Journal of the International Neuropsychological Society (1998), **4**, 447–455.

Personality and social competency following unilateral stroke

SHELBY L. LANGER,[1] L. CREED PETTIGREW,[2,3] JOHN F. WILSON,[1] AND LEE X. BLONDER[1,2,3]

[1] Department of Behavioral Science, University of Kentucky
[2] Stroke Program, Sanders-Brown Center on Aging, University of Kentucky
[3] Department of Neurology, University of Kentucky

(RECEIVED April 14, 1997; REVISED October 22, 1997; ACCEPTED December 4, 1997)

Abstract

Neuropsychological research indicates that the left hemisphere plays a dominant role in verbal production and processing, while the right hemisphere plays a dominant role in nonverbal production and processing. This study sought to examine the effects of such differential hemispheric specialization on personality and social competency. Ten left hemisphere damaged (LHD) stroke patients, 11 right hemisphere damaged (RHD) stroke patients, and 7 neurologically normal (NHD) patients were videotaped while engaging in social interaction with their spouse and an interviewer. Segments of the interactions were independently coded by two observers. Patients and spouses were rated with respect to their level of social competency and the extent to which they were characterized by 10 personality adjectives (e.g., *outgoing*, *warm*). Ratings for the personality items were summed to create an aggregate score. Analysis of these scores revealed both LHD and RHD patients to have lower (i.e., more negative) mean scores than NHD patients, suggesting that stroke patients as a whole were seen as socially impaired. Analysis of the socially competent item revealed particular LHD deficits; LHD patients were seen as less socially competent than *both* RHD and NHD patients. Spouses of LHD, RHD, and NHD patients, in contrast, did not differ in observer-rated social behavior. (*JINS*, 1998, *4*, 447–455.)

Keywords: Stroke, Personality, Social competency, Verbal, Nonverbal

INTRODUCTION

Dating from the original reports of Broca and Wernicke, it is known that structures in the left hemisphere control phonology, morphology, syntax, and semantics in the majority of individuals (Benson, 1985). Dichotic listening experiments with normals (i.e., non-brain-damaged individuals) reveal a right ear/left hemisphere superiority in the identification of verbal material (Springer, 1979). Clinical work demonstrates that damage to the left hemisphere often results in aphasia (Benson, 1985).

Evidence suggests that the right hemisphere mediates nonverbal communication. Tachistoscopic experiments with normals reveal a left visual field/right hemisphere advantage in the perception of emotional facial expressions (Ley & Bryden, 1979, Safer, 1981). Dichotic listening experiments with normals reveal a left ear/right hemisphere advantage in the processing of prosodic information (Carmon & Nachshon, 1973; Ley & Bryden, 1982). Clinical research suggests that individuals with damage to the right hemisphere are impaired in the processing of both emotional facial expressions (Benowitz et al., 1983; Bowers et al., 1985; DeKosky et al., 1980) and emotional prosody (Bowers et al., 1987; Heilman et al., 1975; Tucker et al., 1977).

Neurobehavioral research also supports the conclusion that nonverbal expression is mediated by the right hemisphere. Studies using normals suggest that emotions are expressed more intensely on the left side of the face (Borod & Caron, 1980; Sackeim & Gur, 1978; Sackeim et al., 1978). Research with clinical samples suggests that individuals with damage to the right hemisphere are less facially expressive than are individuals with damage to the left hemisphere and normal controls (Blonder et al., 1993; Borod et al., 1985, 1988; Buck & Duffy, 1980). Lastly, RHD patients show impairments in prosodic expression (Ross, 1981). Such individuals have difficulty, for example, reciting a semantically neutral sentence in a happy tone of voice; they typically speak in a flat monotone (Tucker et al., 1977). To summarize,

Reprint requests to: Lee X. Blonder, Center on Aging, 101 Sanders-Brown Building, University of Kentucky, Lexington, KY, 40536-0230. E-mail: lxblond@pop.uky.edu

https://doi.org/10.1017/S1355617798455048 Published online by Cambridge University Press

individuals with damage to the left hemisphere display deficits in verbal comprehension and production. Persons with damage to the right hemisphere display deficits in nonverbal processing and expression. The purpose of the present study is to examine the effects of such hemispheric specialization, and the communicative and expressive disorders following unilateral stroke, on personality and social competency.

Dyadic social interaction is a complex, intra- and interdependent process (Kelley et al., 1988). Within individuals, there are connections among affect, cognition, and behavior. How one feels, for example, can affect one's behavior. There are also connections *between* individuals; persons engaged in social interaction send verbal and nonverbal messages to one another. Consider the example of Sally and Sam, wife and husband. Sally, upon seeing Sam, thinks that he looks nice. This cognition affects her behavior. She says "I like your new tie" in a positive tone of voice and smiles. Sally's verbal and nonverbal behaviors affect Sam's affect and behavior. He experiences positive emotion and responds by smiling and saying "Thank you." In Dittman's (1972) terms, Sally (the sender) transforms her thought into linguistic, paralinguistic, and facial expressive forms (source encoding). The linguistic and paralinguistic forms are shaped by means of her vocal apparatus; the facial forms are shaped by means of her facial muscles (channel encoding). Sam (the receiver) hears the sounds and sees the facial expressions (channel decoding). He then translates the message into a meaningful idea (user decoding). The process continues as Sam takes on the role of sender, transforming his positive affect into linguistic and facial expressive forms.

