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Contextual Influences on Judgments of Emotionally Ambiguous Stimuli by Brain-Damaged and Normally Aging Adults

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Contextual influences on normal perception are pervasive and powerful; our interpretation of sensory information depends on the environment in which it is embedded (Ashcraft, 1989). Some literature suggests that adults with right hemisphere brain damage (RHD) have difficulty processing contextual cues that contribute to drawing intended interpretations (Joanette, Goulet, & Hannequin, 1990; Myers, 1991), whereas other evidence has identified contextual-processing capacities that are spared after RHD. For instance, priming studies (Tompkins, 1990, 1991) have shown that RHD adults profit from prior linguistic contextual information in certain situations, even when judging materials in domains that are typically problematic (e.g., metaphor or emotional prosody). However, it is important to note that the experimental materials in those studies had a single, unambiguous interpretation.

The study described in this paper examined the influence of linguistic context on RHD adults' judgments of moods conveyed prosodically by ambiguous emotional stimuli. Ambiguous stimuli should provide a more sensitive test of RHD subjects' ability to profit from context. In addition, because most human exchanges are ambiguous to a certain extent (Russell & Fehr, 1988), ambiguous materials should be more ecologically valid than messages having a single, straightforward interpretation.

Our prediction for non-brain-damaged listeners was based on literature demonstrating that emotional inferencing, like other perceptual processing, is relative. Verbal statements of context have been found to influ-

ence the perception of emotional expressions among psychiatric patients and normal adults (Knudsen & Muzekari, 1983), and the same facial expression is seen as conveying different types and degrees of emotion, depending on what other faces are seen before it (Russell & Fehr, 1987). On the basis of these data, we expected normal adult listeners' judgments of ambiguous emotional target stimuli to shift according to the mood conveyed by the linguistic context preceding them.

Predictions for brain-damaged listeners were less certain. However, because the task was designed to tap relatively automatic processes (see Tompkins, 1990, 1991), brain-damaged subjects were expected to perform similarly to non-brain-damaged individuals.

METHOD

Subjects

Sixty adults participated in this study. Twenty were control subjects without known neurologic impairment and 40 were stroke patients (20 each with unilateral right hemisphere damage [RHD] or left hemisphere damage [LHD]). Subjects met strict inclusion criteria concerning radiologic documentation of lesion, hearing acuity, reading ability, and premorbid right-handedness (see Tompkins, 1991, for details from a related study). Descriptive data are summarized in Table 1. The groups did not differ in sociodemographic attributes, but clinical characteristics distinguished LHD and RHD groups in expected ways.

Stimuli and Tasks

Target stimuli came from a pool of semantically neutral phrases (e.g, "I can't believe it") that had been read by female speakers to convey one of four moods (happy, angry, afraid, no emotion) through prosody (see Tompkins & Flowers, 1985, for details). After several validation sessions we identified eight target phrases that conveyed more than one mood both across normally aging subjects and in repeated presentations to the same subjects. These ambiguous targets were used in three experimental tasks in which subjects judged how the speaker "sounded."

In Task 1, subjects judged target phrases presented in isolation. Three blocks of trials (given in two sessions) each consisted of two presentations of the eight targets and of five nonambiguous fillers. Thus, subjects made six judgments of the mood conveyed by each ambiguous target phrase in isolation.

Table 1. Descriptive Data for Three Subject Groups

Patient Characteristics	RHD (N = 20)	LHD (N = 20)	Control (N = 20)
Age (years)	64 (51–75)	64 (49–77)	66 (52–77)
Education (years)	12.4 (8–21)	13.3 (8–20)	12.9 (8–17)
Gender	11 male/ 9 female	10 male/ 10 female	10 male/ 10 female
Estimated IQ[a]	105 (92–127)	108 (88–125)	108 (94–119)
Auditory comprehension[b] (overall *BDAE* %ile)	95 (86–98)	90* (32–98)	97 (94–98)
Percent literal concepts[b] ("Cookie Theft" sample)	63 (44–81)	58 (31–92)	61 (5–75)
Judgment of line orientation[c]	17** (5–28)	23 (17–30)	24 (15–30)
**Contralateral neglect (medical records)	9 = Yes**	0 = Yes	N/A
*Aphasia (medical records)	0 = Yes	16 = Yes*	N/A
Etiology	13 thromboembolic	13 thromboembolic	N/A
Months post onset	26 (8–40)	23 (9–48)	N/A

Note: Data are means (with ranges) unless otherwise indicated. RHD = Right-hemisphere-damaged; LHD = Left-hemisphere-damaged.
[a]Wilson, Rosenbaum, & Brown (1979). [b]From *Boston Diagnostic Aphasia Examination,* (Goodglass & Kaplan, 1983). [c]Benton, Hamsher, Varney, & Spreen (1983).
*LHD significantly poorer than other groups. **RHD significantly poorer than other groups.

For Task 2, each target phrase was combined with four versions of five different prior linguistic contexts (see example in Table 2). The events in each version had been validated to represent one of the four mood choices, but the stories were read with neutral intonation (see Tompkins, 1991). Each story-target pair was presented twice, along with 32 fillers (four blocks of 24 trials each). Subjects judged the mood of the target phrases after the stories were presented.

