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ABSTRACT

Recent findings on the communicative functions of the left versus the right hemisphere of the brain may suggest that there is a distinction between the intentional use of symbols for the sending of specific messages or propositions (language, signing, pantomime) and spontaneous expressive behaviors that signal their meaning through a natural relationship with that which is signified. Recent research into the functions of the left and right cerebral hemispheres and the patterns of communicative deficit in patients suffering from brain damage suggests that the hemispheres play different roles in these communicative processes. The left hemisphere is particularly involved in the symbolic communication process, while the right hemisphere plays a special role in spontaneous communication. Damage to the left hemisphere in right handed people is associated with deficits in language expression and comprehension--the aphasias. Nonverbal communication is relatively intact in aphasic patients, however. While it is likely that the two hemispheres are both associated with either spontaneous or symbolic processes, it should be emphasized that the two systems are highly interactive, and serve to modify one another. One cannot be fully understood without the other. (HTH)

# Left and Right Hemisphere Brain Functions and Symbolic vs. Spontaneous Communication Processes



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In recent years there has been an explosion of interest and research in the role of nonverbal behavior in communication and affective expression involving a wide variety of behaviors: facial expression, eye behavior, body movement, paralanguage, spatial behavior, etc. This general area of investigation has been labeled "nonverbal communication," and its results have led to fundamentally new views of the processes of emotion expression and communication during interaction. Indeed, it has been suggested that in many situations more "meaning" is transferred between people via nonverbal signals than by verbal statements. However, the processes underlying nonverbal communication, and the ways in which they differ from verbal communication, have never been adequately spelled out. The field as a whole has been largely atheoretical, with different points of view revolving more around different kinds of nonverbal behaviors and the methodologies used to measure those behaviors than around different theories about the nature of those behaviors. For example, Duncan's very useful distinction between structural and external variable approaches to nonverbal communication is fundamentally a methodological rather than a theoretical distinction, and major textbooks in the area have employed as their basis of organizing the field the type of behavior measured (facial expression vs. body movement vs. spatial behavior, etc.: cf. Duncan, 1969; Knapp, 1979; Weitz, 1979).

Thus we are left with a phenomenon which seems to tell us much about emotional expression and communication which is fundamentally different from what we had previously understood, and we don't exactly know why. We do not

really understand what is unique about the process that we call nonverbal communication, and how it is different from verbal communication.

The purpose of this paper is to review recent findings on the communicative functions of the left vs. the right hemisphere of the brain, and to suggest that these findings support a distinction between, on the one hand, the intentional use of symbols for the sending of specific messages or propositions, as in language, signing, pantomime, etc., and on the other hand spontaneous expressive behaviors which are nonpropositional and nonsymbolic, signalling their meaning through a natural relationship with that which is signified. We will suggest that many of the findings in the field of nonverbal communication involve spontaneous behavior, but that nonverbal behavior can be symbolic and that verbal behavior can be virtually spontaneous and functionally nonsymbolic. The distinction between symbolic and spontaneous communication is thus more fundamental than the distinction between verbal and nonverbal communication.

Defining "Communication."

We should first make it clear that we are defining "communication" as occuring whenever the behavior of one individual (the sender) influences the behavior of another (the receiver). Many definitions of communication would exclude influences transmitted via spontaneous and nonsymbolic behavior. Thus, Weiner, Devoe, Rubinow and Geller (1972) define communication as necessarily involving a socially shared symbol system, or code, which is symbolic in nature. We consider such definitions of communication to be unduly restrictive in that they do not consider the possibility of a biologically shared signal system. Such a system is implied in Darwin's (1872) analysis in Expressions of the Emotions in Man and Animals which has been of great influence in the recent study of nonverbal communication (Edman, 1973). Darwin argued that facial

expressions and other such displays have adaptive value in social animals because they reveal something about certain inner states of the responder and are thus necessary for social co-ordination. This implies (a) that the inner state of the responder must be "encoded" into an expressive display, (b) that the receiver must be able to receive the expressive display via sensory cues, and (c) that the receiver must be able to "decode" the display: i.e. respond appropriately to it. In other words, Darwin's thesis implies that both sending mechanisms and receiving mechanisms must have evolved in concert with the evolution of emotion expression, in order for the adaptive value of such a system to be realized.

