = 0.73, and prosodic channel = 0.18. Reliability for the Confidence parameter was again calculated after ratings of the experimental data. See Tables 8 and 9 for these results. IRR for the Intensity parameter was greater than .80 across all three channels in the training phase which is considered sufficient (Shrout & Fleiss, 1979). IRR for the Accuracy parameter was greater than 60% in all channels. Because these results reflect 100% agreement on an item across the 4 raters, >60% agreement was considered sufficient. Because IRR in both the Intensity and Accuracy parameters met or exceeded acceptable standards, we were able to move ahead with the ratings of the experimental data, confident in the homogeneity of the 4 raters' approach to their ratings.

Overall, IRR remained fairly consistent in each task, with only a mild decline in values, from training to the experimental data on some tasks, indicating that the Training IRR was a good predictor of the overall agreement on the fuller set of experimental data. The decline was likely due to the significantly larger number of items in the experimental data set as compared to the 30 items used in the training phase. Agreement on the Intensity parameter was again quite good, being greater than .75 across all channels. IRR results for the Accuracy parameter demonstrated that agreement on the prosodic task was the most difficult to achieve, although agreement was still greater than 60%. Agreement on the Confidence parameter was quite high for the facial and lexical channels (.594 and .565 respectively), considering no training for this parameter was conducted. Consistent with findings for the Accuracy parameter, agreement on the Confidence ratings for the prosodic channel was the least strong (.371).

As with the control tasks, IRR on the full experimental data set was determined with each rater removed, in turn, from the overall analysis. See Table 10 for these results. Again, although differences occurred, there was no evidence of one rater significantly influencing the overall results. Therefore all raters' data was maintained.

Because sufficient IRR was achieved on the experimental ratings, the statistical analyses that follow were based on rating data that had been collapsed the across all raters. An overall average was taken across raters unless otherwise specified.

Note that the following analyses were conducted on the overall group of n=52, i.e., excluding the two "extra" right frontals. Tables will include an additional separate column indicating the performance of the RBD poser group when n=19, however, the results reported for the "overall" group will refer to n=52. In a later section we will discuss the effect of including the 2 additional posers with right frontal lesions in the overall analyses.

Effect of Lesion Laterality on Emotional Expression

Right Hemisphere Hypothesis

See Table 11 for data relevant to the following analyses.

Accuracy. In the Group x Channel analyses for the Accuracy parameter, there were significant main effects of Channel, $\underline{F}(2, 98) = 50.30$, $p = .000$, and of Group, $\underline{F}(2, 49) = 4.14$, $p = .022$. There was also a significant Group x Channel interaction, $\underline{F}(4, 98) = 3.25$, $p = .015$ (see Figure 1). Follow-up of the Channel main effect with pairwise comparisons indicated that accuracy was significantly lower in the Prosodic Channel ($\underline{M}=.24 \pm .11$) than in the other two channels and that there was no difference in accuracy for the Lexical ($\underline{M}=.40 \pm .10$) and Facial ($\underline{M}=.38 \pm .11$) Channels (t-tests: Prosodic - Facial/Lexical $p=.000$; Facial - Lexical $p= .381$). The Group main effect indicated that the overall accuracy of the NC group ($\underline{M}= .38 \pm .05$) was higher ($\underline{p}<.05$) than the other two groups (RBD $\underline{M}=.32 \pm .06$; LBD $\underline{M}=.32 \pm .06$), which did not differ from one another. Post hoc tests of the significant interaction indicated that the three groups' accuracy did not differ in the Lexical ($p>.403$) or Facial ($p>.168$) channels, but in the Prosodic channel, the NCs were more accurate ($p=.000$) than the other two groups which were equivalent ($p=.445$).

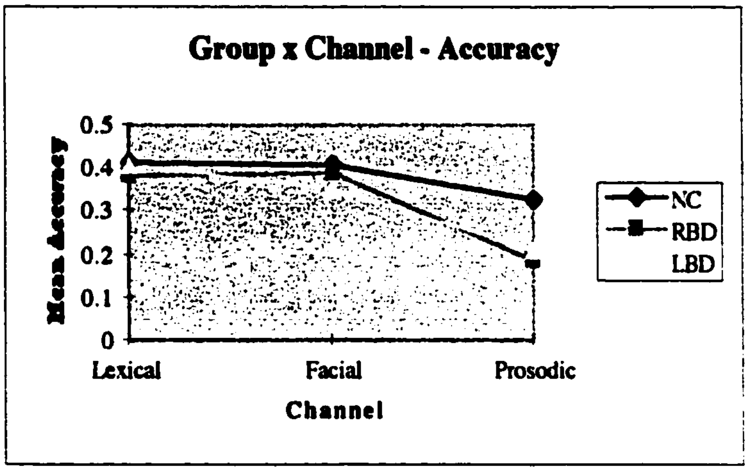

Figure 1 Group by Channel Interaction on Accuracy

Intensity. In the Group x Channel analyses for the Intensity parameter, there was a significant main effect of Channel, *F*(2, 98) = 12.78, p = .000. The Group effect (*p*=.840) and interaction (*p*=.449) were not significant. Follow-up of the main effect of Channel revealed that the intensity of expressions were significantly different in each channel with expressions more intense in the Lexical Channel (*M*=4.34 ± .44) than both the Facial (*M*=4.00 ± .83; p=.024) and Prosodic (*M*= 3.72 ± .82; p=.000) channel. Expressions were also more intense in the Facial than the Prosodic channel (p=.014).

Confidence. In the Group x Channel analyses for the Confidence parameter, there was a significant main effect of Channel, *F*(2, 98) = 56.87, p = .000. Neither the Group main effect (*p*=.478) nor the interaction (*p*=.088) were significant. Pairwise comparisons of the significant Channel main effect indicated that rater confidence was significantly different in all channels (all paired t-tests p=.000) with greatest rater confidence in the Lexical channel (*M*=2.65 ± .28), followed by the Facial channel (*M*=2.45 ± .30), and with the least in the Prosodic channel (*M*=2.10 ± .24).

Valence Accuracy. Because there were few group differences in the analyses reported above and accuracy across the channels did not rise above 40%, we considered the possibility that the tasks were difficult for all groups. Therefore, we rescored the accuracy data to obtain a "Valence Accuracy" score. See Table 12. This score measured the posers' ability to convey the appropriate valence in their expression. In other words, the poser received "credit" for their expression if the rater judged it to be of the same valence as the poser's target emotion. For example, if the target was Happiness and the rater judged it to be Pleasant Surprise, the poser received a '1' and if the rater judged it to be Sadness, the poser received a '0'. A Group (3) by Channel (3) by Valence (2) repeated measures ANOVA was run. Significant main effects of Group, F (2,49)=3.31, p=.045, Channel, F(2,98)=92.15, p=.000, and Valence F(2,49)=38.75, p=.000, as well as a significant Channel by Valence interaction F(2,98)=5.30, p=.007, emerged.

Follow-up of the Group main effect revealed that the NCs (M=.74 ± .06) were significantly more accurate (p=.021) than the LBDs (M=.69 ± .07) and tended to be more accurate (p=.060) than the RBDs (M=.70 ± .06); the LBDs and RBDs did not differ significantly from each other (p=.601). Thus, the LBDs and RBDs had more difficulty than the NCs using the different scoring system. Follow-up of the Channel main effect with paired t-tests (all comparisons p=.000) revealed that performance across the groups was significantly different on all channels, with the best performance for all groups on the Lexical channel (M=.84 ± .09), followed by the Facial (M=.70 ± .11) and Prosodic (M=.60 ± .10) channels. The main effect of valence demonstrated that all expressions were expressed more accurately for the positive (M=.78 ± .11) than negative (M= .64 ± .10) emotions. Follow-up of the Channel by Valence interaction (see Figure 2) with paired samples t-tests showed that the difference between positive and negative valences was significantly different between the Lexical (pos. M=.94 ± .05, neg. M=.73 ± .16) and Prosodic (pos. M= .62 ± .21, neg. M= .58 ± .16) channels only (p=.001). The valence comparisons between the Facial (pos. M=.77 ± .20, neg. M=.62 ± .19) and Lexical channels (p=.288) and between the Facial and Prosodic channels (p=.062) were not significantly different.

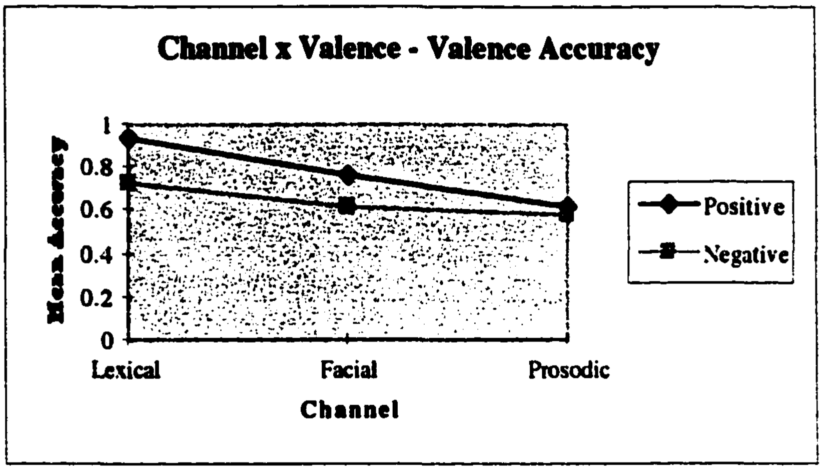

Figure 2 Channel by Valence Interaction on Valence Accuracy

Within each channel, t-tests were conducted to see if performance on positive versus negative emotions was significantly different in any channel. The difference between valence accuracy on positive and negative emotions in the Facial channel was significant t(53)=-3.55, p=.001, indicating that accuracy was higher on the positive (M=.77) than negative (M=.62) emotions. Similarly, the difference was also significant in the Lexical channel, t(53)=-9.76, p=.000, with accuracy higher on positive (M=.94) than negative (M=.73) emotions. However, the difference between positive (M=.61) and negative (M=.58) emotions was not significantly different (t(53)=-.76, p=.451) in the Prosodic channel.

Valence Hypothesis

To determine if the valence hypothesis of emotional expression was operative, we reran the analyses that had been conducted to explore the right hemisphere hypothesis with the addition of Valence as a within-subjects factor. See Table 13.

Accuracy. The Group x Channel x Valence analysis for Accuracy revealed significant main effects for Channel, F (2, 98) = 62.64, p = .000; Group F(2, 49) = 4.34, p = .018; and Valence, F (1, 49) = 44.84, p = .000. Both the two-way interaction of Channel x Valence, F (2, 98) = 19.86, p = .000, and the three-way interaction of Group x Channel x

Valence, F (4, 98) = 4.08, p = .004, were significant. Follow-up of the main effect of Group indicated that the NC posers (M=.40 ± .02) were significantly more accurate than the RBDs (M=.33 ± .02; p=.014) and the LBDs (M=.34 ± .02; p=.016), who did not differ from one another (p=.987). Follow-up of the Channel main effect indicated that performance was least accurate in the prosodic channel (M=.23 ± .01; both comparisons p=.000) and that performance was not significantly (p=.157) different between the facial (M= .42 ± .02) and lexical (M=.41 ± .01) channels. The main effect of Valence indicated that posers were significantly more accurate on the positive emotions (M=.41 ± .16) than the negative emotions (M=.30 ± .13). The main effects and two-way interaction were modified by the 3-way interaction (see Figures 3a, b, and c). The 3-way interaction indicated that the pattern on the positive emotions of the NCs being significantly more accurate than the RBDs (p=.029) in the Facial channel is modified by valence. On the negative emotions, the groups were only different in the Prosodic channel, i.e., the NCs are more accurate than both the RBDs (p=.000) and LBDs (p=.001) who did not differ (p=.236).