Effective social interaction, then, requires both verbal *and* nonverbal sending and processing. While there are individual differences in communicative competence among neuropsychiatrically intact people, brain damage in general and stroke in particular can cause qualitative as well as quantitative changes in an individual's ability to send and receive verbal and nonverbal messages. In addition, damage to these communicative systems may distort the signals in such a way as to influence the impressions these individuals make on others. RHD individuals' lack of facial expressivity, for instance, may result in others' disdain toward them.

While there has been extensive research on communicative disabilities following stroke, there has been little research exploring the effects of unilateral stroke on personality and social behavior. Gasparrini et al. (1978) administered the Minnesota Multiphasic Personality Inventory to LHD and RHD patients. Of the ten clinical MMPI scales, only one revealed significant differences between LHD and RHD patients—that for depression. None of the RHD patients scored in the abnormal range on this scale; 44% of the LHD patients did so. Moreover, the overall MMPI profile among the LHD patients was indicative of a major affective disorder.

Similarly, several studies have examined the effects of stroke on mood and found a higher incidence of poststroke depression following left-side lesions (Astrom, 1996; Castillo et al., 1993; Nelson et al., 1994; Robinson et al., 1984; Starkstein et al., 1987). However, not all investigators have replicated these findings (Andersen et al., 1995; Sinyor et al., 1986). Astrom (1996) and Castillo et al. (1993) found both depression and generalized anxiety disorder among LHD individuals; RHD patients were characterized by generalized anxiety alone. Lastly, right hemisphere damage involving the limbic system has been linked to secondary mania, though it is a rare poststroke occurrence (Starkstein & Robinson, 1989).

In this study, we were interested in exploring the effects of aphasia and disturbances in nonverbal communication that accompany stroke on observers' impressions of personality and social competency. Moreover, we were interested in learning whether personality and social behavior among spouses of stroke patients would vary as a function of communicative disturbances in the partner. Given the interdependent nature of dyadic communication, how do spouses respond to patient communicative deficits? Previous work in this domain has examined psychosocial differences between the spouses of stroke patients and community matched controls. The findings were mixed. In some cases, the spouses of stroke patients appeared more lonely (Kinsella & Duffy, 1979) and depressed (Carnwath & Johnson, 1987) than did NHD spouses. In other cases, spouses of stroke patients did not show elevated depression scores (Ross & Morris, 1988) and appeared equal in morale to NHD spouses (Bishop et al., 1986). We extend this literature by examining potential dispositional and social behavioral differences between the spouses of LHD and RHD individuals.

In order to examine these questions, we made use of existing videotapes of stroke patients, orthopedic (neurologically intact) patients, and their spouses engaging in social interaction. As part of a larger study, these individuals participated in a videotaped semistructured interview. We made edited versions of the videotapes and had trained observers view the videos and rate both the patients and spouses on dispositional and social behavioral dimensions. In addition to the interview, participants completed a battery of neuropsychological and psychosocial tests. We present a subset of these data.

METHODS

Research Participants

Participants consisted of 10 individuals with unilateral infarction involving the left cerebral hemisphere, 11 individuals with unilateral infarction involving the right cerebral hemisphere, and 7 neurologically normal controls with orthopedic disease. Each patient's spouse or significant other also served as a participant. Twenty-seven of the couples were married; the remaining couple lived together.

Stroke and orthopedic patients were recruited during their stay in a rehabilitation hospital. Orthopedic patients were receiving rehabilitation for problems such as hip replacement and knee replacement. All stroke patients had a CT scan, performed for clinical purposes, that indicated the presence of a single event, unilateral infarct in the left or right hemisphere. Potential participants who had negative CT scans or evidence of bilateral lesions were excluded. Additional exclusionary criteria for all participants included the following: fewer than 6 years of formal education; not a native speaker of American English; history of head trauma in which the individual lost consciousness for a period exceeding 30 min; left-handedness or ambidextrality (for stroke and orthopedic patients); and the presence or history of a learning disability or other neuropsychiatric disorder (e.g., attention deficit disorder), substance abuse, psychiatric disease, neurologic disease (for NHD patients and spouses), or neurologic disease other than stroke (for the stroke patients). No patients nor spouses were on medication that could affect mental status.

Demographic, affective, and clinical characteristics of the three patient groups are listed in Table 1. The three groups did not differ with respect to mean age or education, nor with respect to gender composition. They also did not differ on affective dimensions. All three group means for the Positive and Negative Affect Scales fell within standard normal ranges (Watson et al., 1988). Additionally, all three group means for the Geriatric Depression Scale (Brink et al., 1982) and the Cornell Depression Scale (Alexopoulos et al., 1988) fell within normal, nondepressed ranges. Clinically, the two stroke groups did not differ from one another with respect to the severity of upper and lower hemiparesis or facial paresis (using NIH Stroke Scale scores; Brott et al., 1989), nor with respect to the number of days poststroke. Stroke patients averaged 42 days poststroke.