An example of such a sending mechanism is the complex facial musculature of the primate. Another is the evolution of the respiratory tract in primates favoring complex vocalizations. These features presumably evolved in part to serve communicative demands in these highly social species. Andrew (1963) has suggested for example that grunts evolved in baboons because "the nature of their societies was such as to greatly favor any change making the transfer of information by display more explicit and less ambiguous (p. 91)," and has noted (1965) that the displays of the highly social plains-dwelling baboon are more complex than are those of the more solitary forest-dwelling mandrill or drill baboon.

In essence, the reasoning behind the evolution of sending mechanisms is that given that the communication of a certain motivational or emotional state is adaptive to a species, individuals who show evidence of this state in their external behavior will tend to be favored, so that over the generations these behaviors will become "ritualized" into displays (cf. Buck, 1981). The same reasoning applies to the evolution of receiving mechanisms: individuals

who respond appropriately to these displays would tend to be favored, so that the perceptual systems of species members would eventually become "preattuned" to the pickup of these displays. This reasoning is consistent with Gibson's (1966; 1977) theory of perception, which argues that perception must be determined by the nature of the ecological niche in which the species evolved (cf. Baron, 1980; Baron & Buck, 1979). It is also consistent with Sackett's (1966) demonstration that infant monkeys isolated from birth show appropriately fearful responses to a photograph of a threat display, and with recent demonstrations using classical conditioning which show that human facial expressions of anger and fear are more readily associated with aversive events than are happy or neutral expressions (Ohman and Dimberg, 1978; Orr and Lanzetta, 1980).

The result of this evolutionary process is a signal system involving both sending and receiving mechanisms which is biologically based. In Mind Self and Society, (1932), George Herbert Mead argued that this constitutes the primitive system from which human verbal communicative ability evolved and was developed. In doing so he distinguished between communication via "gesture" and via "significant symbol."

Communication via gesture. Mead referred to the spontaneous expressive emotion displays analyzed by Darwin as "gestures." His example of a "conversation of gesture" was a dog fight, in which the antagonists circle each other, growling and snapping, responding instantly to signs of advance or retreat on the part of the other animal. The gestures on which this conversation is based are not voluntary: as Mead says "it is quite impossible to assume that animals do undertake to express their emotions. They certainly do not undertake to express them for the benefit of other animals (p. 16)." Also, these gestures are not symbolic in that their relationship to their referents is not arbitrary.

In the language of semiotics they are "signs" which bear natural relationships with their referents: indeed the sign (the gesture or facial expression) is an external manifestation of the referent (the animal's motivational/emotional state). The advancing and growling of a dog are signs of impending attack just as dark clouds are a sign of impending rain.

Symbolic Communication. In contrast to the nonvoluntary and nonsymbolic conversation of gesture is intentional communication via symbols, in which the communicative behavior has an arbitrary socially-defined relationship with its referent, knowledge of which is shared by sender and receiver. The most obvious example of symbolic communication involves language behavior, but there are a wide variety of "nonverbal" behaviors which are analogous to or directly related to language behaviors and do not seem to involve the expression of internal motivational/emotional states. These include systems of sign language and pantomime, as well as body movements and facial expressions associated with language. Such behaviors were emphasized in Birdwhistell's (1970) pioneering work, which demonstrated the close relationship of body movements and language behaviors, both within a single speaker and between speaker and listener (cf. also Kendon, 1970; Dittman, 1972).