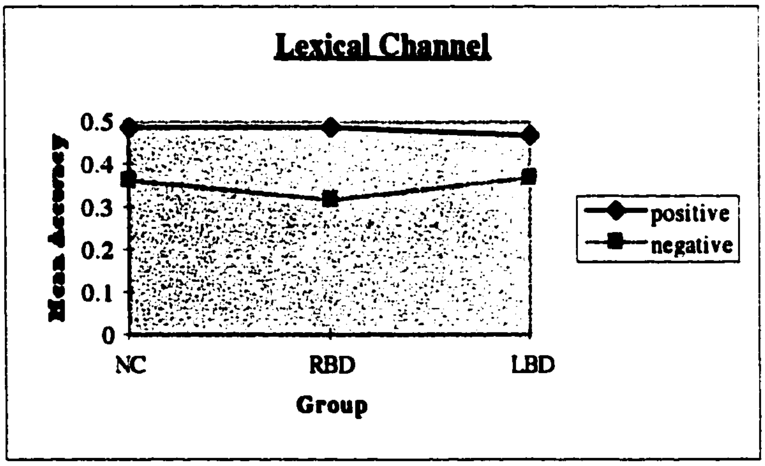

Figure 3a Group by Valence Interaction on Accuracy

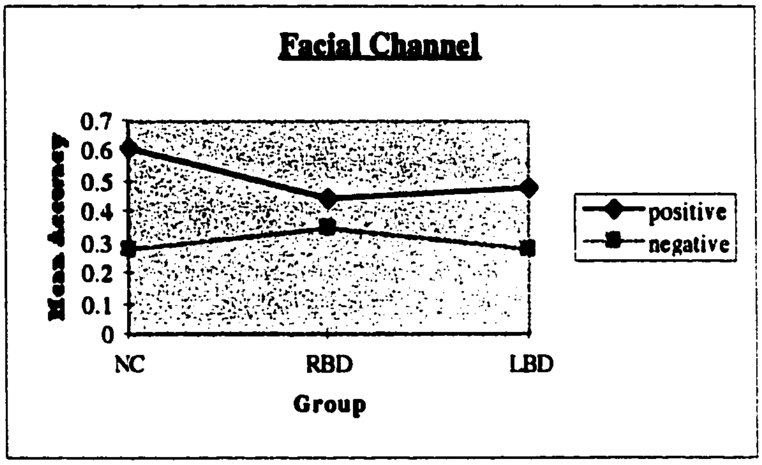

Figure 3b Group by Valence Interaction on Accuracy

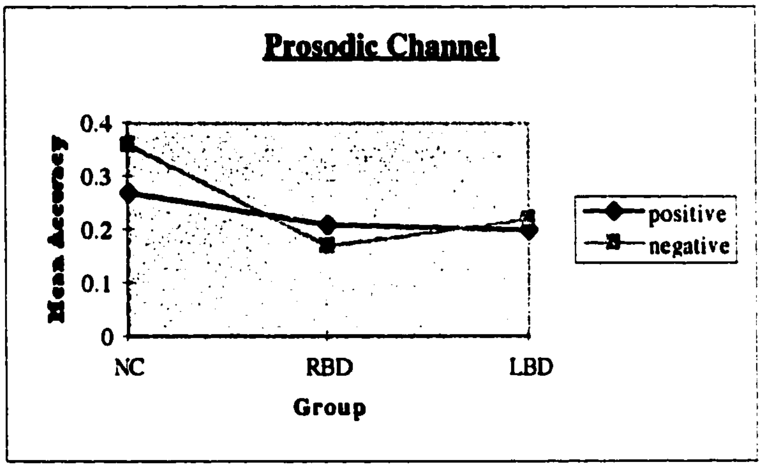

Figure 3c Group by Valence Interaction on Accuracy

Intensity. There was a significant main effect of Channel, F(2, 98) = 6.56, p = .002, but not of Group (p=.924) There was also a significant main effect of Valence, F(1, 49) = 26.42, p = .000. The two-way interaction of Channel x Valence was also significant, F (2, 98) = 88.51, p = .000. The main effect of Valence indicated that expressions were significantly more intense for the negative emotions (M=4.12 ± .76) than the positive emotions (M=3.85 ± .74). Post hoc tests of the two-way interaction (see Figure 4) indicated that the posers were equally intense for positive (M=4.00 ± .12) and negative (M=3.99 ± .013) emotions in the Facial channel (p=.795) but that expressions were significantly more intense for the negative (M=4.76 ± .07) than positive (M=3.34 ± .06) emotions in the Lexical channel (p=.000) and that expressions were significantly more intense for positive (M=3.91 ± .12) than negative (M=3.60 ± .12) emotions in the Prosodic channel (p=.002).

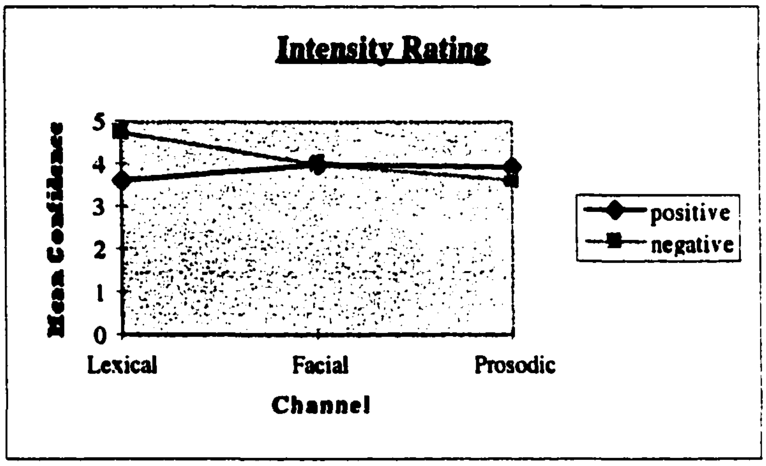

Figure 4 Channel by Valence on Intensity

Confidence. The main effect of Channel was significant, F (1,49) = 58.11, p=.000, but not of Group (p=.686), and there was a significant effect of Valence, F(1, 49) = 13.59, p = .001. The main effect of Valence indicated that raters were significantly more confident on positive (M=2.48 ± .35) than negative emotions (M=2.36 ± .31). The main effect of channel indicated that rater confidence was significantly different in all three channels (p-value of all three t-tests =.000), with confidence highest in the Lexical channel (M=2.66 ± .276), followed by the Facial channel (M=2.46 ± .306) and the Prosodic channel (M=2.09 ± .249). These main effects were modified by a significant interaction between Channel and Valence, , F(2, 98) = 5.40, p = .006. Post hoc tests on the two-way interaction (see Figure 5) indicated that the raters were similarly confident on positive (M=2.68 ± .33) and negative (M=2.64 ± .30) emotions in the Lexical (p=.281) and Prosodic (positive M=2.14 ± .34, negative M= 2.08 ± .28; p=.209) channels but that raters were more confident on positive (M=2.60 + .38) than negative (M=2.36 ± .35) emotions in the Facial channel (p=.000).

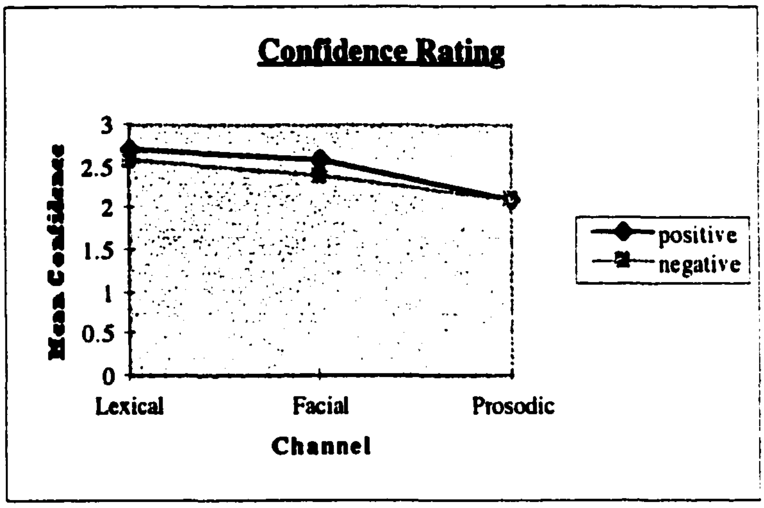

Figure 5 Channel by Valence on Confidence

Controlling for Subject Characteristics, Nonemotional Factors, and the Neutral State

Demographics. Because our hypotheses regarding the impact of lesion laterality on emotional expression were not supported and few systematic group differences were found, we examined a number of factors that could have potentially obscured the performance of posers on tasks of emotional expression. First, we considered relevant subject characteristics. As presented previously, the three poser groups were well matched on demographic factors shown to be relevant in studies of emotional expression, such as age, gender, and education. Although no statistically significant group differences existed, we decided to correlate these three factors with the nine experimental expression tasks in order to determine if significant relationships existed among them (i.e., 27 correlations). See Table 14. Strong relationships were found between education and the facial channel tasks for all subjects. Significant correlations (p<.05) were found between education and facial accuracy (r=.29), facial intensity (r=.43), and facial confidence (r=.58). We then ran univariate ANOVAs on Group (3) for each parameter of the facial channel using education as a covariate to determine if group differences would emerge. None of the group effects was significant (all df=2,49: Accuracy F=1.12, p=.335; Intensity F=0.71, p=.498; Confidence F=0.62, p=.540) There was also an interesting relationship between age and performance on the lexical tasks. For the LBD posers, all 3 correlations between age and the rating parameters were significant (p<.01) (Accuracy r=+.65, Intensity r=+.70, Confidence r=+.73). For the RBD posers, all 3 correlations ranged from -.36 to -.52 and correlations for the NCs ranged from -.10 to +.12. To investigate the effect of age on lexical performance, we ran univariate ANOVAs on Group (3) using age as a covariate for each lexical parameter. No significant group differences emerged (all df= 2, 49: Accuracy F=0.36, p=.697, Intensity F=0.16, p=.855, Confidence F=0.35, p=.709).

Nonemotional Control Tasks. Next we considered nonemotional factors that may have, to some extent, confounded or suppressed group differences. Therefore, one-way ANOVAs were run to compare the performances of the three Groups on each control measure. See Table 15. The groups were not significantly different on any of the control tasks for the Facial or Prosodic channels (i.e., Bucco-facial Accuracy, Bucco-facial Execution, Facial Paralysis, Intonation Contours). The groups were significantly different on both phonemic and semantic fluency which were control measures for the Lexical channel; all df= 2, 49: Animal Naming F = 3.67, p=.033, and FAS F = 8.21, p=.001. The LSD test was used to follow up the significant F-values. For the FAS task, follow-up testing indicated that the NCs (M=43.3 ± 13.3) and RBDs (M=35.0 ± 12.4), who did not differ significantly (p=.063) from each other, produced significantly more words (p=.000 and .039 respectively) than the LBDs (M=25.6 ± 13.1). For the Animal Naming task, the NCs (M=18.7 ± 6.0), again, produced significantly more words (p=.011) than the LBDs (M=13.7 ± 5.5); the RBDs (M=15.4 ± 5.0), however, were not significantly different from either group (from NCs, p=.083; from LBDs, p=.389).

Next, for descriptive purposes, we correlated all the control tasks with their respective experimental tasks. The strongest relationship found was between the Bucco-facial Accuracy measure and accuracy of facial expression (r=.37) due to a particularly strong relationship between these measures in the RBD group (r=.50). Because group differences had emerged on the two control tasks for the lexical channel, we were particularly interested in the degree of correlation between these control tasks and the lexical channel experimental tasks. None of the six correlations rose above .30: (a) FAS and Lexical Accuracy r = .18, p = .197; Lexical Intensity r = .15, p = .299; and Lexical Confidence r = .02, p = .882; and (b) Animal Naming and Lexical Accuracy r = .28, p = .045; Lexical Intensity r = .16, p = .267; and Lexical Confidence r = .10, p = .475. Nonetheless, because group differences had emerged, we explored the impact of the differences in performance on these control tasks across the groups by using each measure as a covariate in one-way ANOVAs for each lexical parameter. None of the six ANOVAs (3 parameters x 2 covariates) resulted in significant group differences; all df=2,48: Lexical Accuracy with Animals F=0.51, p=.60, and with FAS F=0.64, p=.53; Lexical Intensity with Animals F=0.30, p=.74, and with FAS F= 0.37, p=.70; and Lexical Confidence with Animals F=0.45, p=.64, and with FAS F=0.32, p=.73. A full table of correlations (i.e., all control tasks with their respective experimental tasks) is presented in Table 16.

Neutral State. In order to fully understand the emotional expression of posers, we believed it was necessary to appreciate any differences among the groups in their neutral poses or basal state. The neutral state applied only to the facial and prosodic channels in this study as our lexical expression task did not have a parallel neutral pose, i.e., we did not have a means to measure posers' "baseline lexical state". Therefore, we ran two one-way ANOVAs on Group (3) with the dependent variable being the ratings of emotional intensity of the facial and prosodic neutral poses. Neither analysis was significant, indicating that the groups did not differ in the degree of emotionality present in their neutral faces or voices. See Table 17 for group and overall descriptive data and results of the ANOVAs. Nevertheless, on an exploratory basis, we also ran correlations to examine the relationships between the neutral and emotional poses within a channel; see Table 18. As expected, we found meaningful correlations for the overall group of posers between Facial Intensity and Facial Neutral, $r=.47$ and between Prosodic Intensity and Prosodic Neutral, $r=.43$ which were statistically significant at the .001 level, which was significant even after correcting for the number of correlations run (.05/6=.008). Because of these strong correlations, we decided to run one-way ANOVAs on Group (3) for the Facial and Prosodic Intensity parameters using the associated neutral pose as a covariate. Neither analysis resulted in significant group differences, Facial Intensity $F(2,48)=1.17$, $p=.320$ and Prosodic Intensity $F(2,48)=0.12$, $p=.885$. Because we also found a significant correlation between Facial Confidence and Facial Neutral ($r=.43$), an ANCOVA was conducted; again, there was no significant group difference, $F(2,48)=0.86$, $p=.429$.

One other aspect of the posers' neutral state that we explored was the *type* of background emotion that was present in each neutral face/voice, i.e, which, if any, of the 8 emotions was most prominent in the neutral state. We wanted to know if the emotion that raters felt was most prominent in posers' neutral expression, differed among the groups. We took the ratings in which the raters determined "how much" of each emotion was in the neutral pose and ran a Group (3) by Emotion (8) ANOVA for both face and voice. A significant interaction would suggest that the groups differed as to which emotion was most prominent. For the *facial* channel, there were no main effects for group, $F(2,49)=0.55$, $p=.583$, and the interaction was not significant, $F(2,14)=0.66$, $p=.816$. The main effect of emotion (see Figure 6) was significant, $F(7,343)=17.49$, $p=.000$. Follow-up of this effect with paired samples t-tests revealed that several emotions were significantly different from one another. The emotions were thus ordered from most to least present across all posers' neutral faces: interest (1.76 ± .59), sadness (1.24 ± .89), anger (.72 ± .81), happiness (.51 ± .70), unpleasant surprise (.49 ± .52), pleasant surprise (.32 ± .40), fear (.16 ± .26), and disgust (.08 ± .22). For the *prosodic* neutral poses (see Figure 7), there were significant main effects of Group, $F(2,49)=3.39$, $p=.042$, and Emotion $F(7,343)=44.61$, $p=.000$, and the Group x Emotion interaction was significant, $F(2,14)=1.79$, $p=.039$. Across emotions, the neutral voices of the LBD group (M=0.52 ± .13) were significantly more intense (p<.05) than those of the RBD group (M=0.42 ± .13), and the voices of the NC group (M=0.49 ± .11) did not differ significantly from either group (p>.05). Follow-up testing of the interaction revealed that although interest was the most prominent emotion present in the neutral poses of the NCs and RBDs, for the LBDs, sadness was the most prominent. Actually, the pattern for the NCs and RBDs was that interest was the most prominent and sadness was the second most prominent, whereas for the LBDs, sadness was most prominent and interest was second most prominent. For all groups, all other emotions were much less prominent. The emotions are thus ordered from most to least present across all groups' neutral voices: interest (1.43 ± .71), sadness (1.17 ± 1.03), pleasant surprise (.37 ± .58), anger (.26 ± .44), happiness (.21 ± .45), fear (.13 ± .26), disgust (.13 ± .19), and unpleasant surprise (.066 ± .15).