Table 2 depicts additional clinical data for the stroke patients: lesion location (as demonstrated by CT scan), presence or absence of hemispatial neglect (as identified by line bisection and letter cancellation tasks), and aphasia classification (as determined by performance on the Western Aphasia Battery; Kertesz, 1980) for the LHD patients. Five LHD patients were classified as having anomia. Three LHD patients were classified as having conduction, Broca's, and transcortical motor aphasias, respectively; the remaining two were classified as nonaphasic. Aphasia quotient (also derived from the Western Aphasia Battery) was analyzed as a function of patient group. A one-way ANOVA yielded a significant effect of group [$F(2,25) = 10.49$, $p < .001$]. Post-hoc comparisons, using Fisher's least significant difference test, revealed aphasia quotients to be lower for the LHD group ($M = 74.06 \pm 22.77$) as compared to the RHD group ($M = 98.87 \pm 1.08$), $p < .001$, and the NHD group ($M = 98.64 \pm .76$), $p < .01$. Aphasia quotients did not differ between RHD and NHD patients, $p > .05$.

Procedure

Participants and their spouses/partners were interviewed in their homes following discharge from the rehabilitation hospital. A trained research assistant conducted the interviews. She asked each participant and his or her spouse the same set of questions (e.g., "Tell me about the history of your illness/your spouse's illness," "Have you noticed any changes in your ability/your spouse's ability to get around or communicate since the illness," "How has the illness affected your marital relationship?"). Each interview was videotaped with informed consent. Mean interview length (in minutes) did not differ as a function of patient group [$F(2,25) = 1.45$, $p > .05$]. Means were 88.88 ± 12.79 for the LHD group, 89.58 ± 20.19 for the RHD group, and 74.86 ± 25.23 for the NHD group.

Table 1. Characteristics of the diagnostic groups

	Diagnostic group			
Variable	LHD	RHD	NHD	*p*
Age	56.3 (12.48)	54.18 (12.56)	63.29 (13.28)	n.s.
Sex	4 M, 6 F	7 M, 4 F	5 M, 2 F	n.s.
Education (years)	11.9 (3.14)	12.82 (4.12)	12.71 (2.63)	n.s.
PANAS positive	30.9 (9.1)	29.18 (7.76)	34 (4.4)	n.s.
PANAS negative	18.3 (5.7)	17.55 (4.61)	13.29 (2.43)	n.s.
Cornell depression	1.67 (2.35)	4 (3.13)	2 (1.41)	n.s.
Geriatric depression	9.2 (6.2)	6.18 (4.83)	5.14 (3.98)	n.s.
Hemiparesis (arm)	1.44 (1.67)	2.09 (1.7)	n.a.	n.s.
Hemiparesis (leg)	.67 (.71)	1.36 (1.43)	n.a.	n.s.
Facial paresis	.89 (.78)	.82 (.75)	n.a.	n.s.
Days poststroke	49.3 (39.74)	33.91 (13.89)	n.a.	n.s.

Note. Continuous values are expressed as mean (standard deviation). Hemiparesis and facial paresis reflect NIH Stroke Scale scores. Motor performance of arm or leg = 0–4, as *normal to no movement*, excluding absence of limb; motor performance of affected side of face = 0–3, as *normal to complete paralysis*. PANAS scores could range from 10 to 50, with 50 indicative of extreme affectivity. Cornell Depression scores could range from 0 to 38, with higher numbers indicative of major depressive disorder. Geriatric Depression Scale scores could range from 0 to 30 (0–10 = *normal aged, nondepressed*; 11–20 = *mild depression*; 21–30 = *moderate to major depression*).

https://doi.org/10.1017/S1355617798455048 Published online by Cambridge University Press

Table 2. Clinical characteristics of the stroke patients

Case	Lesion location	Aphasia	Neglect
1	R frontotemporal	n/a	−
2	R posterior parietal	n/a	−
3	R frontal, midconvexity	n/a	−
4	R frontoparietal, temporal	n/a	+
5	R temporal	n/a	−
6	R parietal	n/a	+
7	R frontoparietal	n/a	−
8	R post., frontotemporal, parietal, ant. occip.	n/a	−
9	R BG, ext. capsule, temporal	n/a	−
10	R parietal	n/a	−
11	R frontotemporal (extending into BG)	n/a	+
12	L frontal	anomic	−
13	L frontoparietal	conduction	−
14	L occipital, posterior	no aphasia	−
15	L temporoparietal	brocas	−
16	L temporoparietal	anomic	−
17	L frontoparietal w/ subcortical extension	anomic	+
18	L post., frontal, ant., parietal	anomic	+
19	L frontal, BG involvement	transcortical motor	−
20	L cerebral, BG infarct	no aphasia	−
21	L occipital	anomic	−

A 15-min edited version of each videotape was made. For each participant, two 7.5-min segments were extracted. The first segment included the following questions directed to the patient: "Have you noticed any changes in the way that you look; your ability to get around; the way you communicate; and the way that you feel about yourself?" The second segment focused on the couple's marital relationship. The couple was asked to describe how they met and then to discuss how the illness has affected the relationship and what things they agree/disagree on. Two graduate students, blind to both hypothesis and patient diagnosis, independently coded these 15-min edited segments, making judgments about the social competency and personality of each patient and spouse.

