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Facial closure: interrelationship with facial discrimination, other closure tests, and subjective contour illusions

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Abstract

Findings from previous research have argued for the dissociation of two visual–perceptual tasks traditionally thought to be mediated by the nondominant hemisphere (i.e. perceptual closure and facial discrimination). This, primarily methodological, study examined the extent to which the facial closure measure (Mooney closure faces test) involves "closure" and/or facial discrimination. A factor analysis of six visual perceptual measures, carried out separately for left brain damaged (LBDs, $n = 33$) and right brain damaged (RBDs, $n = 30$) patients, resulted in two relatively independent factors (i.e. a *closure* factor and a *facial discrimination* factor), with the Mooney closure faces test loading on both. The mixed factorial structure did not aid the facial closure measure's sensitivity to right-sided brain disease. Moreover, age and education intercorrelated differently with the two factors. Results argue for the use of more discrete visual–perceptual measures when examining perceptual functioning and/or right hemisphere integrity, and imply the existence of at least two discrete cortical level visual–perceptual neural systems.

Keywords: Anomalous contour illusions; Gestalt Completion Tests; Subjective contour illusions

1. Introduction

Perceptual closure and facial discrimination tests classically have been used as critical measures of right hemisphere "Gestalt" functioning (e.g. Benton & Van Allen, 1968; Bogen, De Zure, Tenhouten, & Marsh, 1972; De Renzi, Faglioni, & Spinnler, 1968; Warrington & James, 1967 and De Renzi & Spinnler, 1966; Newcombe & Russel, 1969 for facial discrimination and perceptual closure, respectively). Perceptual closure tests require identification of whole figures from incomplete renditions of various forms. Facial discrimination requires the recognition of faces which may or may not, have been transformed in some way. Facial closure is a subtype of perceptual closure tasks which requires the identification of incomplete renditions of human faces (Lezak, 1995), used in classical studies of right hemisphere visual spatial functioning (e.g. Lansdell, 1968; Newcombe & Russel, 1969) and more recently in electrophysiologic and functional brain imaging studies of the neural basis of perception (George, Jemel, Fiori, & Renault, 1997; Kanwisher, Tong, & Nakayama, 1998; Rodriguez et al., 1999).

The Gestalt closure construct, however, is ambiguous, and thus difficult to operationalize meaningfully (Wasserstein, 2002). Moreover, studies by this group have both demonstrated the heterogeneity of processing demands in many existing closure tests (Wasserstein, 1981; Wasserstein, Zappulla, Rosen, Gerstman, & Rock, 1987), and established an important relationship between the ability to discern subjective contour illusions and the right hemisphere sensitivity of closure measures (Wasserstein et al., 1987). Importantly, results from case studies (Wasserstein, Zappulla, Rosen, & Gerstman, 1984) suggested that closure and facial discrimination may be doubly dissociable right hemisphere abilities which were also unrelated in a larger human lesion study (Wasserstein et al., 1987). Arguably, facial closure also requires components of facial discrimination. Thus, the extent to which facial closure involves "closure", facial discrimination, or both, remained unclear.

This methodological study aimed to clarify the lateralized processing demands of the Mooney closure faces test (closure faces or CF) in a neurosurgical sample. Factor

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structure analysis was used to examine the relationship of CF to the related visual–perceptual tasks with which it may be conflated. Group contrasts were used to assess the relative sensitivity of measures to lateralized damage. Differential impact of demographic variables known to affect many neuropsychological functions (i.e. age and education) was also examined.