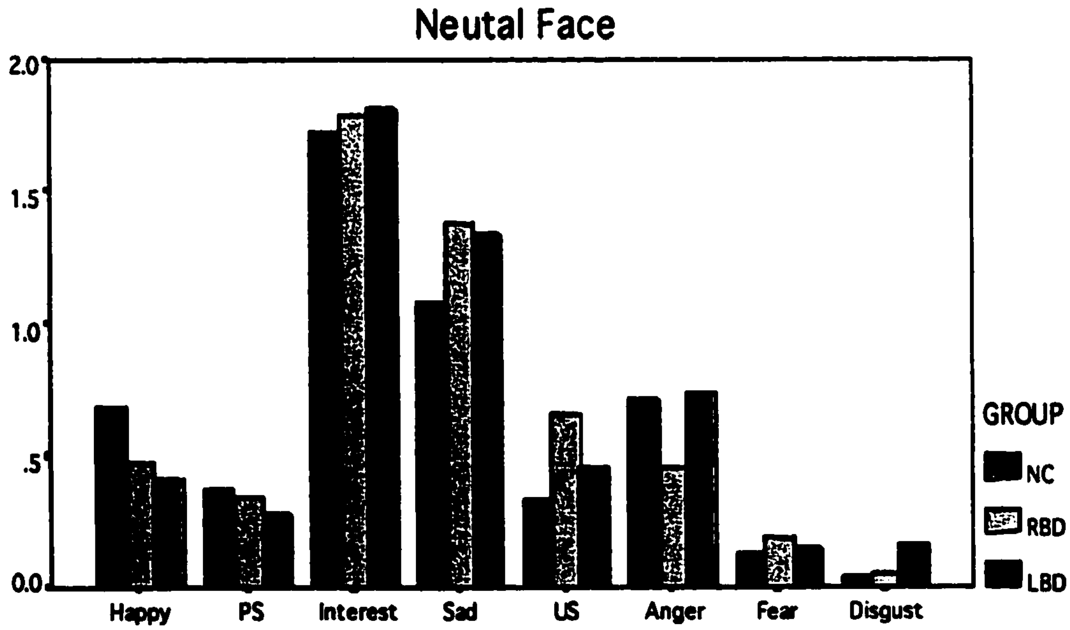

Figure 6 Intensity ratings for the eight emotions on the neutral pose.

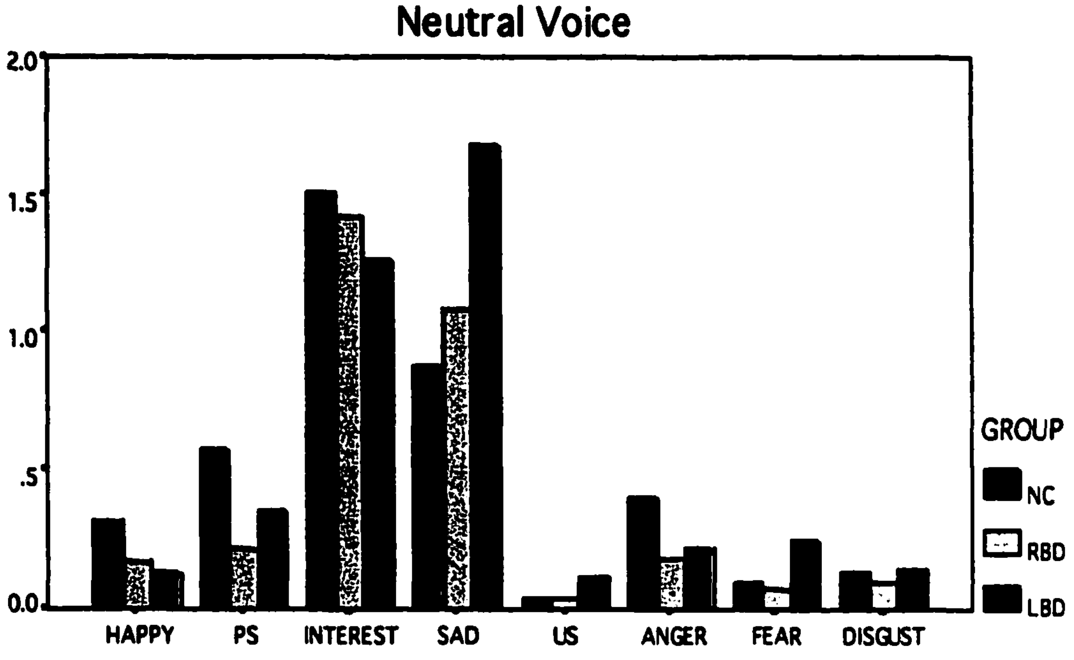

Figure 7 Intensity ratings for the eight emotions on the neutral pose.

Effect of Lesion Site on Emotional Expression

To evaluate whether the location of brain lesion led to group differences in performance, as opposed to lesion laterality reported above, we conducted Group by Channel ANOVAs with different poser groupings. See Table 19. For this analysis, groups were posers with Anterior only (n=6), Posterior only (n=14), or Anterior plus Posterior (n=8) lesions. No group differences emerged for any of the three parameters, all df= 2, 25: Accuracy F=1.97, p=.160; Intensity F=0.95, p=.402; and Confidence F=0.07, p=.931. For all parameters, the main effect of Channel was significant, all df=2, 50: Accuracy F=34.16, p=.000; Intensity F=5.16, p=.009; and Confidence F=39.55, p=.000. None of the group by channel interactions were significant for any parameter (accuracy p=.504, intensity p= .673, or confidence p=.207). Despite the lack of significant group differences, it appeared that the Posterior group had generally lower performances on several parameters. On an exploratory basis, we also looked at the means of all posers with anterior lesions, i.e., the posers with anterior lesions only combined with those with lesions of anterior and posterior lobes (Anterior+), versus the means of the posers with posterior-only lesions. Visual inspection revealed that of18 comparisons, the mean of the Posterior group was higher than that of the Anterior+ group in only 1 comparison, the means were approximately equal in 5 comparisons, and the Anterior+ group's mean was higher than the mean of the Posterior group in 12 comparisons. This pattern could speak to some perceptual processing problem related to the posterior lesions that may have influenced performances. To explore this, we further broke down the posterior group into posers with lesions of a single posterior lobe, i.e., Temporal (n=4), Parietal (n=5), and Occipital (n=2). See Table 20. When ANOVAs on Lesion Subgroup (3) x Channel (3) for each rating parameter were conducted, there were no significant main effects for Lesion Subgroup: Accuracy F(2, 8)=0.54, p=.602; Intensity F(2,8)=2.86, p=.116; and Confidence F(2,8)=1.58, p=.263.

Effect of Emotionality on Language Impairment

In order to determine whether emotion improved (i.e., had a faciliatory effect) performance on lexical tasks for posers with left-hemisphere brain damage and language impairment (coded as "2" based on criteria previously described), we conducted a Group (4: NCs, RBDs, LBDs with documented language impairment [n=7], LBDs without documented language impairment [coded as 0 or 1; n=10]) by Task (4: FAS, Animal Naming, experimental lexical expression task - positive emotions, and negative emotions) repeated-measures ANOVA. The total number of words produced for each task was divided by the number of trials per task to account for the fact that each task had a different number of trials, e.g., total words for FAS was divided by 3. A significant interaction would be needed to suggest a facilitation effect on lexical expression. As expected, there was a significant main effect of Group, F(3, 48)=5.14, p=.004 which, when tested with pairwise comparisons, revealed that the NCs (M=12.50 ± .75) produced significantly more words per trial across all tasks than the other three groups (compared to RBDs p=.011; LBDs without impairment, p=.005; LBDs with impairment, p=.002) which did not differ significantly (all p-values ≥.179) from one another (RBDs M=9.83 ± .73; LBDs without impairment M=8.81 ± 1.00; and LBDs with impairment M=7.78 ± 1.21). There was also a significant main effect of Task, F(3,48)=76.51, p=.000. Follow-up testing revealed that performances on all tasks were significantly different (p=.000) from each other, with the best performance on Animal Naming (M=16.00 ± 5.81), followed by FAS (M=11.60 ± 4.89), Lexical Positive Emotions (M=7.31 ± 3.67), and then, Lexical Negative Emotions (M=6.21 ± 3.42) across all four groups. The interaction of Group and Task was not significant, F(9,148)=1.07, p=.416.

On a post-hoc basis, we also examined the effect of language impairment on emotional expression in the other two channels. Using the same groups described above, six ANOVAs were run to compare the performance of the four groups (NCs, RBDs, LBDs without language impairment, and LBDs with language impairment) on each of the three parameters in the facial and prosodic channels (all df=3, 48). There were no significant group differences for the facial channel: Accuracy F=.86, p=.467, Intensity F=.69, p=.560, and Confidence F=.31, p=.815. For the prosodic channel, there were no significant group differences for Intensity, F=1.86, p=.149 or Confidence, F=1.38, p.261. Consistent with findings in previous analyses, follow-up of the significant group difference on Accuracy, F=9.24, p=.0001, showed that the NCs (M= .32 ± .09) were significantlty (p<.05) more accurate than each of the three other groups (RBDs, M=.19 ± .08; LBDs without impairment, M=.24 ± .11; LBDs with impairment, M=.17 ± .07), which did not differ from one another.

Interrelationships among Variables

As proposed, we explored how channels were related to one another within a parameter. See Table 21. Few correlations were significant. The clearest pattern is that, for all posers (n=52), the correlations between the facial and prosodic channels were significant ($p \leq .01$) for each parameter: accuracy (r=.43), intensity (r=.45), and confidence (r=.34), but the correlations between the lexical channel and either of the two nonverbal channels were not significant across parameters, except in one instance. That is, there was a noninterpretable significant ($p < .05$) inverse correlation (r=-.28) between the lexical and prosodic channels for the confidence parameter.

Then, we conducted Pearson product-moment correlations among the channels to explore inter- and intra-channel relationships. See Table 22. First, we correlated performances on each parameter within a channel, e.g., Facial Intensity with Facial Accuracy, leading to three correlations per channel for a total of 9. All correlations were significant for the overall group (n=52) of posers, indicating that all three parameters were related to one another in each channel. Other patterns within each channel are of also note. In the facial channel, the relationship between intensity and confidence was quite meaningful for all three groups. For the lexical channel, all three parameter comparisons, for all groups, were significant, And, for the prosodic channel, all three parameters were significantly correlated only for the LBDs.

Supplemental Analyses

To potentially increase power, we reran many analyses to include the 2 additional posers with right frontal lesions to the RBD group. As stated earlier (Methods section), the demographic comparisons did not change when these two posers were added. None of the findings reported above changed in a meaningful way. Many of the tables presented throughout include data (means and standard deviations) for the RBD group when these two posers were included. As can be seen from these tables, the addition of two posers with right frontal lesions did not significantly change the overall results of the RBD group.

Discussion

One of the primary goals of this study was to assess two of the main neuropsychological theories of emotion across three communication channels in the same group of subjects. Based on the literature and results from the preliminary study (Canino et al., 1999) with small sample sizes which served as pilot for the current study, we expected that the right hemisphere theory would be operative. That is, we expected that posers with lesions to the right cerebral hemisphere, relative to posers with left hemisphere lesions and normal controls, would show deficits in performance of posed emotional expressions, across all three channels of communication. Another goal was to replicate findings from the pilot study in which we found that good interrater reliability could be achieved using the rating methods previously described. This was important in that these rating methods had not previously been used in a large study when assessing performance of posers across three channels of communication. The continued development of rating procedures that are comparable across channels, allowing for direct comparison of performances across channels, is an important addition to the study of emotional expression in brain-damaged individuals.

This discussion will first address findings regarding the rating methods and their use for future research. The discussion will then address the findings from the current study in terms of how lesion laterality and lesion location impacts upon emotional expression. Then, we will address other nonemotional factors that were relevant and how these factors may have affected the results. Finally, the issue of whether or not a general processor for emotional expression exists will be discussed in light of the current findings.

Interrater Reliability

This study corroborated previous findings (Canino et al., 1999) which found good interrater reliability across three channels of communication using human judges. The current study allowed us to conclude that the methods used here to prepare the data for ratings and train the raters promoted high interrater reliability when studying a large group of posers, including those with unilateral brain lesions. These rating methods were constructed with analogous properties, thereby allowing results to be comparable across the three channels. Although the emotion literature has offered many sophisticated means of rating emotional expressions within one communication channel (e.g., Bloom et al., 1993; Ekman & Friesen, 1978; Scherer, 1986;), the development of rating methods for a single modality has limited the ability to systematically integrate findings across channels. Also, although the use of human judges has been determined to be an effective means to evaluate expressions (e.g., Ekman et al., 1972), no uniform rating method has been devised, studied, and presented in the literature which can be used by researchers when studying expression in more than one channel. The training and rating methods used here help us move toward this goal. The process of preparing the data for rating and preparation of training materials (e.g., exemplars and practice items) is certainly replicable. Similarly, the instructions for the three levels of training are also sufficiently articulated that they could be used by others with minimal difficulty. We believe that, to some extent, it was the careful explication of these methods that allowed us to achieve our interrater reliability results, despite three different groups of raters and three different communication channels. The next step would be to have other experimenters take the written training materials used here and attempt to use them in a similar study. This would hopefully establish that the IRR results found here were not experimenter-specific, as the experimenter in this study was also the experimenter in the Canino et al. (1999) study.