Social competency coding

Coders rated each participant with respect to his/her level of social competency using the bipolar item *incompetent/socially competent*. The rating was made on a 7-point scale, ranging from (1) *incompetent* to (7) *socially competent*. Coders were instructed to view this item as a global judgment, and to determine the individual's *overall ability to successfully engage in the interaction*. In so doing, they were advised to consider the individual's verbal and nonverbal sending abilities, as well as listening and receiving abilities (e.g., picking up on the others' nonverbal cues).

Personality coding

Based on a modification of Swann et al. (1987), patients and spouses were rated with respect to the descriptiveness of 10 bipolar trait adjectives: *unsociable/sociable*, *unconfident/socially confident*, *socially awkward/poised*, *shy/outgoing*, *cold/warm*, *nervous/at ease*, *quiet/talkative*, *unfriendly/friendly*, *reserved/lively/animated*, and *self-doubting/self-assured*. Judgments were made on a 7-point scale. Ratings for the items were summed to create an aggregate score, ranging from 10 to 70, with 70 indicative of extreme positivity of personality.

Training

Prior to the commencement of this coding, the two raters spent time in training. Drawing from a sample of videotaped interviews similar to those described here, the raters completed the items for three stroke patients and two orthopedic control patients. Interrater reliability using Rosenthal's (1982) *R* (or effective reliability estimate) for the practice patient personality aggregate scores reached .79, and that for the spouse summary scores reached .95. In addition to this practice coding, the two coders were asked to view all 28 of the experimental videos prior to coding. This was done in order to provide the coders with a conception of the *range* of personalities and social behaviors they would be encountering.

Nonverbal communication measures

As part of a larger study, our patients and spouses completed a questionnaire designed to assess the nonverbal communication of the patient during the few weeks since the onset of the illness. Patients were asked to rate their nonverbal communication (specifically, tone of voice, facial ex-

https://doi.org/10.1017/S1355617798455048 Published online by Cambridge University Press

pressivity, volume of voice, frequency of smiling, frequency of laughter, frequency of crying, frequency of yelling, and frequency of eye contact) on 5-point scales, with 5 indicative of extreme expressivity or frequency. Patients made self-ratings, and spouses made ratings with respect to the patient.

RESULTS

Social Competency Ratings of the Patient

Interrater reliability for the incompetent/socially competent item reached .82 using Rosenthal's (1982) *R*. Given this adequate reliability, the two coders' ratings were averaged. A one-way analysis of variance (ANOVA), by patient group (LHD, RHD, or NHD), was performed on the coder-averaged ratings. This analysis yielded a significant effect of group [$F(2,25) = 10.97$, $p < .001$]. *Post-hoc* comparisons using Fisher's least significant difference test indicated that LHD patients were rated as less socially competent than were both RHD patients ($p < .05$) and NHD patients ($p < .05$). Ratings did not differ between RHD and NHD patients ($p > .05$). Mean ratings as a function of patient group can be seen in Table 3.

Personality Ratings of the Patient

The two coders' ratings for each of the 10 personality items (e.g., *friendly*, *outgoing*) were averaged. An internal consistency analysis was performed on the items. Cronbach coefficient alpha reached .96, suggesting that these items were indeed internally consistent. Personality ratings were analyzed in the aggregate; ratings for each of the 10 items were summed to create an aggregate score, ranging from 10 to 70. Interrater reliability using Rosenthal's (1982) *R* for the summary scores reached .84. A one-way ANOVA by patient group was performed on the summary scores; this yielded a significant effect of group [$F(2,25) = 3.83$, $p < .05$]. *Post-hoc* comparisons using Fisher's least significant difference test revealed that NHD patients had significantly higher (more positive) personality summary scores than did both LHD patients ($p < .05$) and RHD patients ($p < .05$); the two stroke patient groups did not differ from one another ($p > .05$). Mean aggregate scores are displayed in Table 3.

Personality Ratings of the Spouse

The two coders' ratings for each of the 10 spouse personality items were averaged. An internal consistency analysis was then performed on the items. Cronbach coefficient alpha reached .94, suggesting that these items were internally consistent. Spouse personality ratings were analyzed in the aggregate. Interrater reliability using Rosenthal's (1982) *R* for the summary scores reached .86. A one-way ANOVA by patient group was performed on the summary scores; this analysis yielded no effect of group [$F(2,25) = .4$, $p > .05$]. Mean spouse summary scores for the three groups were as follows: 49.07 ± 11.49 for the spouses of NHD patients, 49.46 ± 9.73 for the spouses of RHD patients, and 45.85 ± 8.65 for the spouses of LHD patients.

Nonverbal Communication Data

Patients and spouses made ratings with respect to the expressivity and frequency of the patient's nonverbal communication during the few weeks since the onset of the illness. Internal consistency analyses were performed separately on the eight items for patient self-ratings and spouse ratings of the patient. These analyses revealed two of the items to be problematic, both for patient self-ratings and spouse ratings. Yelling and crying were so infrequently endorsed that item variability was inadequate. These two items were therefore deleted; an internal consistency analysis was again performed, this time on the remaining six items: tone of voice, facial expressivity, volume of voice, frequency of smiling, frequency of laughter, and frequency of eye contact. Cronbach coefficient alpha reached .83 for the patient self-ratings and .77 for spouse ratings of the patient.