Several manipulations were made to discourage subjects from adopting a conscious strategy of "matching" target responses to mood information in the stories. First, subjects performed a distractor task (monitoring for the occurrence of the words *he* or *she*) to keep them from focusing on the stories' emotional content. Second, target phrases followed the stories

Table 2. Sample Story Context in Four Versions

Amy left home early one morning.	
She was going	to the beach.[a] to traffic court.[b] to a dental surgeon.[c] to the store.[d]
She was	relaxing on her day off.[a] fighting an unjust ticket.[b] having her teeth pulled.[c] driving there in her car.[d]

[a]Version for "happy." [b]Version for "angry." [c]Version for "afraid." [d]Version for "no emotion."

after a brief interval (550 ms) to reduce the opportunity to form expectancies. Third, through instruction, demonstration, and practice, subjects were informed that the mood of the story would not "go with" the speaker's voice much of the time, so they should ignore the story and try to judge the target phrase as if it had occurred by itself. Twenty of the 32 fillers contained nonambiguous target phrases, paired in incongruent trials with stories of different moods, to reinforce these instructions. Finally, although response-time data were not collected, subjects were encouraged to respond as quickly as possible.

For Task 3, each version of the five story contexts (20 trials total) was presented in isolation. Subjects were asked to select the mood label that indicated how the main character would feel in the situation described.

Subjects also performed two preliminary emotion recognition tasks (see Tompkins, 1991). For the first, they chose the mood label *(happy, angry, or afraid)* that was synonymous with each of 18 emotion words presented singly on index cards (e.g., *delighted, furious, anxious*). For the second, they selected the mood label that described each of 12 orally described emotional situations (e.g., "Your brakes don't work on the freeway").

Test Procedures

Experimental stimuli were tape-recorded for consistency of production. Trials within each block were pseudorandomly ordered: a filler always occurred first, and no more than three trials of each type (experimental vs. filler) or emotion occurred in sequence. The order of presentation of various blocks of trials was counterbalanced. Subjects responded manu-

ally to the experimental tasks by pressing one of four labeled buttons on a custom-built response-time apparatus (see Tompkins, 1991). Experimental tasks were interspersed with tasks from a related study and with the clinical descriptive tasks reported in Table 1. The blocks of the isolated target judgment task (Task 1) were separated as much as possible, and the isolated story judgment task (Task 3) was given last. Most subjects completed the study in two sessions, 5–10 days apart.

Scoring Procedures

Because the experimental target phrases were intended to be ambiguous, there was no standard by which to describe performance as correct or incorrect. We developed a scoring system that captured the extent to which the mood judgment of a single target phrase in Task 2 *shifted* from one interpretation to another when it was preceded by linguistic contexts describing situations associated with differing emotional reactions.

Before any scoring was done, we assessed the accuracy of judgments for stories presented in isolation (Task 3). When a story context was assigned a mood different from that intended, we substituted the subject's judgment for our own before examining the influence of prior context on target judgments in Task 2. This occasionally occurred when subjects, especially males, indicated that our female characters would be afraid in situations that had been validated as creating anger.

"Shift" point values were assigned to each target phrase when it matched the mood of its prior context in Task 2. Scoring rules depended on whether the moods selected for a target phrase in Task 2 had also been selected when that target phrase was judged in isolation (Task 1), or whether the mood selected in Task 2 had never been chosen in the isolation task. The scoring procedures for each occasion will be described separately.

When a mood choice had been made *in isolation* for a particular target phrase, conservative scoring procedures were applied. Two criteria had to be met before a target phrase was evaluated for scoring. First, that target phrase must have been judged as portraying two or three different moods when presented in isolation. To illustrate, Target A, variously identified as "happy" and "afraid" in Task 1, would qualify for a shift score in Task 2. Target B, always judged as "happy," and Target C, for which all four mood choices were made over six presentations, would not be scored in Task 2. The second criterion for assigning shift scores was that both occurrences of a single target phrase had to be judged with the same mood as that conveyed by the prior context in Task 2.

After selecting qualifying target phrases in this manner, we gave more weight to shifted target moods that were selected less often in isolation, and vice versa. To accomplish this, we determined the proportional fre-

quency with which each mood choice occurred for these targets in the isolation task (e.g., four judgments of "happy" and two of "afraid" for Target A represent a 0.67–0.33 split). The shift point value awarded was the inverse of the ratio calculated for that mood's occurrence in isolation (e.g, when an "afraid" judgment followed an "afraid" story on *both* occurrences of Target A, 0.67 points were awarded, the inverse of the relative occurrence for "afraid" in Task 1).

For target moods that were *never chosen in isolation* (e.g., an "angry" judgment for Target A, above), scoring was much more liberal. Here, a full point was given any time the target judgment in Task 2 matched the mood of its prior context, capturing the strong influence exerted by the story on the target judgment.