Effect of Lesion Site

Effect of Lesion Laterality.

Although our results did not show consistent group differences which would have firmly implicated either the right or left cerebral hemisphere in the expression of posed emotions, certain group differences and patterns of performance emerged which are of interest. Of the three parameters of emotional expression studied, only the measure of accuracy led to a significant group difference; specifically, the normal control group posed expressions with better accuracy than the brain-damaged posers in the prosodic channel. There were no significant differences between the left and right brain-damaged groups on any parameter. However, there is one pattern that emerged that is important to appreciate in order to better understand the failure to find consistent group differences on these measures. That is, there was striking consistency in how all the groups performed across parameters, in all channels, in terms of "best" performance. Best performance was determined by finding which channel led to the highest mean scores for each group, for each parameter. Visual inspection of group means (see Table 6) showed that in 8 of 9 cases, best performance was achieved in the lexical channel, followed by the facial channel. The only exception to this was that for the RBDs; higher accuracy was achieved in the facial channel, but only over the lexical channel by a difference in means of .004. In _all_ cases, performance in the prosodic channel was least accurate, least emotionally intense, and generated the least rater confidence.

This consistent pattern of performance, together with the experiences reported by the posers, suggested that one reason for the lack of consistent group differences was that the three emotional expression tasks differed in their level of difficulty. As can be seen in Tables 6, 7, and 8, performance in the prosodic channel led to clearly lower scores in the accuracy and confidence parameters. Other studies have found relatively higher overall accuracy in the prosodic channel for normal controls (Tucker et al., 1977: NC _M_=58% correct when studying three emotions; Borod, Welkowitz et al., 1990: NC _M_ accuracy=.41 [on a scale from .00 to 1.00]) but have also found low prosodic accuracy for brain-damaged posers (Tucker: RBD _M_=28% correct; Borod: RBD _M_=.25). This suggests that our results are not unusual for the brain-damaged posers but that the accuracy performance of our NC posers (_M_=.33) is relatively poor compared to that obtained in other studies. Possible explanations for low NC performance will be discussed below.

Prosodic Channel. Why should the prosodic channel lead to weakest performances of all subjects? Isolating channels of communication is a contrived situation that, for most adults, is quite uncommon. However, posers appeared to be most comfortable isolating the lexical channel, possibly, because daily life more frequently presents situations which isolate our lexical expression (e.g., written communications). And, isolation of the facial channel is arguably more familiar than prosodic isolation (e.g., interpreting and responding to facial expressions of infants). The prosodic expression task here was likely the most contrived or unnatural as it is difficulty to think of a situation of communication between adults in which we are asked to vocally intone an otherwise neutral statement with emotional meaning. While it can be argued that the level of difficulty should have been equivalent for all posers, who were well-matched on demographic factors, this is not known. Follow-up of the channel main effect for the confidence ratings revealed that raters were least confident in their judgments of the prosodic channel ($\underline{M}$=2.10 ± .24) compared to judgments for the lexical ($\underline{M}$=2.65 ± .28) and facial ($\underline{M}$=2.45 ± .29) channels. As discussed in the Introduction, the combination of low accuracy scores and low confidence scores for the prosodic channel suggests that poses were relatively ambiguous. Without a clear measurement of how the posers perceived the difficulty of each task (e.g., a self-report instrument), it cannot be determined that each group was impacted in an equivalent way. The apparent differences in level of difficulty is a source of variance and, therefore, leaves open the possibility that an uncontrolled factor minimized our ability to find group differences. Therefore, although the tasks were developed with the same theoretical underpinnings, carried out with similar procedures, and evaluated using similar criteria, a basic difference in the level of difficulty for posers, and/or a floor effect on the prosodic task, may have contributed, at least in part, to the lack of more group differences.

Valence Accuracy. As described in the Results section, we recalculated our "scoring" of the groups' performances on all three accuracy tasks in an effort to decrease the overall difficulty level on a post-hoc basis. We retabulated mean scores to derive an accuracy score that reflected groups' ability to pose positive emotions versus negative emotions. In effect, this changed the task into a measure of posers' ability to pose the target valence instead of one of eight emotions. This changed the pattern of results ever so slightly. Whereas on the traditional scoring system, the NCs (M=.38) were more accurate than the RBDs (M=.32) and LBDs (M=.32) who did not differ from one another, with the valence scoring system, the LBDs' performance was significantly (p<.05) less accurate than the NCs, and the RBDs' performance tended (p<.10) to be less accurate than the NCs. Again, the NCs (M=.74) were the most accurate and the RBDs (M=.70) and LBDs (M=.69) obtained nearly the same level of performance for the valence accuracy rescoring. Again, highest accuracy was achieved across the groups on the lexical task, followed by the facial task, with the least accuracy attained on the prosodic task.

This rescoring also provides some insight into qualitative aspects of posers performances. Valence accuracy across all groups was nearly 70% whereas accuracy across all groups with the traditional scoring was below 40% in all channels. This suggests that when posers made errors, at least 30% of errors were within the same valence as the target emotion and approximately 30% of errors were of the opposite valence.

Valence Hypothesis. The valence hypothesis of emotion was also tested in this study. We had not predicted that this theory would be operative, largely, because valence effects have not been consistently reported in the literature, particularly when more than one channel of communication is studied. Indeed, our data did not support the notion that laterality of lesion differentially impacts performance on positive and negative emotions. However, there was a main effect of valence for all parameters, although some of these findings were modified by significant channel by valence interactions. Generally, expressions were more accurate for positive emotions and raters were more confident when judging positive. Valence findings for intensity were not consistent as negative emotional expressions were more intense in the lexical channel, positive emotional expressions were more intense in the prosodic channel, and there was no valence difference in the facial channel. Although there is a possibility that these findings were impacted by the fact that positive and negative valence were not equally represented (i.e., 5 negative emotions and only 3 positive emotions), these findings are not consistent with Borod, Welkowitz, et al. (1990) who, also using a different number of positive (3) and negative (4) emotions, found that RBDs and NCs (the study did not utilize LBD posers) produced facial expressions more intensely for positive than negative emotions; for prosody, NCs' expressions were more intense for positive than negative emotions, whereas RBDs' expressions were more intense for negative than positive emotions. Differences (e.g., poser age and months post onset) that may account for the discrepancies in findings between that study and the current study will be discussed below.

Effect of Intrahemispheric Location of Lesion. Our study also did not suggest that the site of the lesion, i.e., intrahemispheric site, differentiated performances of brain-damaged posers, independent of lesion laterality. Based on the literature, it had been expected that posers with anterior lesions would perform more poorly than other posers on expression tasks, particularly facial expression (e.g., Borod, Koff, et al., 1985; Caltagirone et al., 1989; Kolb & Milner, 1981; Kolb & Taylor, 1990; Mammucari et al., 1988; Ross & Mesulam, 1979; Weddell et al., 1990). Of interest, however, was the finding in the lexical channel that the LBDs with anterior lesions performed with more accuracy than any other group (see Table below). This offers support to the notion that adding emotionality to a lexical expression task improves performance of individuals with left brain damage, particularly those with mild to moderate language impairment (Bloom et al., 1993; Borod, Rorie et al., 2000). The LBD posers with anterior lesions (n=2) may have benefited more than other LBD posers from the addition of emotional content because these two posers were both determined to have language impairment on the BDAE. Of the LBD posers with posterior lesions (n=7), only 3 had confirmed language impairment, and of those with anterior and posterior lesions (n=4), only 2 had confirmed language impairment. LBDs with frontal lobe damage would be expected to have the most difficulty on a word generation task (Lezak, 1995, p. 545), and, therefore, may have benefited most from the addition of emotional content which may have accessed the right hemisphere.

Lex Accuracy	Anterior Only	Posterior Only	Ant. & Post.	Overall
RBDs (n=15)	.356 (.155)	.367 (.006)	.406 (.009)	.374 (.009)
LBDs (n=13)	.492 (.004)	.391 (.140)	.369 (.120)	.400 (.124)

Similarly, in the lexical channel, LBDs with frontal lesions were found to generate more rater confidence than other groups. See table below.

Lex Confidence	Anterior Only	Posterior Only	Ant. & Post.	Overall
RBDs (n=15)	3.28 (.170)	3.09 (.162)	3.41 (.292)	3.23 (.234)
LBDs (n=13)	3.52 (.009)	3.28 (.495)	3.21 (.260)	3.30 (.388)

Understanding the lack of group differences

Methodological factors. There are several possible reasons for our failure to find group differences when testing both neuropsychological theories of emotion or when exploring the impact of anterior versus posterior lesions on either side of the brain. There are two methodological reasons. First, other studies of posed emotional expression have often used fewer emotions, and these emotions often differed from those used here. For example, Kent et al. (1988) found support for the right hemisphere hypothesis when studying facial expressions of 8 emotions, however, two of the emotions differed from those used here. They used sexual arousal and confusion instead of pleasant and unpleasant surprise, although their results did not differ when analyses were rerun without these two emotions. Similarly, Tucker et al. (1977) studied only NCs (n=8) and RBDs (n=8) posing only 3 emotions (happy, sad, angry) as well as an "indifferent" pose. Based on a review of studies of emotional expression by Borod (1993), experimenters (outside of the Borod laboratory) typically study less than 6 posed emotions, with most studies employing 3 emotions in total. The degree to which study results might differ as a function of the types of emotions used has not been discussed in the literature. It is possible that the task of rating accuracy of emotional expressions is different depending upon how many emotions are used, the degree of similarity in emotions, or whether emotions are considered "basic" (Ekman, 1982) or not. Therefore, the question remains open and future research should explore this methodological issue by using Emotion as a separate factor in analyses.

Another difference in study methodology which makes our results difficult to compare to other studies, is the use of very different lexical expression tasks. Although many studies employ a similar pose to command task for the facial and prosodic channels, methods to study posed lexical expression are more variable. Typical lexical tasks study <u>spontaneous</u> expressions and require a poser to view a slide or other stimuli and then describe their feelings (e.g., Borod et al., 1985; Buck & Duffy, 1980). Because we were studying posed expressions, these types of lexical tasks were not appropriate for our study. The lexical task used here has a common non-emotional correlate familiar to neuropsychology (e.g., Animal Naming and Controlled Oral Word Association), however, it is rarely used in the study of emotional expression. One reason this task may not be used in the study of emotional lexical expressions is because the task relies too heavily on cognitive abilities, such as efficient strategizing for accessing words, mental flexibility, and short-term memory (e.g., Lezak, 1995), thereby increasing the cognitive component and potentially reducing the emotional component of the task. As discussed below, all of our tasks may have been more cognitive than emotional in nature.

<u>Poser factors</u>. Differences in posers may also explain our failure to find significant group differences which would be in line with current theories. As indicated above, an interesting difference arises when results from the current study are compared to a study

(Borod, Welkowitz, et al., 1990) that used nearly the same emotions, elicitation protocol, and rating procedures. That paper presented mean scores for RBD and NC posers on accuracy and intensity for facial and prosodic posed expression. Comparison of performances between the studies reveals that RBDs' performances are quite similar, however, performances of the NCs in the current study were lower (i.e., lower accuracy and intensity ratings) than those in the Borod et al. study. Further investigation shows that the NCs in the Borod study were approximately 10 years younger than those used here. Another difference may have been in the average months post onset of the RBD posers. Although the actual mean MPO is not provided in that study, they state that RBDs were tested "at least 6 weeks postonset of stroke" (p.251), suggesting that at least some of their RBDs were tested much sooner after stroke than our posers. Similarly, the mean age of all posers in two studies of posed facial expression using similar methodology to the current study (Borod et al., 1986; Kent et al., 1988), which found support for the right hemisphere hypothesis, was younger than the current posers (Borod/Kent: M age= 57, here: M age= 65). These differences suggest that the lack of group differences in the current study could, to some extent, be due to weak performance of the normal control group or, rather, that previous findings overestimated "normal" performance. Similarly, posers in a study by Madigan (1998) which found support for the right-hemisphere hypothesis were somewhat younger than those in the current study (i.e., mean age in Madigan = 62.8 ± 8.9). Other differences in poser demographics may account for these discrepancies and will be discussed below.

Nonemotional factors. This leads us to consider other nonemotional factors that may have impacted our findings. We found no group differences on most of the tasks which served as control measures for our experimental tasks. For example, we found no group differences in performance on the Bucco-facial apraxia control task which was not anticipated as it has been demonstrated that cortical brain lesions impair praxis, or the ability to execute learned movements (e.g., Rinn, 1984). Other evidence comes from comparison of the current findings to those of a study from which the current procedures for rating this task were taken (Madigan, 1998). That study found that LBDs performed significantly more poorly on both the accuracy and ease of execution aspects of the Bucco-facial apraxia task than either of the other two groups (i.e., RBDs and NCs). Review of the group means from that study revealed that the posers in the current study, particularly the LBDs, tended to perform better and with less within-group variability than in the Madigan study. This suggests that, perhaps, the brain-damaged posers, particularly the LBDs, in the current study were less impaired than the brain-damaged posers in the Madigan study. This is possible as review of subject characteristics in both studies revealed that the brain-damaged posers in the current study were tested much longer post stroke than those in the Madigan study (e.g., LBD MPO: Madigan- M=16.2 ± 17.9, current- M=23.6 ± 33.6; RBD MPO: Madigan- M=16.6 ± 26.4, current- M=33.8 ± 37.8).