Given this adequate internal consistency, patient self-ratings and spouse ratings were analyzed in the aggregate. Patients' self-ratings for each of the six items were summed to create an aggregate measure of nonverbal expressivity; the same was done for spouse ratings of patient nonverbal expressivity. Aggregate scores could range from 5 to 30, with 30 indicative of extreme nonverbal expressivity. A one-way ANOVA performed on the patient self-rating aggregate scores revealed a significant effect of group [$F(2,25) = 5.05$, $p < .05$]. *Post-hoc* comparisons using Fisher's least significant difference test revealed that scores for the RHD group were significantly lower (indicating less nonverbal expres-

Table 3. Mean social competency, personality, and nonverbal ratings as a function of patient group

Item	LHD	RHD	NHD	*p*
Socially competent	3.75 $(1.88)_a$	5.5 $(.67)_b$	6.43 $(.35)_b$	<.001
Aggregate personality	43.95 $(15.25)_a$	48.64 $(9.24)_a$	60.36 $(6.33)_b$	<.05
Nonverbal (self-rating)	19 $(3.65)_{ab}$	16 $(4.98)_a$	22.29 $(3.04)_b$	<.05
Nonverbal (spouse rating)	17.4 $(4.33)_a$	16.36 $(4.57)_a$	21.86 $(4.98)_b$	=.055

Note. Means not sharing a subscript differ at the $p < .05$ level. Parenthetical values are standard deviations.

https://doi.org/10.1017/S1355617798455048 Published online by Cambridge University Press

sivity) than that for the NHD group ($p < .01$). Mean scores did not differ between RHD patients and LHD patients ($p > .05$), nor between LHD and NHD patients ($p > .05$). A one-way ANOVA performed on spouse rating aggregate scores revealed a marginally significant effect of group [$F(2,25) = 3.25$, $p = .055$]. Post-hoc comparisons indicated that scores for the RHD group were lower than that for the NHD group ($p < .05$); scores for the LHD group were also lower than that for the NHD group ($p < .06$). Mean scores did not differ between RHD patients and LHD patients ($p > .05$) (see Table 3 for group means and standard deviations).

Correlations Between Measures of Verbal–Nonverbal Proficiency and Social Competency

Correlations were performed between the stroke patients' scores on the Western Aphasia Battery (Kertesz, 1980), a measure of verbal proficiency, and their social competency rating, and the stroke patients' scores on the nonverbal communication measures and their social competency rating. The correlations excluded NHD patient data. These analyses afford an examination of the separate relationships between verbal proficiency and observer-rated social competency and between nonverbal proficiency and observer-rated social competency.

The correlation between patients' scores on the Western Aphasia Battery and social competency ratings was significant and positive ($r = .80$, $p < .01$), suggesting that individuals scoring high in verbal competency were also seen as socially adept. The correlation between aggregate patient self-ratings of nonverbal behavior and social competency ratings was nonsignificant ($r = -.04$, $p > .05$). That between aggregate spouse ratings of the patients' nonverbal behavior and social competency ratings was similarly nonsignificant ($r = .09$, $p > .05$), suggesting that nonverbal expressivity and social competency were not related.

DISCUSSION

Stroke patients as a whole were found to exhibit social deficits. The stroke group received lower (more negative) personality summary scores than did the NHD group. LHD patients were seen as less socially competent as compared to *both* RHD and NHD patients. These findings suggest that, while all stroke patients display interpersonal deficits, LHD patients are perhaps at *heightened* interpersonal risk.

What is the likely explanation for such LHD interpersonal deficits? We suggest that group differences in personality and social competency are a result of differential verbal and nonverbal impairments. LHD patients alone exhibited verbal deficits. The mean Western Aphasia Battery score for the LHD group was 74, falling well within the aphasic range and significantly lower than that for the RHD or NHD groups. Both RHD *and* LHD patients exhibited, to varying degrees, nonverbal expression deficits. The RHD group rated themselves as less nonverbally expressive than did the NHD group. Spouses of RHD patients rated their partner as less nonverbally expressive than did spouses of NHD patients. We also have some evidence that LHD patients were perceived as lacking in nonverbal expressivity. LHD patients did not differ from the other patients with respect to *self*-ratings of nonverbal behavior, but spouses of LHD patients rated their partner as less nonverbally expressive than did spouses of NHD patients (this difference was of marginal statistical significance, $p < .06$).

To reiterate, we suggest that the observers' differential perceptions of the patients' social behavior were a result of differential verbal/nonverbal competencies. Neurologically intact patients were perceived as socially competent (relative to the other patient groups). They also exhibited both verbal and nonverbal competencies (as measured by the Western Aphasia Battery and the self/spouse ratings of nonverbal expressivity). RHD patients received lower personality aggregate scores as compared to NHD patients. Nonverbal expression deficits likely contributed to this difference; NHD and RHD patients did not differ on the Western Aphasia Battery. LHD patients, too, received lower personality aggregate scores as compared to NHD patients, and they were judged less socially competent than both NHD *and* RHD patients. LHD persons' unique *verbal* deficits likely contributed to these differences.