Ekman (1979) has recently distinguished these "conversational" facial expressions from emotional facial expressions. Conversational expressions include facial actions which are related to the process of speaking or listening, or facial emblems which may occur without speech. Such conversational expressions may involve well-established habits which, like many aspects of language, may be learned so well that they operate virtually "automatically" and outside conscious awareness, but they are not signs of an existing motivational/emotional state. Ekman suggests a series of empirical criteria to distinguish

conversational facial expressions from emotional facial expressions. In brief, emotional expressions are characterized by the following: (a) they occur earlier during the development of the individual; (b) it is somewhat more difficult to interfere with them or voluntarily perform them; (c) they occur when the person believes that he or she is unobserved; (d) they are universal to the human species; (e) the actual facial behavior differs in subtle respects from conversational expressions; and (f) different neural mechanisms are involved in emotional and conversational expressions.

Thus far we have suggested that there are two kinds of communication processes: a spontaneous process based upon the changing motivational/emotional state of the sender, and a symbolic process involving intentional messages or propositions. A consideration of recent research into the functions of the left and right cerebral hemisphers and the patterns of communicative deficit in patients suffering from brain damage, suggests that the right and left hemispheres play different roles in these communicative processes. We will suggest that the left hemisphere is particularly involved in the symbolic communication process, while the right hemisphere plays a special role in spontaneous communication.

Right vs. Left Hemisphere Brain Functions and Communication.

It has long been known that damage to the left hemisphere is associated in most right-handed people with a variety of deficits in language expression and comprehension--the aphasias. The role of the left hemisphere in spontaneous communication--facial and gestural expressiveness--has not been the subject of formal studies until recently, and informal clinical observations were mixed as we shall see. The study of the functions of the right hemisphere received

much less study until recently--the right hemisphere was termed the "minor," "silent" hemisphere, and most attention was paid to the left hemisphere, where damage resulted in much more serious clinical symptoms. Thus the roles of the right and left hemispheres in spontaneous and symbolic communication are just beginning to be understood.

Left hemisphere functions. The communication deficits suffered due to left hemisphere brain damage have been demonstrated in symbolic nonverbal behaviors as well as verbal behaviors: for example, deaf mutes who suffer left hemisphere damage have been found to lose their abilities at signing and finger spelling (Critchley, 1975, pp. 26-29). Also, a number of studies have demonstrated deficits of gesture and pantomime recognition and/or expression in aphasic patients (Goodglass and Kaplan, 1963; Gainotti and Lemmo, 1976; Pickett, 1974; Duffy, Duffy and Pearson, 1975; Duffy, Duffy and Alderdice, 1977; Varney, 1978). Moreover, the degree of gesture/pantomime impairment has been closely related to the degree of verbal impairment in these patients, with $r$'s ranging from .50 to .89. The technique of combining results from independent studies suggested by Rosenthal (1979) yields a combined $r$ of ($p$ ), indicating a strong relationship between the degree of verbal impairment and these "nonverbal behaviors.

On the other hand, a number of investigators have commented that nonverbal communication is relatively intact in aphasic patients. For example, Chester and Egolf (1974) state that nonverbal communication is more likely than verbal communication to remain "intact or at least functional" following brain damage, and Jenkins, Jimenez-Pabon, Shaw and Sefer (1975) state that aphasic patients show a "nearly normal competence" for communication via facial expression and gesture. The apparent contradiction between these statements and the results of the studies above can be resolved only if the investigators are speaking of

different kinds of "nonverbal communication."

We suggest that the studies demonstrating nonverbal deficits in aphasic patients involved symbolic nonverbal behavior, while the latter observations were based upon spontaneous behavior. The distinction is analogous to the one that has long been made in the literature on verbal behavior between "propositionizing," the use of words for the deliberate communication of a message, and "emotional utterance," which involves the use of words (such as expletives) in the expression of a presently existing motivational/emotional state It is possible that certain phrases may become so overlearned that they are virtually nonsymbolic conditioned responses to internal motivational/emotional states: an aphasic patient may swear when frustrated or say "hello" when greeting a friend, but be utterly unable to repeat those words a few moments later when the motivational/emotional state which elicited them is past.