This last comment raises the possibility that the lack of group differences was due to a "recovery" effect, which has been documented in a study of stroke patients (i.e., Egelko, Simon, Riley, Gordon, Ruckdeschel-Hibbard, & Diller, 1989). That study found that RBDs, but not LBDs, demonstrated improvement in the comprehension (i.e., perception) of facial and prosodic affect within the first 10 months post-CVA. However, the authors commented that the failure to find improvement in the LBDs on the prosodic task may have been due to a ceiling effect. In another study (Zgaljardic, Borod, & Sliwinski, 2001) of the recovery of emotional perception across the same three channels of communication used in the current study and probably involving some of the same posers as in the current study, the authors found a recovery effect for male RBDs but only on lexical (i.e., not facial or prosodic) perception tasks. One study using the same lexical expression task used here and likely some of the same posers used here (Zgaljardic, Nakhutina, Tabert, & Borod, in press) found no improvement in the number of emotion words produced in either RBDs or LBDs up to several years post-stroke. To our knowledge, no studies have evaluated the recovery of the ability to pose emotions across three channels of communication. Therefore, it is unclear whether the lack of group differences among posers in the current study was due to recovery of function and/or compensation for deficits. One way to evaluate this possibility is to review similar studies and compare months post-stroke onset. Borod (1993) provides an extremely useful review for this purpose. She reviewed several studies in each channel that have similar or higher MPO which found group differences on emotional expression tasks. It would therefore seem unlikely that recovery of function can entirely explain the current findings. However, what also stands out in the Borod review is that none of the studies with comparable MPO also had comparable poser ages. That is, all studies with longer MPOs used younger subjects. It is possible that the combination of somewhat older subjects and lengthy MPOs in the current study minimized group differences. One could hypothesize that in order for our older subjects (M age= 66 ± 11) to have participated in this battery of tests, they may have been healthier than other groups of posers, which could have led to more effective recovery post CVA.

Another possibility is that we did not sufficiently identify nor control for nonemotional components of posed emotional expression. One reason to consider this is that only one of the correlations between our nonemotional control tasks and their related experimental task was significant (BF Accuracy vs. Facial Accuracy r=.37) and none of the eighteen correlations reached above an r of .40. This argument is difficult to sustain, however, in the face of prior studies which also did not find correlations between nonemotional control tasks and experimental emotional tasks yet did find group differences in performance on some parameters of emotional expression (Borod, Koff, Lorch, Nicholas, & Welkowitz, 1988; Madigan, 1998). Borod et al. (1988) argued for "the dissociation between systems controlling facial emotional expression and non-emotional facial movement" (p. 831).

Our findings are more consistent with Caltigirone et al. (1989) which employed 23 RBDs, 34 LBDs, and 28 NCs who were asked to pose six emotions: happiness, sadness, anger, fear, disgust, and surprise. All posers were in their 50s, and information regarding months post-stroke onset was not provided. That study also found no differences among NCs, LBDs, and RBDs on posed facial emotional expression, using FACS scoring as well as human judges, and no relationship between oral apraxia and posed facial emotional expression. They concluded that the right hemisphere does not play a specific role in the control of facial expression. They cited Pizzamiglio et al. (1987) and hypothesized that control of posed facial movements is diffusely represented in the cortex, implying that a focal lesion will not be sufficient to cause deficits on these behaviors. They suggest that there may be several different cognitive processes that allow for posed facial expressions, such as verbal mediation, rehearsal, or imagery. Our finding that posers with posterior lesions produced expressions that were less accurate, were less intense, and generated less rater confidence than did posers with anterior lesions may support this notion that other, more perceptual cognitive processes may be involved in posing facial expressions. This also suggests that posed expressions may be less "emotional" and more "cognitive" in nature. Our tasks lent themselves to significant cognitive processing. For each task, instructions and examples were given which allowed the poser to consider the task and plan responses. For the facial and prosodic tasks, posers were given two trials for each emotion; the first was always called a "practice" trial. It can be argued, therefore, that this induction process minimized the emotionality of the response and rendered it more thoughtful, cognitive, or artificial vis-à-vis a genuine emotional experience.

More detailed neurological information regarding the lesion size would be necessary to further explore Pizzamiglio et al.'s (1987) hypotheses.

Central Processor?

Relationships among Communication Channels. Finally, we explored relationships among channels and parameters of emotional expression. The current findings did not support the notion that the three channels of communication studied here were related, arguing against a "central processor" for the voluntary expression of facial, prosodic, and lexical emotion in brain-damaged or normal control posers. However, consistent with other studies of emotional expression (Borod et al., 1985; 1990; Lo Castro, 1972), we found a relationship between the facial and prosodic channels, with no reliable relationships between the lexical channel and either of the other two nonverbal channels, for all subjects. The consistency of this finding is particularly striking given the difference in methods. For example, in the Borod et al. 1985 study, expressions were spontaneous responses to emotionally laden slides. Similarly, several other studies (from the same larger project) examining all three channels, albeit with a focus on emotional perception, also reported nonsignificant correlations between the lexical channel and the two nonverbal channels (Borod, Cicero, et al., 1998; Borod, Pick et al., 2000 [for discrimination]; Zgaljardic et al., 2001, submitted). Also, two other perception studies in brain-damaged subjects (Blonder et al., 1991; Schmitt et al., 1997) found dissociations between the lexical and the facial and prosodic channels. An explanation for this relationship, similar to that proposed by Borod, Pick, et al. (2000), is that the lexical channel may be more conceptual in nature, whereas facial and prosodic expressions are more sensory-based (e.g., iconic and echoic), as well nonverbal. A different explanation for the relationship may simply be that, as discussed by Bowers et al. (1991), facial and prosodic expression involve the planning and imagination of, as well as an actual, motor response, which is different from lexical expression in which the motoric response is automatic. In other words, it could be argued that the planning of a response during our lexical expression task was primarily lexical, not motoric, in nature.

Relationships among Rating Parameters. Another aspect of the question about whether there is a central processor for emotion is to further explore the mode of emotional processing by looking at relationships among the three parameters of emotional expression. Within the facial channel, intensity and confidence were highly correlated (r=.77, p<.001) for all posers combined, whereas other parameter comparisons were much less strong (rs=.29 and .31 for all posers). The finding of a very strong relationship between facial intensity and facial confidence is consistent with a finding from a study of posed facial expression and aging (Yecker, Borod, Moreno, Welkowitz, & Alpert, 2000) which found a similarly strong relationship (r=.71) for their older posers (M age=69.9 ± 6.8), using similar experimental procedures, as well as for their middle-aged (r=.42) and young (r=.50) posers. Further, the lack of a strong relationship between accuracy and intensity of facial expression was also found in an earlier study of both posed and spontaneous facial expression (Borod et al., 1988). Our finding suggests that, in the facial channel, raters felt more confident in their accuracy rating if the expression was emotionally intense. Similarly, in the prosodic channel for all posers combined, a relatively strong relationship was found between intensity and confidence (r=.58, p< .001) with lower correlations for the other parameter comparisons (rs=.28 and .30). Again, this finding suggests that enhanced expression intensity led to increased feelings of rater confidence. Taken together, these patterns of correlations provide further support for the connection between the facial and prosodic channels that was discussed above.

Also of interest in the prosodic channel is the finding that for the LBDs, but not for the RBDs or NCs, correlations among all parameters were significant. The speech output component of the prosodic expression task may have affected the LBDs' performance somewhat differently than the performance of the RBDs or NCs. In other words, the distinctions among parameters may have been superseded for the LBDs due to the heavy expressive speech component of the prosodic expression task. Or, perhaps another intervening, but as yet unidentified, variable was operative that led the LBDs to approach the tasks differently in some way than the RBDs and NCs, which resulted in these consistently significant correlations for the LBD group.

The pattern of correlations among rating parameters was different in the lexical channel, again supporting a distinction between the lexical channel and the other two channels. For all three poser groups and all posers combined, significant correlations were found among all parameters in the lexical channel (range= .55 to .89, median r=.76). These relationships suggest that the three parameters of lexical expression, as measured in the current study, tapped a unitary dimension of lexical emotion across subject groups. One possible explanation for this is based on the fact that in order to rate the data (i.e. words) in the lexical channel, raters had to consider the same aspect of the expression (i.e., the meaning of the word) to rate both intensity and accuracy. In contrast, in the facial and prosodic channels, raters considered different aspects of the expression for their intensity versus their accuracy ratings. For example, to rate intensity in the facial channel, raters focused on the degree of musculature involvement in several specific areas of the face, whereas to rate accuracy, they considered the overall configuration of the face.

Conclusions and Recommendations for Future Research

There are several means by which a future study could be improved over the current study. If the same experimental tasks are to be used, a measure of "level of difficulty" should be implemented to determine if posers find certain tasks more difficult than others. A simple self-report measure would also allow us to determine if the level of difficulty, independent of emotion, was the same for all groups or not. If differences are found among the tasks or among the groups, this rating could be used as a covariate in analysis in order to control for this experiential factor. Similarly, it would be interesting to ask posers which emotions they found most difficult to pose (e.g., via a rank-ordering procedure). This could be another way to explore the valence hypothesis (e.g., look for Group by Emotion interactions), as well as determine if certain emotions were simply too difficult to pose. Along the same line of thought, it might be beneficial in the future to limit the number of emotions studied. We found somewhat different results when the accuracy parameter was made easier on a post-hoc basis by changing the scoring system. This change appeared to affect the brain-damaged posers differently. We had considered rescoring the data using only 2 or 4 emotions, presumably the more common/basic ones, however, because the data were based on raters' selection of one emotion from 8 choices, we felt that reduction to specific emotions was less appropriate than using the more general valence accuracy system. However, to make results somewhat more comparable to other studies and potentially limit the difficulty level of the task, the number of target emotions posed should be reduced in future research. Also, emotions should be chosen based on predictions that are relevant to the channel and mode of processing being studied which would likely increase statistical power.

Relatedly, decreasing the number of emotions studied would also shorten the time necessary for the administration of the battery and rating of the data. While the time involved was not prohibitive, it is our experience that some potential subjects decided not to participate in the larger study due to the lengthy time committment involved. Despite our efforts to make participation as easy as possible (e.g., provision of transportation and flexibility in scheduling), several people were not willing to make several trips to the hospital in order to participate. Also, the length of the battery makes it more difficult for people to participate closer in time to their stroke. Many people were completing outpatient rehabitation programs and adjusting to their changed abilities and, therefore, were not inclined to make a significant time committment to a research protocol until these aspects of their lives were settled. Thus, shortening the battery might increase the number of subjects enrolled and might enhance their ability to participate at an earlier point post-stroke which would allow us to look at the impact of more acute lesions on emotional expression.

It would also be interesting in future studies to look at the performances of specific subjects in addition to the overall group data. That is, the groups could be reconfigured post-hoc, based on a rank ordering of all subjects for each task, i.e., create a list of the subjects ordered from least to highest accuracy, intensity, and confidence ratings for each parameter in each channel. This method is similar to that in studies of drug efficacy which often determine which subjects were "responders" and which were not, independent of group assignment. This would allow us to know which subjects generated the highest and lowest scores across all tasks. It would be interesting to see if patterns emerged which indicated that certain subjects were outliers on more than one task. If so, factors common to these subjects could be explored. This approach, particularly in the face of a limited number of statistically significant group differences, could offer insight regarding factors, or combinations of factors, which impact performance that are not obvious using the traditional statistical approach.

Another basic element missing from this study was a measure of lesion size and/or severity of stroke. Although we made significant attempts to accurately localize the lesion to a particular site based on radiological data, we have no means of comparing the basic neurological information about the stroke itself. The demands of the larger study for which posers were recruited (e.g., several 2-3-hour visits to Mount Sinai Medical Center and significant verbal communication to understand the tasks) required posers to be relatively intact cognitively and physically. This naturally selected out posers with both very high and very low severity strokes. In other words, for the latter case, individuals with very mild strokes, in many cases, had resumed their normal activities and were not interested in participating in a lengthy research protocol. For example, we enrolled very few posers who returned to work although many had been contacted. Therefore, we did have a mechanism for including posers with strokes of relatively similar severity, but this mechanism was not quantified. The most reasonable method for future studies is to use hand-scoring or computer-based techniques to determine the volume of the lesion from MRI slices. This would allow us to better characterize our poser groups, limit our comparisons to groups of posers with lesions of similar sizes, and analyze the differential effects of focal versus distributed lesions within a particular lobe. Additionally, a measure of stroke severity could be used to better quantify functional impairment at the acute stage, and this measure could be administered again at the time of testing for the study. This would allow for a direct measure of recovery and would improve our ability to match subjects. Using the approach discussed above, subjects could also be stratefied based on stroke severity on a post-hoc basis to explore the impact of this factor on emotional expression.

A primary success of this study was to have achieved substantial interrater reliability across three channels and on all three parameters of emotional expression. However, the need to use different groups of raters for each channel may have added unwanted variance to the data. We attempted to minimize these differences by having groups of raters that were matched on relevant demographic factors, such as age and education, and all were selected from the same pool (i.e., Queens College students). However, this cannot guarantee that the experience of training the raters would be the same across the groups. There were two primary reasons for having different raters for each channel and for the control tasks. First, we believed that raters would become "overexposed" to the emotions and parameters which would necessitate counterbalancing the order in which channels were rated. Because all raters had to be trained together, multiple groups of raters would have been necessary if counterbalancing was carried out. The significant potential increases in the number of raters needed, in the time required to run rating sessions, and in the cost to pay additional raters were not deemed to be an efficient use of resources. Second, the number of hours required to rate just one channel demanded a significant time commitment, (e.g., rating of all control tasks took a total of 8 hours and rating of the lexical data alone took approximately 16 hours). It was not feasible to require raters to be available to rate all the data, particularly since raters needed to be available at the same time in order to be trained together.