The fact that the LHD patients received lower social competency ratings as compared to both RHD and NHD patients suggests that language impairments put the LHD individuals at heightened interpersonal risk. Similarly, the findings suggest that perhaps the verbal element of communication is particularly key to social interaction, a notion termed "verbal primacy" (Buck, 1984; Ekman, 1985; Langer, 1996; Swann et al., 1992). In support of this argument, we found a significant, positive correlation between social competency ratings and Western Aphasia Battery scores, suggesting that social competency is related to verbal competency, but nonsignificant correlations between the aggregate measures of nonverbal competency and social competency ratings, suggesting that social competency is *unrelated* to nonverbal competency.

One might offer an alternative explanation for our findings: namely, that group differences in personality and social competency were influenced by differential affective states. As stated previously, a number of researchers (e.g., Astrom, 1996) have found evidence for LHD depression; such depression could indeed channel impaired social behavior (Andrews, 1989). This was *not* the case in our sample, however. LHD patients did not exhibit elevated depression levels as compared to RHD and NHD patients. All three of our patient groups fell within the normal, nondepressed ranges on the Geriatric Depression Scale (a self-rating measure) and the Cornell Depression Scale (an observer-rated measure). All three of our patient groups also fell within the normal ranges for the PANAS positive and negative subscales. In this setting, affect did not drive social behavior.

https://doi.org/10.1017/S1355617798455048 Published online by Cambridge University Press

A second alternative explanation for our findings stems from work on social emotions and display rules (Ekman & Friesen, 1975; Ross, 1996; Ross et al., 1994). Social display rules dictate that individuals enhance the expression of positive emotions and suppress the expression of negative emotions. Cheerfulness, for example, is expected in the majority of formal social situations. Clinical research suggests that the left hemisphere plays a role in the regulation of such displays. Buck and Duffy (1980) examined the spontaneous facial expressions of LHD, RHD, and Parkinson patients, adult controls, and children in response to the viewing of emotionally evocative slides (e.g., slides of familiar people, slides of unpleasant situations). Adult controls and children were judged emotionally expressive and exhibited display rules. RHD and Parkinson patients exhibited reduced emotional expressivity, but did in fact follow display rules. LHD patients exhibited emotional expressivity, but did not follow display rules; reactions to all types of slides were strong and identifiable. More recently, Ross et al. (1994) reviewed a series of cases of emotional recall in patients undergoing the WADA test. Recall of emotional stories following right-sided injection resulted in the attenuation of primary emotions and the enhancement of social emotions.

Perhaps the LHD patients in our sample, like those in the Buck and Duffy (1980) sample, had difficulty following display rules. Perhaps they did not enhance positive emotional expression or suppress negative emotional expression. Because display rules are an important aspect of social communication, disregard for such rules would certainly be associated with perceived social incompetency. We do not have coder-derived evidence of the positivity *versus* negativity of our patients' emotional expressions *during* the interactions and therefore cannot exclude this alternative hypothesis. However, LHD spouses rated their partners as less emotionally expressive than NHD spouses judged their partners, suggesting that inappropriate expression of negative affect was not a factor.

Implications and Future Directions

The present findings offer implications for stroke rehabilitation. In addition to the physical and language aspects of rehabilitation, the social and interpersonal aspects need to be addressed, both by health professionals *and spouses*. Because dyadic social interaction is an interdependent process, patient incompetencies can affect spouse communications. Fortunately, this does not seem to have been the case in our sample. Observations of spouses' personality and social communicative characteristics did not differ as a function of hemispheric side of lesion in the partner. Spouses of LHD patients did not exhibit particular social failings; likewise, we know that LHD patient impairments were not driven by spouse personality impairments.

Nonetheless, communication with *all* stroke patients and, in particular, LHD patients, is no doubt a difficult task. Spouses need to be made aware of patients' specific interpersonal deficits. To prevent communication breakdowns, spouses need to *send* especially clear messages and, perhaps, lend greater attention to the patient's dominant channel of communication. Future work might include a social or communicative intervention. Spouses of LHD patients could be trained to lend greater attention to and send especially strong nonverbal messages. Spouses of RHD patients could be trained to lend greater attention to and send especially strong verbal messages.

This study serves as an introductory examination of brain–*social* behavior relationships, an area yet to receive much empirical exploration. While our sample size did not afford an examination of intrahemispheric differences in personality and social behavior, we did reveal interhemispheric differences. Our results suggest that unilateral stroke in general and left hemisphere damage in particular poses an interpersonal hazard. Language impairments make interaction with the LHD individual especially difficult. Future research that further elucidates the chain of both verbal and nonverbal social interaction between stroke patients and their spouses is called for, as is work that examines social behavior as a function of anterior *versus* posterior lesions. This study serves only as an initial examination of personality and social behavior following unilateral stroke.