Critchley (1975) has suggested that spontaneous facial expressions and gestures associated with motivational/emotional states may be analogous to emotional utterance, while similar but intentionally posed expressions and gestures in the absence of an affective state are analogous to propositionizing. Most formal studies of nonverbal communication have studied only the deliberate and intentional use of gestures and pantomime, as opposed to spontaneous nonverbal behavior. However, Buck and Duffy (1977, 1980) have recently used a slide-viewing paradigm developed from Robert E. Miller's (1964) studies of nonverbal communication in rhesus monkeys to study spontaneous expression in brain-damaged patients. In this procedure, the patient is shown a series of color slides in different categories: i.e. familiar people (nurses and other hospital personnel), unfamiliar people, unpleasant, and unusual slides--while their spontaneous facial/gestural responses to the slides are videotaped. Later, a panel of observers views the videotapes and attempts to guess what kind of slide the

subject viewed on that trial. The resulting accuracy scores indicate the "sending accuracy" of the patient: the ability of the observers to correctly guess the slides he viewed. This study found that observers could determine the category of slide viewed by the aphasic patients as well as they could from the facial expressions of non-brain-damaged controls, despite considerable facial paralysis in some of the aphasic patients. Moreover, Duffy and Buck (1979) showed that the sending accuracy scores of aphasic patients was essentially unrelated to the extent of verbal ability ($r$ = .00) while pantomime recognition and expression were strongly related to verbal ability ($r$ = .90 and .99 respectively). The lack of relationship between sending accuracy and verbal ability stands in sharp contrast to the high positive correlations with verbal ability found in studies of intentional gesture/pantomime.

Finally, Buck and Duffy (1980) found that right hemisphere damaged patients showed significantly lower sending accuracy scores relative to left hemisphere damaged patients and controls, and that in fact right hemisphere damaged patients did not differ significantly in sending accuracy from a sample of patients with Parkinson's disease, a disorder that has long been associated with "mask-like" dearth of facial expression.

Right-hemisphere functions. We have seen that left-hemisphere damage leads to deficits in propositional and symbolic verbal and nonverbal communication abilities, while emotional speech and spontaneous nonverbal behavior still occur. Right hemisphere damage in contrast does not normally lead to deficits in verbal behavior or in intentional gesture and pantomime (Duffy, Duffy and Pearson, 1975), while spontaneous nonverbal expression seems to be reduced. Other recent evidence has implicated the right hemisphere in a variety of processes associated with emotion and emotion expression. For example, a number

of studies have shown that facial assymetry or "facedness" is significantly left-sided (indicating relative right-hemisphere activation) during the posing of emotional expressions (cf. Borod and Caron, 1980; Borod, Caron, and Koff, in press; Campbell, 1978; Sackheim, Gur, and Saucy, 1978). Also, Moscovich and Olds (1979) have reported analogous left facedness in the expressions associated with relating emotional experiences, and Graves and Natale (1979) have found that right-hemisphere dominant subjects (as measured by a preponderance of left-sided conjugate lateral eye movements) are more accurate senders via spontaneous facial expression. Together with the findings of Buck and Duffy (1977; 1980) presented above, these results strongly suggest significant right-hemisphere involvement in the process of facial expression.