There are also means to improve the study by adding features to incorporate different experimental methods. This would begin to address the difficulties posed by the use of different posing conditions and rating methods reported in the literature. It would be helpful to know how using human judges to rate emotional expressions, i.e., a communicative approach to measuring expressions, compares to other methods which tend to isolate specific aspects of the communication (e.g. FACS). For example, acoustical analysis of our prosodic expressions could be compared to our ratings in an attempt to determine what, if any, acoustical parameters correlate with the parameters rated here. These types of comparisons would allow us to better understand what elements of the expressions human judges utilize. If significant correlations are found, the seemingly disparate methods reported in the literature would become more comparable.

Overall, this study's similarities and discrepancies with previous findings provide ample questions for the future study of emotional expression in the neuropsychological literature. Through the continued use of behavioral paradigms with rating procedures that are similar across channels or more channel-specific methods, as well as the use of functional neuroimaging techniques (e.g., FMRI), it is hoped that our understanding of brain-behavior relationships in emotional processing will continue to be elucidated.

Table 1
Lesion Site

Category of Lesion	**LBD (N=17)**	**RBD (N=17) {N=19}**
Anterior Cortical	Frontal +SCWM (CR)	Frontal
	Frontal + SCWM (CR)	Frontal + SCWM (CR)
		{Frontal}
		{Frontal}
Posterior Cortical	Temporal	Temporal
	Temporal	Temporal
	Occipital	Occipital
	Parietal	Parietal
	Parietal	
Posterior + SCWM	Parietal + SCWM (non-specified)	Parietal + CR
	Temporal, Occipital, IC	Parietal + SCWM (non-specified)
		Temporal, Occipital, Parietal, optic radiations
Anterior + Posterior	Frontal, Parietal	Frontal, Parietal
	Frontal, Temporal, Parietal, EC	Frontal, Temporal, CR
	Frontal, Temporal, IC, EC, Claustrum, CR, Putamen	Frontal, Parietal, IC, EC, Claustrum, ExtrC
	Frontal, Temporal (Insula), Parietal	Frontal, Parietal, CR
Subcortical Only	Basal Ganglia	Putamen, Globus Pallidus
	Thalamus	Thalamus, CR, IC, Putamen, Globus Pallidus, Basal Ganglia
	IC, Basal Ganglia	IC, Caudate
	EC, Claustrum, Putamen	EC, Claustrum, CR, IC, ExtrC

SCWM=Subcortical White Matter; CR=Corona Radiata; IC=Internal Capsule; EC=External Capsule; ExtrC=Extreme Capsule

Table 2
Summary of Lesion Site Locations

Structure	**LBD (N=17)**	**LBD % of total**	**RBD (N=17) {N=19}**	**RBD % of total**
Frontal Lobe	6	16.2	6 {8}	13.6 {17.4}
Temporal Lobe	6	16.2	4	9.1
Occipital Lobe	2	5.4	2	4.5
Parietal Lobe	6	16.2	7	15.9
Corona Radiata	3	8.1	6	13.6
Internal Capsule	3	8.1	4	9.1
External Capsule	3	8.1	2	4.5
Extreme Capsule	0	0.0	2	4.5
SCWM, other	1	2.7	2	4.5
Caudate	0	0.0	1	2.3
Putamen	2	5.4	2	4.5
Globus Pallidus	0	0.0	2	4.5
Basal Ganglia (not specified)	2	5.4	1	2.3
Claustrum	2	5.4	2	4.5
Thalamus	1	2.7	1	2.3
Total Number of Structures Involved	37		44 {46}	

Table 3
Demographics

DEMOGRAPHIC	GROUP	N	MEAN	STANDARD DEVIATION	One-Way ANOVA p-value
AGE	NC	18	66.7	11.9	.862 {.958}
	RBD	17 {19}	64.6 {65.6}	13.5 {13.1}	
	LBD	17	66.3	10.5	
	TOTAL	52 {54}			
EDUCATION	NC	18	15.6	1.9	.991 {.992}
	RBD	17 {19}	13.6 {13.5}	2.8 {3.6}	
	LBD	17	13.6	3.6	
	TOTAL	52 {54}			
HOLLINGSHEAD (SES)	NC	18	6.3	1.0	.651 {.696}
	RBD	17 {19}	5.8 {5.7}	1.9 {2.2}	
	LBD	17	5.2	2.3	
	TOTAL	52 {54}			
MONTHS POST-ONSET	NC	N/A			t-test: .354 {.404}
	RBD	17 {19}	35.6 {33.8}	39.6 {37.8}	
	LBD	17	23.6	33.6	
	TOTAL	34 {36}			

Table 3 continued

	Group	N	Ratio	Chi Square* p-value
GENDER (% Male)	NC	18	61	.969 {.913}
	RBD	17 {19}	65{63}	
	LBD	17	59	
ETHNICITY	NC	18	11W:6B:1A	.969 {1.00}
	RBD	17 {19}	10W:7B {11W:8B}	
	LBD	17	11W:5B:1O	
* Chi Square with unequal frequencies expected				

W=White; B=Black; A=Asian; O=Other

Table 4
Descriptive Statistics for Screening Measures

TASK	Possible Range of raw scores	GROUP	N	MEAN	Standard Deviation	Grant Cutoff	p-value
WAIS Block Design	0-51	NC	18	21.6	10.7	< 7	.716
		LBD	17	22.9	10.7		
WAIS Information	0-29	NC	18	22.1	4.7	< 7	.115 {.125}
		RBD	17 {19}	19.5 {19.4}	4.5 {5.7}		
BDAE CIM	0-12	NC	18	10.8	1.1	< 4/6 of first 6	.844 {.821}
		RBD	17 {19}	10.8 {10.7}	1.5 {1.5}		
		LBD	17	11.0	1.3		
DRS Memory	0-25	NC	18	24.4	.9	< 22	.325 {.355}
		RBD	17 {19}	23.7 {23.8}	2.3 {2.2}		
		LBD	17	23.6	2.0		
DRS Attention	0-37	NC	18	36.3	.9	< 34	.013 {.006}
		RBD	17 {19}	35.5 {35.4}	1.5 {1.4}		
		LBD	17	36.1	.6		
BDI	0-63	NC	18	1.9	2.3	N/A	.316 {.189}
		RBD	17 {19}	3.5 {3.8}	3.5 {3.9}		
		LBD	17	2.8	2.9		

Table 5
Rater Demographics

Demographic	Group	N	Mean	Standard Deviation	p-value
Age	Facial Channel	4	20.7	1.9	.530
	Prosodic Channel	4	24.7	8.2	
	Lexical Channel	4	25.5	5.4	
	Control Data	3	21.3	1.5	
Education	Facial Channel	4	14.0	1.4	.259
	Prosodic Channel	4	15.2	.5	
	Lexical Channel	4	14.7	.5	
	Control Data	3	14.3	.6	
Gender (% Male)	Facial Channel	4	25	N/A	.965
	Prosodic Channel	4	25		
	Lexical Channel	4	25		
	Control Data	3	33		

Table 6

Control Data - Interrater Reliability - Training Phase

Channel	**Task**	**Interrater Reliability**
Facial	Bucco-facial Execution[1]	.61
	Bucco-facial Accuracy[2]	97%
	Facial Paralysis[2]	83%
Prosodic	Intonation Contours[2]	83%

Control Data - Interrater Reliability - Experimental Data Phase

Channel	**Task**	**Interrater Reliability**
Facial	Bucco-facial Execution[1]	.56
	Bucco-facial Accuracy[2]	97.2%
	Facial Paralysis[1]	.90
Prosodic	Intonation Contours[2]	84.7%

[1] Intensity IRR calculated with intraclass correlation
[2] Accuracy IRR calculated with %complete agreement

Table 7
Control Data - Interrater Reliability - Experimental Data Phase
Changes to IRR with each Rater removed

Bucco-facial Execution	**Intraclass Correlation**
Overall	.56
Rater 1 Removed	.41
Rater 2 Removed	.31
Rater 3 Removed	.59

Bucco-facial Accuracy	**% Agreement**
Overall	97.2%
Rater 1 Removed	96.9%
Rater 2 Removed	98.0%
Rater 3 Removed	96.7%

Facial Paralysis	**Intraclass Correlation**
Overall	.90
Rater 1 Removed	.87
Rater 2 Removed	.88
Rater 3 Removed	.81

Intonation Contours	**% Agreement**
Overall	84.7%
Rater 1 Removed	85.9%
Rater 2 Removed	85.3%
Rater 3 Removed	84.1%

Table 8
Experimental Tasks - Interrater Reliability - Training Data Phase

Channel	Task	Interrater Reliability
Facial	Intensity[1]	.89
	Accuracy[2]	80.8%
Prosody	Intensity	.82
	Accuracy	62.9%
Lexical	Intensity	.88
	Accuracy	78.2%

Table 9
Experimental Tasks - Interrater Reliability - Experimental Data Phase

Channel	Task	Interrater Reliability
Facial	Intensity[1]	.86
	Accuracy[2]	74.1%
	Confidence[1]	.59
Prosody	Intensity	.85
	Accuracy	60.7%
	Confidence[1]	.37
Lexical	Intensity	.76
	Accuracy	72.9%
	Confidence[1]	.57

[1] Intensity IRR calculated with intraclass correlation
[2] Accuracy IRR calculated with %complete agreement

Table 10
Experimental Data - Interrater Reliability - Experimental Data Phase
Changes to IRR with each Rater removed

Facial Accuracy	% Agreement
Overall	74.1%
Rater 1 Removed	74.8%
Rater 2 Removed	74.3%
Rater 3 Removed	76.6%
Rater 4 Removed	78.7%

Prosodic Accuracy	% Agreement
Overall	60.7%
Rater 1 Removed	68.1%
Rater 2 Removed	61.8%
Rater 3 Removed	63.3%
Rater 4 Removed	62.3%

Lexical Accuracy	% Agreement
Overall	72.9%
Rater 1 Removed	74.0%
Rater 2 Removed	73.5%
Rater 3 Removed	77.9%
Rater 4 Removed	74.4%

Facial Intensity	Intraclass Correlation
Overall	.86
Rater 1 Removed	.86
Rater 2 Removed	.85
Rater 3 Removed	.83
Rater 4 Removed	.87

Prosodic Intensity	Intraclass Correlation
Overall	.85
Rater 1 Removed	.90
Rater 2 Removed	.85
Rater 3 Removed	.86
Rater 4 Removed	.85

Lexical Intensity	Intraclass Correlation
Overall	.76
Rater 1 Removed	.77

Rater 2 Removed	.79
Rater 3 Removed	.80
Rater 4 Removed	.77

Table 10 continued

Facial Confidence	Intraclass Correlation
Overall	.59
Rater 1 Removed	.45
Rater 2 Removed	.54
Rater 3 Removed	.51
Rater 4 Removed	.58

Prosodic Confidence	Intraclass Correlation
Overall	.37
Rater 1 Removed	.34
Rater 2 Removed	.32
Rater 3 Removed	.27
Rater 4 Removed	.29

Lexical Confidence	Intraclass Correlation
Overall	.57
Rater 1 Removed	.43
Rater 2 Removed	.44
Rater 3 Removed	.61
Rater 4 Removed	.43

Table 11
Effect of Lesion Laterality on Emotional Expression by Parameter
Mean (SD)

Channel	RBD n=17	LBD n=17	NC n=18	RBD n=19	Overall n=52
ACCURACY					
Facial	.386 (.101)	.351 (.128)	.405 (.109)	.390 (.097)	.381 (.113)
Lexical	.382 (.075)	.407 (.118)	.411 (.103)	.383 (.091)	.401 (.099)
Prosodic	.186 (.081)	.210 (.099)	.325 (.090)	.184 (.076)	.242 (.108)
INTENSITY					
Facial	3.85 (.864)	4.16 (.947)	3.98 (.672)	3.99 (.987)	4.00 (.826)
Lexical	4.38 (.342)	4.33 (.609)	4.31 (.354)	4.38 (.323)	4.34 (.443)
Prosodic	3.82 (.729)	3.52 (1.02)	3.81 (690)	3.86 (.699)	3.72 (.820)
CONFIDENCE					
Facial	2.41 (.296)	2.50 (.329)	2.43 (.266)	2.44 (.331)	2.45 (.294)
Lexical	2.69 (.246)	2.65 (.354)	2.62 (.234)	2.69 (.241)	2.65 (.278)
Prosodic	2.05 (.240)	2.07 (.294)	2.18 (.181)	2.03 (.250)	2.10 (.244)

Table 12
Effect of Lesion Laterality on Valence Accuracy by Parameter
Mean (SD)

Channel		RBD n=17	LBD n=17	NC n=18	RBD n=19	Overall n=52
Facial	positive	.768 (.22)	.706 (.20)	.852 (.19)	.766 (.21)	.777 (.20)
	negative	.644 (.16)	.648 (.19)	.562 (.23)	.637 (.15)	.617 (.19)
Lexical	positive	.939 (.04)	.935 (.07)	.954 (.03)	.943 (.04)	.943 (.05)
	negative	.704 (.13)	.711 (.20)	.770 (.16)	.704 (.14)	.729 (.16)
Prosodic	positive	.593 (.19)	.564 (.23)	.688 (.21)	.592 (.18)	.616 (.21)
	negative	.554 (.16)	.566 (.18)	.624 (.16)	.557 (.15)	.582 (.16)

Table 13
Effect of Lesion Laterality on Emotional Expression by Valence
Mean (SD)