ACKNOWLEDGMENTS

This research was supported by an NIH/NINDS FIRST Award NS29082 to Dr. Blonder and a National Institute of Mental Health Training Grant MH15730 (Dr. Langer's postdoctoral training). We thank Research Assistants Amy Kirkpatrick, Robin Lightner, Michelle Staton, and Michelle Zak, the staff of Cardinal Hill Hospital, and the individuals who participated in the study.

REFERENCES

Alexopoulos, G.S., Abrams, R.C., Young, R.C., & Shamoian, C.A. (1988). Cornell scale for depression in dementia. *Biological Psychiatry*, *23*, 271–284.

Andersen, G., Vestergaard, K., Ingemann-Nielsen, M., & Lauritzen, L. (1995). Risk factors for post-stroke depression. *Acta Psychiatrica Scandinavica*, *92*, 193–198.

Andrews, J.D.W. (1989). Psychotherapy of depression: A self-confirmation model. *Psychological Review*, *96*, 576–607.

Astrom, M. (1996). Generalized anxiety disorder in stroke patients. *Stroke*, *27*, 270–275.

Benowitz, L.I., Bear, D.M., Rosenthal, R., Mesulam, M.M., Zaidel, E., & Sperry, R.W. (1983). Hemispheric specialization in nonverbal communication. *Cortex*, *19*, 5–11.

Benson, D.F. (1985). Aphasia. In K.M. Heilman & E. Valenstein (Eds.), *Clinical Neuropsychology* (pp. 17–48). New York: Oxford University Press.

Bishop, D.S., Epstein, N.B., Keitner, G.I., Miller, I.W., & Srinivasan, S.V. (1986). Stroke: Morale, family functioning, health status, and functional capacity. *Archives of Physical Medicine and Rehabilitation*, *67*, 84–87.

Blonder, L.X., Burns, A.F., Bowers, D., Moore, R.W., & Heilman, K.M. (1993). Right hemisphere facial expressivity during natural conversation. *Brain and Cognition*, *21*, 44–56.

Borod, J.C. & Caron, H.S. (1980). Facedness and emotion related to lateral dominance, sex and expression type. *Neuropsychologia*, *18*, 237–241.

Borod, J.C., Koff, E., Lorch, M.P., & Nicholas, M. (1985). Channels of emotional communication in patients with unilateral brain damage. *Archives of Neurology*, *42*, 345–348.

Borod, J.C., Koff, E., Lorch, M.P., Nicholas, M., & Welkowitz, J. (1988). Emotional and non-emotional facial behaviors in patients with unilateral brain damage. *Journal of Neurology, Neurosurgery, and Psychiatry*, *51*, 826–832.

Bowers, D., Bauer, R.M., Coslett, H.B., & Heilman, K.M. (1985). Processing of faces by patients with unilateral hemisphere lesions. *Brain and Cognition*, *4*, 258–272.

Bowers, D., Coslett, H.B., Bauer, R.M., Speedie, L.J., & Heilman, K.M. (1987). Comprehension of emotional prosody following unilateral hemispheric lesions: Processing defect versus distraction defect. *Neuropsychologia*, *25*, 317–328.

Brink, T.L., Yesavage, J.A., Lum, O., Heersema, P.H., Adey, M., & Rose, T.L. (1982). Screening tests for geriatric depression. *Clinical Gerontologist*, *1*, 37–43.

Brott, T., Adams, H.P., Olinger, C.P., Marler, J.R., Barsan, W.G., Biller, J., Spilker, J., Holleran, R., Eberle, R., Hertzberg, V., Rorick, M., Moomaw, C.J., & Walker, M. (1989). Measurements of acute cerebral infarction: A clinical examination scale. *Stroke*, *20*, 864–870.

Buck, R. (1984). *The communication of emotion*. New York: Guilford.

Buck, R. & Duffy, R.J. (1980). Nonverbal communication of affect in brain damaged patients. *Cortex*, *16*, 351–362.

Carmon, A. & Nachshon, I. (1973). Ear asymmetry in perception of emotional nonverbal stimuli. *Acta Psychologica*, *37*, 351–357.

Carnwath, T.C.M. & Johnson, D.A.W. (1987). Psychiatric morbidity among spouses of patients with stroke. *British Medical Journal*, *294*, 409–411.

Castillo, C.S., Starkstein, S.E., Fedoroff, J.P., Price, T.R., & Robinson, R.G. (1993). Generalized anxiety disorder after stroke. *Journal of Nervous and Mental Disease*, *181*, 100–106.

DeKosky, S., Heilman, K.M., Bowers, D., & Valenstein, E. (1980). Recognition and discrimination of emotional faces and pictures. *Brain and Language*, *9*, 206–214.

Dittmann, A.T. (1972). *Interpersonal messages of emotion*. New York: Springer.

Ekman, P. (1985). *Telling lies*. New York: W.W. Norton.

Ekman, P. & Friesen, W.V. (1975). *Unmasking the face*. Englewood Cliffs, NJ: Prentice-Hall.

Gasparrini, W.G., Satz, P., Heilman, K.M., & Coolidge, F.L. (1978). Hemispheric asymmetries of affective processing as determined by the Minnesota Multiphasic Personality Inventory. *Journal of Neurology, Neurosurgery, and Psychiatry*, *41*, 470–473.