All points were summed to create the shift scores shown in Table 3. Because individual scores were based on different numbers of qualifying targets, each element of the shift score (points for choices made in isolation plus points for choices not in isolation) was divided by the number of targets contributing to its score and summed to provide an adjusted shift score (see Table 3). Finally, Table 3 reports the number of incongruent, nonambiguous filler trials for which story mood and target judgments matched. This provides an indication of the extent to which subjects' shift scores might have been due to the previously mentioned simple matching strategy.

Table 3. Experimental Task Performance for Three Subject Groups

Scores	**RHD** ***(N = 20)***	**LHD** ***(N = 20)***	**Control** ***(N = 20)***
Shift score			
Mean	8.1	7.5	7.4
(Range)	(3–20)	(1–23)	(0–24)
SD	4.8	5.8	5.7
Adjusted shift score[a]			
Mean	1.2	1.0	1.0
(Range)	(0.5–2.7)	(0.2–3.0)	(0.0–3.0)
SD	0.7	0.8	0.7
Story-target "matches"[b]			
Mean	4.4	4.5	3.7
(Range)	(2–8)	(1–9)	(2–6)
SD	2.1	2.5	1.3

Note: RHD = Right hemisphere-damaged; LHD = Left hemisphere-damaged
[a]Shift score adjusted for number of targets contributing to its computation; score reflects extent of shifting per target. [b]For nonambiguous filler targets, paired with incongruent stories (maximum possible = 20).

RESULTS

Preliminary analyses indicated that there were no gender differences in shift scores (t for each group < 1.5). The groups did not differ in the number of targets contributing to the adjusted scores (M from 6.5 to 7.0 for choices made in isolation and from 6.9 to 7.7 for choices not made in isolation), so raw shift scores were used in subsequent analyses. In addition, the groups did not differ in the number of fillers for which story and target mood judgments "matched" [F (2, 57) = 2.3; $p > .05$; see Table 3].

One-way ANOVA on the three groups' shift scores (Table 3) was not significant [F (2, 57) = 0.91; $p > .05$]. Table 3 shows that the range of scores for brain-damaged subjects overlapped completely with the range for non-brain-damaged listeners. Pearson correlations indicated that shift scores were positively associated with the number of "matched" filler judgments for each group ($r_{LHD} = .70$; $r_{RHD} = .51$; $r_{Control} = .49$), with the strength of correlation similar for RHD and control groups. For the LHD group, the shift score was also correlated with overall auditory comprehension scores ($r = -.57$) and with the preliminary task involving mood recognition for emotional situations ($r = -.58$). There were no other meaningful correlations ($r > .50$) with shift scores for RHD or control subjects.

DISCUSSION AND IMPLICATIONS

Results of this study indicate that the perception of emotionally ambiguous target phrases was influenced by prior linguistic context to a comparable extent for all three subject groups: Listeners shifted their judgments of a single target phrase as the moods conveyed by its associated contexts changed. Although nonsignificant results can be difficult to interpret, the complete overlap in group distributions increases our confidence that our brain-damaged adults appraised emotionally ambiguous signals just as non-brain-damaged control subjects did. Of course, subtle group differences might have been detected with more sensitive response-time methods.

These results, together with those from previous priming studies (Tompkins, 1990, 1991), suggest that adults with RHD can process linguistic context sufficiently to influence judgments of intended meanings, even in domains (e.g., emotion or prosody) that tend to cause them difficulty. The findings extend results obtained with stimuli that conveyed mood information in a clear-cut, nonambiguous way.

Given the task manipulations incorporated to discourage extensive reliance on strategies, the contextual benefit for RHD adults probably reflects, at least in part, nonconscious spreading activation through an affective network (see Blaney, 1986; Gilligan & Bower, 1984; Tompkins, 1991). The correlations between shift scores, however, and the number of matched filler judgments suggest that all subjects probably did adopt a strategy to manage ambiguity by choosing moods for target phrases based on the emotional information implied by the prior context.

All groups resorted to this type of strategy on a similar proportion (about 20%) of the nonambiguous filler trials, but the strategy was more strongly related to LHD adults' shift scores than to either RHD or normal controls' shift scores. Apparently, RHD subjects were no more likely than normal controls to base target judgments on a simple matching strategy. Shift scores for LHD subjects were negatively correlated with auditory comprehension performance on the *Boston Diagnostic Aphasia Examination* (Goodglass & Kaplan, 1983) and with mood judgments of emotional situations. These correlations suggest that those LHD subjects who performed more poorly in task-relevant domains (e.g., auditory comprehension or emotional recognition) were more likely to adopt a matching strategy, relying on their understanding of the linguistic context to assist with judgments of emotional ambiguity. This pattern is frequently observed in studies of context effects on cognitive processing in normally aging individuals (e.g., Stine & Wingfield, 1987; Tompkins, 1991) and brain-damaged adults (e.g., Pierce & Wagner, 1985; Tompkins, 1991). Cohen and Faulkner (1983) suggest that this situation arises because listeners coping with a deterioration in stimulus quality or representation rely more heavily on available contextual cues.

In any case, the results call for continued investigation of conditions under which RHD adults exploit contextual information successfully. The conventional wisdom suggesting that RHD adults do not appreciate context needs to be carefully examined, as these sorts of data have implications for designing stimulus materials and conditions that may facilitate performance in treatment.

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