Channel	Valence	RBD n=17	LBD n=17	NC n=18	RBD n=19	Overall n=52
ACCURACY						
Facial	positive	.451 (.236)	.476 (.206)	.611 (.190)	.456 (.224)	.515 (.219)
	negative	.348 (.127)	.277 (.146)	.281 (.131)	.351 (.127)	.301 (.136)
Lexical	positive	.492 (.074)	.480 (.118)	.495 (.093)	.505 (.083)	.489 (.095)
	negative	.316 (.106)	.366 (.145)	.361 (.134)	.319 (.126)	.348 (.129)
Prosodic	positive	.211 (.177)	.196 (.121)	.269 (.153)	.219 (.170)	.226 (.152)
	negative	.171 (.087)	.218 (.125)	.358 (.126)	.163 (.086)	.251 (.138)
INTENSITY						
Facial	positive	3.81 (.967)	4.08 (.919)	4.11 (.739)	3.99 (1.13)	4.00 (.871)
	negative	3.87 (.935)	4.21 (1.03)	3.91 (.723)	3.99 (1.01)	4.00 (.898)
Lexical	positive	3.69 (.340)	3.62 (.551)	3.60 (.425)	3.63 (.464)	3.64 (.454)
	negative	4.80 (.381)	4.75 (.678)	4.73 (.433)	4.80 (.360)	4.76 (.503)
Prosodic	positive	3.88 (.764)	3.67 (1.14)	4.19 (.705)	3.90 (.728)	3.92 (.897)
	negative	3.78 (.782)	3.43 (1.04)	3.59 (.812)	3.83 (.751)	3.60 (.877)
CONFIDENCE						
Facial	positive	2.49 (.382)	2.61 (.309)	2.70 (.415)	2.52 (.414)	2.60 (.375)
	negative	2.37 (.328)	2.44 (.416)	2.27 (.292)	2.40 (.350)	2.36 (.349)
Lexical	positive	2.67 (.286)	2.71 (.429)	2.66 (.282)	2.68 (.278)	2.68 (.332)
	negative	2.71 (.267)	2.61 (.371)	2.60 (.252)	2.70 (.261)	2.64 (.298)
Prosodic	positive	2.02 (.353)	2.13 (.381)	2.27 (.257)	1.99 (.353)	2.14 (.343)
	negative	2.07 (.240)	2.04 (.343)	2.13 (.246)	2.05 (.271)	2.08 (.276)

Table 14
Demographic Variables Correlated with Emotion Tasks by Group
Pearson product-moment correlation coefficients

Variable		Facial			Lexical			Prosodic		
		Accuracy	Intensity	Confidence	Accuracy	Intensity	Confidence	Accuracy	Intensity	Confidence
Age	RBD n=17	-.183	.181	.088	-.305	-.517*	-.357	.139	.391	.384
	p-value	.482	.486	.737	.234	.034	.159	.595	.121	.128
	LBD	-.156	.323	.371	.647**	.702**	.729***	.074	.273	-.091
	p-value	.551	.207	.143	.005	.002	.001	.777	.289	.730
	NC	-.398	.113	.053	-.095	.115	.074	.152	.334	-.210
	p-value	.102	.656	.835	.707	.649	.772	.547	.175	.404
	RBD n=19	-.157	.223	.107	-.258	-.494*	-.344	.118	.415	.259
	p-value	.522	.358	.663	.287	.032	.149	.630	.077	.284
	Overall N=52	-.236	.210	.168	.109	.151	.157	.132	.309*	.066
	p-value	.092	.136	.235	.443	.286	.266	.350	.026	.640
Gender^{+}	RBD n=17	.178	-.176	-.101	.176	.000	.176	-.063	-.427	-.378
	p-value	.495	.500	.701	.499	1.000	.500	.809	.087	.134
	LBD	-.171	-.037	-.196	-.366	-.195	-.293	-.135	.-.024	-.282
	p-value	.511	.889	.452	.149	.453	.254	.605	.926	.274
	NC	-.034	.165	.110	-.011	-.187	.121	-.145	.450	.044
	p-value	.895	.513	.663	.966	.458	.633	.565	.061	.862
	RBD n=19	.121	-.199	-.180	-.040	.060	.060	-.111	-.299	-.439
	p-value	.623	.414	.462	.871	.808	.808	.652	.214	.060
	Overall N=52	-.023	-.016	-.069	-.100	-.173	-.034	-.077	-.020	-.219
	p-value	.874	.911	.629	.480	.221	.810	.588	.889	.119

			Facial			Lexical			Prosodic	
Variable		**Accuracy**	**Intensity**	**Confidence**	**Accuracy**	**Intensity**	**Confidence**	**Accuracy**	**Intensity**	**Confidence**
Education	**RBD n=17**	.290	.336	.550*	.052	-.115	-.060	-.160	-.060	-.001
	p-value	.260	.187	.022	.844	.661	.820	.541	.819	.998
	LBD	.301	.466	.629**	.215	.013	.129	.547*	.416	.394
	p-value	.240	.060	.007	.408	.960	.622	.023	.097	.117
	NC	.323	.548*	.551*	.164	.164	.055	.298	.159	.133
	p-value	.191	.018	.018	.515	.516	.828	.229	.528	.598
	RBD n=19	.304	.411	.632**	.462*	-.089	.147	-.062	-.100	.243
	p-value	.206	.080	.004	.047	.718	.549	.801	.683	.317
	Overall N=52	.289*	.430***	.575***	.154	.010	.062	.214	.222	.212
	p-value	.038	.001	.000	.275	.942	.664	.127	.114	.132

*** Spearman's correlation; 1=Male**

***P ≤ .05, **P ≤ .01, ***P ≤ .001**

Table 15
NonEmotional Control Variables

Channel/Variable		M	SD	F	df	p
Facial						
Bucco-facial Accuracy	**RBD**	.899	.10	2.22	2,50	.119
Score range: 0-1	**LBD**	.884	.12			
	NC	.951	.07			
	RBD n=19	.895	.11			
Bucco-facial Execution	**RBD**	2.863	.17	1.91	2,50	.159
Score range 1-3	**LBD**	2.904	.13			
	NC	2.951	.07			
	RBD n=19	2.865	.17			
Facial Paralysis	**RBD**	.250	.15	1.34	2,51	.272
Score range: -2 to +2	**LBD**	.345	.18			
M is of absolute value	**NC**	.316	.19			
	RBD n=19	.250	.14			
Prosody						
Intonation Contours	**RBD**	.632	.16	0.36	2,50	.699
Score range: 0-1	**LBD**	.601	.18			
	NC	.648	.15			
	RBD n=19	.619	.16			
Lexical						
Phonemic Fluency	**RBD**	35.00	12.39	8.21	2,51	.001
(F,A,S total)	**LBD**	25.59	13.09			
	NC	43.33	13.33			
	RBD n=19	34.89	11.85			
Semantic Fluency	**RBD**	15.35	5.00	3.67	2,51	.033
(Animals total)	**LBD**	13.71	5.52			
	NC	18.67	5.99			
	RBD n=19	15.00	5.01			

Table 16
Performance on Control Tasks Correlated with Emotion Tasks by Group
Pearson product-moment correlation coefficients

		Facial			Lexical			Prosodic	
Variable	**Accuracy**	**Intensity**	**Confidence**	**Accuracy**	**Intensity**	**Confidence**	**Accuracy**	**Intensity**	**Confidence**
Bucco-facial Acc RBD	.495*	-.034	.098						
p-value	.043	.896	.708						
LBD	.308	.088	-.031						
p-value	.229	.738	.906						
NC	.223	-.040	.171						
p-value	.390	.878	.511						
RBD n=19	.492*	.087	.248						
p-value	.033	.725	.305						
Overall n=52	.368**	.007	.034						
p-value	.008	.959	.811						
Bucco-facial Exe RBD	.189	-.253	-.410						
p-value	.469	.327	.102						
LBD	.344	.241	.402						
p-value	.176	.352	.110						
NC	.281	.151	.278						
p-value	.275	.564	.279						
RBD n=19	.222	-.010	-.218						
p-value	.362	.685	.370						
Overall n=52	.256	.019	.023						
p-value	.070	.894	.875						

Variable		Accuracy	Facial Intensity	Confidence	Accuracy	Lexical Intensity	Confidence	Accuracy	Prosodic Intensity	Confidence
Facial Paralysis	RBD	.043	.185	.317						
	p-value	.869	.478	.215						
	LBD	-.011	.175	.119						
	p-value	.967	.502	.650						
	NC	-.099	-.286	-.365						
	p-value	.695	.251	.136						
	RBD n=19	.053	.176	.297						
	p-value	.830	.471	.217						
	Overall n=52	-.049	.065	.034						
	p-value	.733	.649	.812						
FAS Total score	RBD				-.141	-.261	-.392			
	p-value				.589	.313	.120			
	LBD				.249	.122	.093			
	p-value				.335	.640	.722			
	NC				.384	.661**	.390			
	p-value				.116	.003	.110			
	RBD n=19				-.001	-.258	-.325			
	p-value				.996	.286	.175			
	Overall N=52				.182	.147	.021			
	p-value				.197	.299	.882			

Variable		Accuracy	Facial Intensity	Confidence	Accuracy	Lexical Intensity	Confidence	Accuracy	Prosodic Intensity	Confidence
Animal Naming	RBD				.145	.305	.229			
	p-value				.580	.234	.376			
	LBD				.103	-.088	.058			
	p-value				.694	.738	.824			
	NC				.556*	.508*	.160			
	p-value				.017	.031	.525			
	RBD n=19				.270	.277	.277			
	p-value				.263	.250	.251			
	Overall n=52				.279*	.157	.101			
	p-value				.045	.267	.475			
Inton Contours	RBD							-.056	.010	.324
	p-value							.836	.972	.220
	LBD							.556*	.453	.478
	p-value							.021	.068	.052
	NC							.136	-.267	-.327
	p-value							.592	.285	.185
	RBD n=19							-.051	-.015	.282
	p-value							.839	.954	.257
	Overall n=52							.253	.157	.249
	p-value							.074	.272	.078

*$P \leq .05$, **$P \leq .01$, ***$P \leq .001$

Table 17
Neutral Poses

Variable		M	SD	F	df	p
Facial Neutral	**RBD**	2.57	.660	0.15	2,49	.858
	LBD	2.46	.639			
	NC	2.56	.705			
	RBD n=19	2.68	.716			
	Overall n=52	2.53	.669			
Prosodic Neutral	**RBD**	2.91	.785	2.39	2,49	.102
	LBD	2.47	.931			
	NC	3.10	.879			
	RBD n=19	2.93	.745			
	Overall n=52	2.83	.867			

Table 18
Correlations between the Intensity rating for the Neutral Poses and related Experimental Tasks

Pearson product-moment correlation coefficients

Variable		Correlation with Facial Neutral
Facial Accuracy	RBD	.050
	p-value	.849
	LBD	-.377
	p-value	.136
	NC	-.386
	p-value	.113
	RBD n=19	.068
	p-value	.783
	Overall n=52	-.235
	p-value	.094
Facial Intensity	RBD	.542*
	p-value	.025
	LBD	.434
	p-value	.082
	NC	.534*
	p-value	.022
	RBD n=19	.522*
	p-value	.022
	Overall n=52	.474***
	p-value	.000
Facial Confidence	RBD	.467
	p-value	.059
	LBD	.512*
	p-value	.036
	NC	.373
	p-value	.128
	RBD n=19	.380
	p-value	.109
	Overall n=52	.432***
	p-value	.001

$*P \leq .05$, $**P \leq .01$, $***P \leq .001$

Table 18 continued
Correlations between the Intensity rating for the Neutral Poses and related Experimental Tasks

Pearson product-moment correlation coefficients

Variable	Correlation with Prosodic Neutral
Prosodic Accuracy RBD	-.003
p-value	.992
LBD	-.030
p-value	.910
NC	.291
p-value	.242
RBD n=19	-.004
p-value	.987
Overall n=52	.176
p-value	.212
Prosodic Intensity RBD	.807***
p-value	.000
LBD	.207
p-value	.426
NC	.344
p-value	.162
RBD n=19	.802***
p-value	.000
Overall n=52	.428**
p-value	.002
Prosodic Confidence RBD	.302
p-value	.238
LBD	-.189
p-value	.467
NC	-.044
p-value	.861
RBD n=19	.265
p-value	.273
Overall n=52	.040
p-value	.778

*$P \leq .05$, **$P \leq .01$, ***$P \leq .001$

Table 19
Effect of Lesion Site on Emotional Expression
Anterior versus Posterior Lesions
Mean (SD)

Channel/ Parameter		Anterior	Posterior	Anterior + Posterior	All Posers with Anterior Leisons*
Accuracy					
Facial	LBD	.27 (.07)	.29 (.10)	.422 (.06)	.37 (.10)
	RBD	.41 (.06)	.33 (.12)	.408 (.10)	.41 (.08)
Lexical	LBD	.49 (.04)	.39 (.14)	.369 (.12)	.41 (.11)
	RBD	.36 (.16)	.37 (.06)	.406 (.09)	.38 (.12)
Prosodic	LBD	.09 (.00)	.20 (.09)	.273 (.14)	.21 (.14)
	RBD	.21 (.05)	.14 (.07)	.203 (.11)	.21 (.08)
Intensity					
Facial	LBD	4.27 (1.08)	4.04 (.60)	4.32 (1.66)	4.30 (1.38)
	RBD	4.52 (1.50)	3.63 (1.06)	3.87 (.40)	4.19 (1.07)
Lexical	LBD	4.34 (.06)	4.36 (.72)	4.41 (.64)	4.39 (.50)
	RBD	4.30 (.17)	4.31 (.38)	4.55 (.40)	4.42 (.31)
Prosodic	LBD	3.31 (.80)	3.10 (.89)	4.07 (.83)	3.82 (.83)
	RBD	4.03 (.24)	3.81 (1.07)	3.87 (.52)	3.95 (.39)
Confidence					
Facial	LBD	2.63 (.44)	2.43 (.24)	2.59 (.60)	2.60 (.50)
	RBD	2.66 (.45)	2.41 (.29)	2.17 (.15)	2.41 (.40)
Lexical	LBD	2.77 (.15)	2.68 (.45)	2.71 (.22)	2.73 (.18)
	RBD	2.68 (.17)	2.63 (.22)	2.82 (.33)	2.75 (.25)
Prosodic	LBD	1.95 (.33)	2.03 (.21)	2.23 (.24)	2.14 (.28)
	RBD	1.91 (.21)	2.16 (.33)	1.91 (.08)	1.91 (.15)