2. Method

2.1. Subjects

Sixty-three patients with focal unilateral hemispheric lesions participated in this study. All were right-handed inpatients in the Neurosurgery Service of the Mt. Sinai Medical Center in New York City, and without organic mental syndrome (i.e. behavioral/cognitive evidence of diffuse higher cortical dysfunction). All were also subjects in the previously published study of closure performance (Wasserstein et al., 1984). Patients were divided into two groups: those with right-sided brain damage (RBDs) and those with left-sided brain damage (LBDs), with 30 and 33 subjects, respectively. Locus of lesions was determined by computerized axial tomography in 60 cases, and by angiogram and surgical reports in three remaining cases.[1] Most of the patients had neoplastic disease, with no significant differences between the LBDs and the RBDs. Level of education was coded into six ordinal scale categories (i.e. 1: not HS graduate, 2: HS graduate, 3: some college, 4: college graduate, 5: MA, 6: Ph.D., M.D. or other advanced degree). Mean age, sex and level of education were not significantly different between the two larger groups (i.e. 39.1 and 42.7 years, 54 and 36.7% male, and 2.7 and 2.8 education level; means for LBDs and RBDs, respectively). Subjects without brain damage were not studied, since they tend to show very little variability in performance on one of the critical measures (i.e. nearly 100% accuracy for subjective contour illusions) (Hamsher, 1978).

2.2. Instruments and procedure

All tests were individually administered and given preoperatively.

2.2.1. Mooney closure faces test

Stimuli consist of high contrast photographs of an artist's renditions of human faces (Mooney, 1957), effectively "incomplete" faces (CF or closure faces). The subject is required to sort these pictures into one of six piles: boy, girl, grown man, grown woman, older man, older woman. A subset of 20 items from an original 40 item set was used. Items were chosen to preserve the difficulty range of the whole set (Mooney, 1957), as well as the relative representation of the six target groups. Fifteen minutes were allotted for the task (i.e. half of the 30 min time limit recommended for the full set). Sample items are shown in Fig. 1.

2.2.2. Other closure tests

Four closure tests: street Gestalt Completion Test (Street)—13 items (Street, 1931); street unstandardized figures (Street)—9 items (Street test as reproduced in Thurstone) (Thurstone, 1949); a subset from the[2] Mooney closure test (Mooney)—11 items (Mooney & Ferguson, 1951); and the education testing service Gestalt Completion Test (ETS)—22 items (Ekstrom, French, Harman, & Dermen, 1976) were used. All consisted of fragmented figures of objects, animals and people. Minor modifications were made on several items in order to maximize uniformity of the stimulus array (i.e. reversal of white-on-black ground items to the more typical black-on-white format, and deleting figural information which had no relationship to the depicted shape). Items were shown for a maximum of 15 s each. Correct response consisted of either naming or, in the case of some aphasics, describing the incomplete figure. Scores consisted of number correct for individual tests.

2.2.3. Subjective contour test

A set of 15 subjective contour illusion stimuli (SC illusions) were collected and provided, with norms, by Hamsher (personal communication). These were assembled from Kanizsa (1976) and Coren (1972). The stimuli were shown individually and without time limit. Patients were asked to name and/or outline all the forms they saw. Correct response consisted of identification of the illusory shape.

2.2.4. Facial discrimination test

The test of facial recognition (faces) of Benton and Van Allen-Short Form (Levin, Hamsher, & Benton, 1975) calls for the matching of unfamiliar faces photographed under different conditions of presentation (i.e. variations in lighting and/or orientation). Response consisted of pointing to correct choices selected from a confusion matrix.

Since few of the measures provided norms and/or age corrections, all statistical analyses are based on raw scores.

3. Results and discussion

3.1. Factor analyses

In order to investigate and confirm the dimensionality of the facial discrimination measure and the five nonfacial

[1] For one-third of patients (i.e. the first 23 in the series, 11 LBDs and 12 RBDs) extent of lesion was determined by a neurosurgeon's classification of localizing data into four ordinarily scaled categories (1: small, 2: medium, 3: large, 4: very large). No significant differences in lesion extent were discerned between these subsamples (i.e. LBD versus RBD).

[2] Mooney created two closure tests, one consisting entirely of faces to be clustered by sex and age (CF) and the other (Mooney) consisting of more typical object/animal closure stimuli to be named.