There have also been a number of recent studies implicating the right hemisphere in emotion recognition, both in normal right-handed subjects and brain-damaged patients. In normals, it has been found that the left ear better recognizes emotion expression in speech in dichotic listening tasks (i.e. how the statement is expressed as opposed to what is expressed. Carmon and Nachson, 1973; Haggard and Parkinson, 1971; Safer and Leventhal, 1977). Also, there is a left visual field superiority for the processing of faces, particularly faces expressing emotion (Ley and Bryden, 1979; Suberi and McKeever, 1977). In brain damaged patients, it has been found that right-hemisphere-damaged patients have particular difficulty comprehending and discriminating affective speech (how it was said) but not propositional speech (what was said: Heilman, Scholes & Watson, 1975; Tucker, Watson & Heilman, 1977). Similarly, right-hemisphere-damaged patients have difficulty with the recognition and discrimination of emotional faces and pictures (Cicone, Wapner & Gardner, in press; DeKosky, Heilman, Bowers, & Valenstein, 1980), and they do poorly on the

Rosenthal, Hall, DiMatteo, Rogers and Archer (1979) Profile of Nonverbal Sensitivity (PONS: Benowitz, Bear, Rosenthal & Mesulam, 1980).

The right hemisphere has also been implicated in more general emotional processes. In normal right-handed subjects, left-sided conjugate lateral eye movements indicative of relative right-hemisphere activation occur when answering affective questions (Schwartz, Davidson, and Maer, 1975) and during stress (Tucker, Roth Arneson and Buckingham, 1977). Also, it has been reported that hysterical conversion symptoms appear more frequently on the left side (Galin, Diamond & Braff, 1977; Stern, 1977). In brain damaged patients, left hemisphere damage has been associated with a "catastrophic reaction" of anxiety, hostility and depression, while right hemisphere damage has been associated with an "indifference reaction" characterized by indifference, denial of illness, disinhibition, and euphoria (Gainotti, 1972; Geshwind, 1979). Terzian (1964; Terzian and Ceccotto, 1959) noted similar symptoms in patients whose right or left hemispheres were inactivated temporarily in the Wada sodium amytal test, which involves the injection of the barbituate sodium amytal into either the right or left carotid artery (Wada and Rasmussen, 1960). Finally, Lishman (1971) has discussed observations of patients whose hemispheres were disconnected through commissurotomy which suggest that the right hemisphere is capable of an integrated emotional response of which the disconnected left hemisphere is totally unaware. Thus a patient may smile when a photograph of a nude is presented to the right hemisphere, without being able to explain the smile verbally (Sperry and Gazzaniga, 1967).

Motor pathways. We have seen that there is considerable evidence that the left and right hemispheres play special roles in the processes of spontaneous vs. propositional communication. It might be noted that there is evidence that the

motor pathways for facial expression also vary along what Critchley (1975, p. 34) referred to as a "continuum of calculation" between the deliberate and the automatic. Thus "voluntary" facial expression appears to be mediated by corticobulbar pathways descending in the internal capsule to the nucleus of the facial nerve,, while "involuntary" facial expression is mediated by pallido-bulbar and corticobulbar pathways whose course and direction are incompletely understood (cf. Monrad-Krohn, 1924; 1939; Myers, 1969; Schwartz, Ahern and Brown, 1979).

Implications

In this paper we have been concerned with distinguishing between spontaneous and symbolic communication processes, and have thus taken pains to isolate them and point out how they differ. However, it should be emphasized that in the intact human, and most of us are reasonably intact, these systems are highly interactive. Human communication occurs in two simultaneous streams: a spontaneous stream particularly associated with right hemisphere functioning and a symbolic and propositional stream particularly associated with left hemisphere functioning. The two streams have both expressive and receptive aspects. One stream is not more important than the other: the kinds of meanings communicated by the two streams is different, and in some situations the propositional message may be more important; in others the spontaneous message may take precedence. In any case, they interact and modify one another. However, it could be argued that the spontaneous stream is more important than we heretofore realized. It is not (as I think Mead considered) interesting only as a primitive form which preceeded symbolic communication: it is still very much with us and influences all interpersonal communication. The role of

spontaneous communication is just beginning to be understood.

The study of spontaneous communication will lead to greater understanding of propositional communication: how it evolved in the human species, how it develops in the growing child, how it functions in adults. It is clear that propositional and spontaneous communication have always formed a close partnership, and that one cannot be fully understood without the other.