

# Posed prosodic emotional expression in unilateral stroke patients: Recovery, lesion location, and emotional perception<sup>☆</sup>

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## Abstract

Recovery of emotional functioning following stroke has received limited attention in the neuropsychological literature. By emotional functioning, we refer to a range of processing modes, including perception, expression, experience, and behavior. The aim of the current study was to evaluate the course of prosodic emotional expression over time in individuals with stroke. Posed prosodic expression tasks from the New York Emotion Battery were administered to right brain-damaged (RBD), left brain-damaged (LBD), and demographically matched normal control (NC) participants at two separate testing times (median interval of 25 months). Posers (i.e., individuals producing the emotional expressions) were required to produce neutral-content sentences using four different emotional tones (happiness, sadness, anger, and fear). Raters judged poser output for accuracy, intensity, and confidence. For accuracy ratings, RBDs and LBDs were impaired relative to NCs at baseline. In terms of recovery, there was a tendency for LBDs to improve over time, and there was a significant decline for RBDs. Inspection of the group mean data suggested that frontal lesions had a negative impact on prosodic emotional expression in RBDs and that lesion extent did not systematically influence performance at baseline or over time. Participants maintained their relative standing on the NYEB expression tasks over time. Finally, no significant relationships were found between participant performance on prosodic emotional perception and expression tasks at either testing time, suggesting that these two processing modes are relatively independent.

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## 1. Introduction

Despite an ever-increasing literature on the recovery of brain functions following stroke, there are relatively few investigations on the recovery of emotional functioning. Emotional processing is an integral component of behavioral and psychological adaptation necessary for learning, motivation, coping, and decision-making. Thus, increasing our understanding of emotional sequelae following stroke is important (e.g., [Eslinger, Parkinson, & Shamay, 2002](#)).

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Previous research examining speech and language functions in aphasic patients (e.g., Fazzini, Bachman, & Alpert, 1986) has shown that whereas most spontaneous recovery occurs in the first 6 months following stroke, significant improvement can continue to take place several years after stroke (Kertesz, 1993). Moreover, neuroimaging studies have demonstrated a complex pattern of brain reorganization subsequent to recovery from stroke that can be viewed as a mechanism enabling recovery (e.g., Chollet et al., 1991; Weiller, 1995).

The course of functional recovery following stroke is uncertain and may depend on a number of factors, including lesion location (Nelson, Cicchetti, Satz, Sowa, & Mitrushina, 1994) and environmental variables (Eslinger et al., 2002). For instance, Nelson et al. (1994) assessed behavioral disturbance (e.g., depression, mania, and indifference) in left brain-damaged (LBD) and right brain-damaged (RBD) patients at 2-week, 2-month, and 6-month intervals. Their findings revealed differential recovery rates, depending on hemispheric side of lesion. Initially, LBDs exhibited a slower rate of recovery, as compared to RBDs; however, at 6 months post-stroke onset, the rate of recovery for the LBDs stabilized, whereas the RBDs continued to demonstrate functional decline.

Few studies have examined the recovery of prosodic emotional expression, however, aprosodia is a condition commonly observed in stroke patients. Although case reports have documented recovery of prosodic functioning, aprosodia can persist (Hughes, Chan, & Su, 1983). Ross and Mesulam (1979) described two patients with aprosodia following a right-hemisphere lesion. One regained the ability to express emotion 8 months later, but the second did not show improvement at a 5-year follow-up. Egelko et al. (1989) investigated the recovery of facial and prosodic affective comprehension in RBD, LBD, and normal control (NC) participants and reported improvements in facial perception in RBDs but not in LBDs. More recently, a study of facial, prosodic, and lexical emotional perception conducted in our laboratory (Zgaljardic, Borod, & Sliwinski, 2002) revealed limited recovery, whereby RBDs significantly improved relative to LBDs and NCs, but only on lexical perception tasks. The current study extended previous work from our laboratory by focusing on the recovery of emotional expression. Posed prosodic emotional expression tasks from the New York Emotion Battery (NYEB; Borod, Welkowitz, & Obler, 1992) were administered, on two separate occasions, to individuals with unilateral stroke and to demographically matched NCs. The prosodic output was later evaluated by raters for accuracy and intensity of emotional expression.

A second objective of this study was to investigate brain lateralization of prosodic emotional expression functions. The literature on prosodic expression in brain-damaged patients points to the right hemisphere as dominant for this function (e.g., Blonder, Pickering, Heath, Smith, & Butler, 1995; Borod, Bloom, Brickman, Nakhutina, & Curko, 2002; Borod, Koff, Lorch, & Nicholas, 1985; Gorelick & Ross, 1987; Ross, 1993, 1997; Ross & Mesulam, 1979; Schmitt, Hartje, & Willmes, 1997; Tucker, Watson, & Heilman, 1977). These findings have been corroborated by studies that have employed a wide variety of methods: (a) the Wada technique (Ross, Edmondson, Siebert, & Homan, 1988), (b) progressively reduced verbal-articulatory conditions (Ross, Thompson, & Yenkosky, 1997), (c) acoustical analysis of fundamental frequency (Pell, 1999a, 1999b), and (d) the examination of the use of tonal languages, such as Chinese and Thai (Gandour, Larsen, Dechongkit, Ponglorpisit, & Khunadorn, 1995).

When examining site of lesion, there is considerable literature implicating frontal brain structures in the expression of emotion (e.g., Hornak, Rolls, & Wade, 1996; Kolb & Taylor, 1990; Pick, Borod, Ehrlichman, & Bloom, 2003; Wasserman, Borod, & Winnick, 1998; Weddell, Miller, & Trevarthen, 1990) and some specifically within the right hemisphere (Borod, 1993; Borod et al., 1985; Ross, 1985, 1997; Ross & Rush, 1981). In spite of these findings, the right-hemisphere hypothesis has not received unequivocal support (e.g., Borod, Bloom, et al., 2002; Bradvik et al., 1991; Davidson, 1984; Heller, 1990; Kinsbourne & Bemporad, 1984). For instance, Van Lancker and Sidtis (1992) suggested that prosodic processes involve multiple functions that are distributed across the two cerebral hemispheres. Moreover, several brain structures, regardless of hemispheric location, have been implicated as playing an important role in the ability to express emotion through prosody. These include the supra-Sylvian region (Ross, 1985), deep white matter below the supplemental motor area (Ross et al., 1997), and the basal ganglia (Cancelliere & Kertesz, 1990). Thus, identifying brain structures that are critical for prosodic emotional expression remains a relevant objective in emotion research. The current study will explore the role of intra-hemispheric sites, while focusing on investigating hemispheric specialization for this function.

The third objective of the current study was to examine the relationship between expressive and perceptual prosodic emotion. Research using brain-damaged and NC participants has demonstrated that a lesion may affect one mode but not the other (Borod, 1993; Borod, Koff, Lorch, & Nicholas, 1986; Gainotti, 1987; Ross, 1981; Ross & Mesulam, 1979). Furthermore, findings in RBDs have suggested a dissociation, whereby emotional expression may be subserved by anterior brain structures and emotional perception by posterior structures (Ross, 1985, 1997; Ross & Rush, 1981).

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