Heilman, K.M., Scholes, R., & Watson, R.T. (1975). Auditory affective agnosia: Disturbed comprehension of affective speech. *Journal of Neurology, Neurosurgery and Psychiatry*, *38*, 69–72.

Kelley, H.H., Berscheid, A.C., Harvey, J.H., Huston, T.L., Levinger, G., McClintock, E., Peplau, L.A. & Peterson, D.R. (1988). Analyzing close relationships. In H. Kelley, E. Berscheid, A. Christensen, J. Harvey, T. Huston, G. Levinger, E. McClintock, L.A. Peplau, & D. Peterson (Eds.), *Close relationships* (pp. 20–67). New York: W.H. Freeman.

Kertesz, A. (1980). *Western Aphasia Battery*. London, Ontario: University of Western Ontario Press.

Kinsella, G.J. & Duffy, F.D. (1979). Psychosocial readjustment in the spouses of aphasic patients. *Scandinavian Journal of Rehabilitation Medicine*, *11*, 129–132.

Langer, S. (1996). *The effects of channel-consistent and channel-inconsistent interpersonal feedback on the formation of metaperceptions*. Unpublished doctoral dissertation. Lehigh University, Bethlehem, PA.

Ley, R.G. & Bryden, M.P. (1979). Hemispheric differences in recognizing faces and emotions. *Brain and Language*, *7*, 127–138.

Ley, R.G. & Bryden, M.P. (1982). A dissociation of right and left hemispheric effects for recognizing emotional tone and verbal content. *Brain and Cognition*, *1*, 3–9.

Nelson, L.D., Cicchetti, D., Satz, P., Sowa, M., & Mitrushina, M. (1994). Emotional sequelae of stroke: A longitudinal perspective. *Journal of Clinical and Experimental Neuropsychology*, *16*, 796–806.

Robinson, R.G., Kubos, K.L., Starr, L.B., Rao, K., & Price, T.R. (1984). Mood disorders in stroke patients: Importance of lesion location. *Brain*, *107*, 81–93.

Rosenthal, R. (1982). Conducting judgment studies. In K. Scherer & P. Ekman (Eds.), *Handbook of methods in nonverbal behavior research* (pp. 287–361). Cambridge: Cambridge University Press.

Ross, E.D. (1981). The aprosodias: Functional–anatomic organization of the affective components of language in the right hemisphere. *Archives of Neurology*, *38*, 561–569.

Ross, E.D. (1996). Hemispheric specialization for emotions, affective aspects of language and communication and the cognitive control of display behaviors in humans. In G. Holstege, R. Bandler, & C.B. Saper (Eds.), *Progress in Brain Research* (Vol. 107). Elsevier Science.

Ross, E.D., Homan, R.W., & Buck, R. (1994). Differential hemispheric lateralization of primary and social emotions: Implications for developing a comprehensive neurology for emotions, repression, and the subconscious. *Neuropsychiatry, Neuropsychology, and Behavioral Neurology*, *7*, 1–19.

Ross, S. & Morris, R.G. (1988). Psychosocial adjustment of the spouses of aphasic stroke patients. *International Journal of Rehabilitation Research*, *11*, 383–386.

Sackeim, H.A. & Gur, R.C. (1978). Lateral asymmetry in intensity of emotional expression. *Neuropsychologia*, *16*, 473–481.

Sackeim, H.A., Gur, R.C., & Saucy, M.C. (1978). Emotions are expressed more intensely on the left side of the face. *Science*, *202*, 434–436.

Safer, M.A. (1981). Sex and hemispheric differences in access to codes for processing emotional expressions and faces. *Journal of Experimental Psychology: General*, *110*, 86–100.

Sinyor, D., Jacques, P., Kaloupek, D.G., Becker, R., Goldenberg, M., & Coopersmith, H. (1986). Poststroke depression and lesion location. *Brain*, *109*, 537–546.

Springer, S. (1979). Speech perception and the biology of language. In M. Gazzaniga (Ed.) *Handbook of behavioral neurobiology* (pp. 153–177). New York: Plenum.

Starkstein, S.E. & Robinson, R.G. (1989). Affective disorders and cerebral vascular disease. *British Journal of Psychiatry*, *154*, 170–182.

Starkstein, S.E., Robinson, R.G., & Price, T.R. (1987). Comparison of cortical and subcortical lesions in the production of poststroke mood disorders. *Brain*, *110*, 1045–1059.

Swann, W.B., Jr., Griffin, J.J., Jr., Predmore, S.C. & Gaines, B. (1987). The cognitive affective crossfire: When self-consistency confronts self-enhancement. *Journal of Personality and Social Psychology*, *52*, 881–889.

Swann, W.B., Jr., Stein-Seroussi, A., & McNulty, S.E. (1992). Outcasts in a white-lie society: The enigmatic worlds of people with negative self-conceptions. *Journal of Personality and Social Psychology*, *62*, 618–624.

Tucker, D.M., Watson, R.T., & Heilman, K.M. (1977). Discrimination and evocation of affectively intoned speech in patients with right parietal disease. *Neurology*, *27*, 947–950.

Watson, D., Clark, L.A. & Tellegan, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.