Group N		
	Anterior:	LBD 2, RBD 4
	Posterior:	LBD 7, RBD 7
	Ant + Post:	LBD 4, RBD 4
	All Posers with Ant. Lesions:	LBD 6, RBD 8

* Anterior + (Ant + Post) group

Table 20
Effect of Lesion Site on Emotional Expression
Frontal vs. Temporal vs. Parietal vs. Occipital Lesions
Mean (SD)

Channel/Parameter		Anterior	Temporal	Parietal	Occipital
Accuracy					
Facial	LBD	.27 (.07)	.30 (.15)	.24 (.08)	.28
	RBD	.41 (.06)	.25 (.18)	.31 (.00)	.31
Lexical	LBD	.49 (.04)	.31 (.20)	.43 (.15)	.51
	RBD	.36 (.16)	.43 (.02)	.39 (.01)	.35
Prosodic	LBD	.09 (.00)	.19 (.09)	.18 (.13)	.25
	RBD	.21 (.05)	.06 (.04	.17 (.02)	.25
Intensity					
Facial	LBD	4.27 (1.08)	4.02 (.20)	3.94 (.47)	5.09
	RBD	4.52 (1.50)	3.20 (.73)	2.89 (.15)	3.88
Lexical	LBD	4.34 (.06)	4.07 (.93)	4.45 (.88)	5.00
	RBD	4.30 (.17)	4.61 (.17)	4.50 (.45)	4.14
Prosodic	LBD	3.31 (.80)	2.66 (.71)	3.17 (.46)	4.72
	RBD	4.03 (.24)	3.02 (.07)	3.25 (.18)	3.91
Confidence					
Facial	LBD	2.63 (.44)	2.48 (.02)	2.40 (.37)	2.59
	RBD	2.66 (.45)	2.20 (.15)	2.28 (.31)	2.56
Lexical	LBD	2.77 (.15)	2.40 (.85)	2.81 (.31)	2.96
	RBD	2.68 (.17)	2.84 (.05)	2.72 (.20)	2.40
Prosodic	LBD	1.95 (.33)	2.08 (.33)	1.90 (.08)	2.32
	RBD	1.91 (.21)	1.84 (.18)	2.20 (.38)	2.28

Group N

Anterior: LBD 2, RBD 4
Temporal: LBD 2, RBD 2
Parietal: LBD 3, RBD 2
Occipital: LBD 1, RBD 1

Table 21
CHANNEL INTERRELATIONSHIPS by Group

Relationships among Parameters across Channels by Group

	RBD N=17	LBD N=17	NC N=18	RBD N=19	Overall N=52
Accuracy					
Lexical & Facial	-.02	-.08	.39	.09	.09
p-value	.953	.763	.109	.706	.515
Lexical & Prosodic	-.35	.32	.37	-.23	.21
p-value	.172	.218	.128	.353	.138
Facial & Prosodic	.44	.62**	.23	.44	.43***
p-value	.076	.009	.359	.063	.001
Intensity					
Lexical & Facial	-.27	.24	.09	-.21	.07
p-value	.292	.346	.715	.391	.647
Lexical & Prosodic	-.45	.40	-.13	-.44	.09
p-value	.067	.113	.602	.060	.528
Facial & Prosodic	.54*	.59**	.21	.48*	.45***
p-value	.027	.012	.404	.036	.001
Confidence					
Lexical & Facial	-.45	.24	.28	-.23	.05
p-value	.073	.355	.266	.352	.730
Lexical & Prosodic	-.52*	-.12	-.30	-.37	-.28*
p-value	.032	.660	.234	.117	.044
Facial & Prosodic	.42	.39	.25	.40	.34**
p-value	.092	.124	.324	.093	.013

*P ≤ .05, **P ≤ .01, ***P ≤ .001

Table 22
CHANNEL INTERRELATIONSHIPS by Group

Relationships among Parameters within a Channel by Group

	RBD N=17	LBD N=17	NC N=18	RBD N=19	Overall N=52
Facial					
Accuracy & Intensity	.61**	.25	.20	.60**	.31*
p-value	.010	.339	.439	.007	.026
Accuracy & Conf	.41	.19	.40	.45	.29*
p-value	.100	.465	.099	.056	.041
Intensity & Conf	.60**	.87***	.85***	.70***	.77***
p-value	.011	.000	.000	.001	.000
Lexical					
Accuracy & Intensity	.75***	.70**	.55*	.58**	.64***
p-value	.001	.002	.019	.010	.000
Accuracy & Conf	.79***	.76***	.67**	.76***	.71***
p-value	.000	.000	.002	.000	.000
Intensity & Conf	.89***	.85***	.76***	.86***	.83***
p-value	.000	.000	.000	.000	.000
Prosody					
Accuracy & Intensity	-.07	.55*	.29	-.08	.28*
p-value	.795	.023	.251	.743	.042
Accuracy & Conf	-.01	.49*	-.04	.03	.30*
p-value	.978	.045	.886	.901	.033
Intensity & Conf	.59**	.69**	.39	.46*	.58***
p-value	.014	.002	.108	.049	.000

*P ≤ .05, **P ≤ .01, ***P ≤ .001

Appendix A

Lexical Category Accuracy Rating Instructions

Welcome back to our last day of rating together. So far you have discussed and rated words in terms of their emotional intensity and pleasantness. Today you will asked to make determinations about what category a word best fits into. As before, I will define all the terms you will need to know, we will review some exemplars, we'll discuss more words, together; then, you will rate two sets of words on your own. Again, this session may take about 3-4 hours and a lengthy break is planned in about 2 hours. If you need a short break before then, please let me know.

So today, we are going to evaluate words in terms of their association with certain categories; the categories are specific emotions. I will present you with the 8 emotion categories and you will be asked to put the word in the category you think it best represents. Again, the goal is for all of us to agree as often as possible so you should consider the word in its most widely used connotation. Try to think of how most people would categorize the word.

PRESENT ENLARGED LIST OF 8 EMOTIONS FOR ALL TO SEE.

Please read each one on the list, then I will go through them individually to tell you what they refer to.

OK, now I will define each one, even though most may seem obvious to you.

Happiness: The category of "happiness" refers to feelings or things that are associated with pleasure, contentment, relief, and/or anticipation of something pleasurable.

PS: The category of "pleasant surprise" refers to feelings or things that are associated with being caught unexpectedly, "by surprise", but in a good or pleasurable way.

Interest: The category of "interest" refers to feelings or things that are associated with being engaged in, caught-up in, or curious about something.

Sadness: The category of "sadness" refers to feelings or things that are associated with loss, disappointment, or hopelessness.

US: The category of "unpleasant surprise" refers to feelings or things that are associated with being caught unexpectedly but in a negative or unpleasant way.

Fear: The category of "fear" refers to feelings or things that are associated with being scared.

Anger: The category of "anger" refers to feelings or things that are associated with being mad or frustrated.

Disgust: The category of "disgust" refers to feelings or things that are associated with aversion or being offended in some way.

ANY QUESTIONS?

Now let's review some exemplars of each emotion category. I will show you four exemplars for each category. If you are unsure of the meaning of any word, please ask me; also if you strongly disagree with the appropriateness of a word in a certain category, ask me and we can discuss it. Otherwise we will discuss more examples later.

PASS OUT EXEMPLAR BOOKLET.

As you see, the booklet in front of you contains several pages; each one has all eight emotion categories at the top with one that is highlighted and 4 exemplar words underneath.

Please turn to Page 1 which contains exemplars for the category Happy (birthday, gleeful, loving, and smile). All of these words reflect are associated with the category of happiness. While some of us may not look forward to EVERY birthday, most people would think of birthday as an event that causes feelings of happiness.

Please turn to Page 2 which contains exemplars for the category Pleasant Surprise (gee, lottery, prize, winner). All of these words are associated with the category of pleasant surprise.

Please turn to Page 3 which contains exemplars for the category Interest (attention, curious, intrigued, and involved). All of these words are associated with the category of interest.

Please turn to Page 4 which contains exemplars for the category Sadness (down, regret, remorse, and unhappy). All of these words are associated with the category of sadness.

Please turn to Page 5 which contains exemplars for the category of Unpleasant Surprise (jarred, jolted, mishap, and shocked). All of these words are associated with the category of unpleasant surprise.

Please turn to Page 6 which contains exemplars for the category of Fear (monster, petrified, scared, and threat). All of these words are associated with the category of fear.

Please turn to Page 7 which contains exemplars for the category of Anger (hostile, indignation, madden, and rage). All of these words are associated with the category of anger.

Please turn to Page 8 which contains exemplars for the category of Disgust (aversion, filth, gross, and vomit). All of these words reflect things that cause a feeling of disgust.

ANY QUESTIONS?

Conferencing Stage:

Now let's review some words together. Remember that our goal is to gain consensus in our decisions about which emotion category a word is most closely associated with. Let's discuss some strategies that might be helpful in this process. Probably, strategies similar to those you have used in the other two rating sessions will also be helpful here.

RESEARCHER ENCOURAGES MEMBERS TO GENERATE STRATEGIES TO PROMOTE GROUP CONSENSUS.

Strategies may include things such as:

Ask yourself, "What emotion comes most readily to mind when I see this word?"

Ask yourself, "If someone said this word, what would they most likely be feeling?" What context is this word usually associated with? What emotion best describes that context?

In general, you should rely on your own impression of how the word should be rated. Occasionally, a word may strike you differently than it does other raters. At times like this, you can ask yourself if you are thinking of a particular context for the word that, perhaps, represents a personal memory for you. If so, try to think how people, in general, would think of the word.

End this discussion of strategies when all members seem to have an idea of the general strategies that should be used. If necessary, review some strategies that would not be helpful. For example, members should not be relying on a personal/idiosyncratic image of what the word means.

All members should have several "tools" for rating the conferencing words before moving on.

PASS OUT CONFERENCING BOOKLET.

Now we will practice rating some words together. As you will see this booklet contains more words. On each page, the categories are listed below each word. One set of choices is marked "1st Rating" and the other, "2nd Rating". We will discuss each word in turn. Remember, it is essential that you all participate since the goal is to reach group consensus on as many words as possible. As we have been doing in the past two sessions, I will ask you to record your response in the space provided, where it says "1st rating". Then you will all state your ratings aloud. Please listen to how others rated the word so you can judge how you are rating compared to the rest of the group. If most of you agree on which category the word best fits into, we will not need to have much discussion since agreement among you is already high. For the items where there are more disparate ratings, we will review and discuss your different points of view. If at any point you feel a review of the exemplars would be helpful, please let me know and we will all review those materials. Hopefully, after we discuss the item, more of you will agree with each other than prior to the discussion. After we discuss the item, you will have the opportunity to re-rate the word in case discussion has changed your mind. I will also ask you to state your 2nd rating aloud so that I can keep track of how much group consensus there is. You will record this rating in the space labeled, "2nd rating". If you have not changed your mind, just rewrite your original category. I will collect your rating sheets at the end of this part of today's session.

ANY QUESTIONS?

Researcher should keep a tally of the group's rating before and after discussion in order to gauge the progress of each member and the group as a whole. This will allow the researcher to flag any raters who are posing significant problems to reaching sufficient IRR.

In general, the Conferencing process for Category Accuracy should proceed in a manner similar to the Conferencing stage of the Intensity and Pleasantness ratings.

When all Conferencing words have been reviewed, review notes to determine if the group is ready for IRR determination. Group consensus should have been reached for a majority of items (near 70-80%) for the group to be considered ready. If necessary, tell the group that we need to work on some more words because there is not enough agreement yet. Use back-up list of words for the second conferencing. Again, appropriate strategies should be reinforced. Alternate strategies can be discussed and more time devoted to some of the words that pose the most difficulty.

Inter-Rater Reliability Determination:

Now we are ready to move on to rating some words on your own. Please keep in mind the strategies we found helpful in our previous discussions. Again group consensus is the goal but you will be working on your own now.

ANY QUESTIONS?

PASS OUT IRR BOOKLET

Please do not open your booklets yet. You will see that this booklet is very similar to the one you just used for discussion. Please circle your choice for each item. There are 60 words in this booklet. Work at your own pace; take your time. We will take a break after you're all through so that I can tally your responses and see how well you all agree.

ANY QUESTIONS BEFORE YOU START?

OK. Open your booklets and begin rating the words.

Determine IRR.. If IRR was not achieved, reconvene the group and present them with a review of the exemplars, more words for Conferencing, and/or another set of IRR words, whichever is deemed more appropriate for the group.

Experimental Ratings:

Once adequate IRR has been achieved, have the members regroup.

You all agreed very closely! Congratulations! Thank you; you are all doing very well. Now, I'm going to ask you to rate one final set of words.

PASS OUT EXPERIMENTAL RATING BOOKLET. COLLECT ALL OTHER TRAINING MATERIALS.

Please don't open the booklet until I ask you to. There are XXX words in this set. Again, please keep in mind the strategies that you have been using successfully so far. Work at your own pace; take your time.

ANY QUESTIONS?

OK, begin rating these words please.

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