ADVANCES IN EXPERIMENTAL AESTHETICS: AN ANALYSIS OF EVALUATIVE AESTHETIC AND DESCRIPTIVE SYMMETRY JUDGMENT PROCESSES USING EVENT-RELATED BRAIN POTENTIALS

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Abstract

We report an event-related brain potential (ERP) study comparing descriptive (symmetry) and evaluative (aesthetic) judgments. Physically identical stimuli were used for both judgment types in order to control for perceptual processes. Participants viewed novel symmetrical and asymmetrical two-dimensional patterns in a two-alternative forced-choice task setting. Aesthetic judgments ("beautiful" / "not beautiful") and symmetry judgments ("symmetric" / "not symmetric") were precued in a mixed design. Detailed paramorphic models of the individual judges' cognitive systems as well as a group model were derived using multiple regression analyses of behavioral data. The symmetry feature of the stimuli and aesthetic judgments were strongly correlated for all participants and descriptive judgments were performed faster than evaluative judgments. The event-related potentials revealed a phasic frontal negativity for the "not beautiful" judgments as compared to the other judgments in the 300 to 400 millisecond time range. This deflection reflected early evaluative processes. A sustained posterior negativity for the "symmetric" judgments relative to the other judgments in the time range between 600 and 1100 milliseconds reflected processes of the visual analysis of symmetry. All four conditions showed late positive potentials (LPP). Evaluative judgment LPPs revealed a more pronounced right lateralization. In summary, although correlated behaviorally, descriptive symmetry judgment and evaluative aesthetic judgment processes differ qualitatively and recruit, at least in part, distinct neural machinery.

Descriptive versus Evaluative Cognition

The distinction between descriptive and evaluative cognition evolved in the wake of the cognitive revolution and is prevalent in contemporary cognitive theories (Gardner, 1985). Evaluative cognition is concerned with processing the individual, subjective value of an entity, whereas descriptive cognition is non-evaluative in character. The present research used novel stimuli (graphic patterns) that required participants to contemplate the beauty of the material during the course of the study and did not permit the retrieval of ready-made, stored, attitude-like

evaluations. They were asked to judge the patterns according to their aesthetic value (evaluative task) and whether they were symmetric or not (descriptive task).

Judgment Analysis

Social Judgment Theory (SJT) defines judgment as a process that involves the integration of information from a set of cues into a judgment about some distal state of affairs (Hammond, Stewart, Brehmer, & Steinmann, 1975). SJT provides the foundation for judgment analysis (JA). Individual as well as group models are derived. In accordance with Stewart (1988, p. 41), JA is defined as "using statistical methods to derive algebraic models of the judgment process." In the present study, judgment analysis was used to learn about the participants' ways of making aesthetic judgments.

Electrophysiology of Evaluative Processing

An electrophysiology of evaluative processing has been evolving in recent years. In a number of studies, Cacioppo and coworkers (e.g., Cacioppo, Crites, Gardner, & Berntson, 1994; Ito & Cacioppo, 1999) reported a centroparietally preponderant late positive potential (LPP) reflecting operations of evaluative categorizations. The LPP shows a hemispheric asymmetry with larger amplitudes over the right hemisphere of the scalp.

The Present Study

To isolate judgmental from perceptual processes, symmetry and aesthetic judgments were investigated using the same set of stimuli. While the EEG was continuously recorded, the two types of judgment processes were investigated in a mixed design with task pre-cueing. The stimuli were newly designed in order to control for novelty effects and to prevent the activation and use of predefined attitudes. Participants were pre-exposed to the stimuli so that they could form stable judgments relative to the entire item set. Judgment analysis was employed to derive individual case models of the judges' cognitive systems as well as group models during the phase 1 test and main experiment.

It was predicted that group models and individual case models would replicate previous reports on symmetry and complexity as determinants of aesthetic judgments. In addition, it was predicted that substantial differences between individuals could be found. Also, a replication of results on the relative speed of descriptive and evaluative judgments was expected given the relative difficulty of both tasks in the present study.

Finally, morphological and topographical difference in the ERP waveforms between both tasks were predicted. ERP deflections reflecting evaluative processing were expected to show frontal involvement and reveal a more right hemisphere pronounciation (LPP). The descriptive symmetry judgment task, on the other hand, was predicted to show stronger occipital involvement reflecting processes of detailed visual analysis.

Method

Participants

Twelve young adults (7 males, 5 females) participated in the experiment for partial fulfillment of course requirements. All were second-year psychology students at the University of Leipzig. Eleven of them were right-handed, one was left-handed. Their mean age was 22.3 years, ranging from 20 to 26. None had received professional training in the fine arts or participated in a similar experiment before. Participants reported normal or corrected-to-normal visual acuity and no known neurological condition. Three participants had to be excluded from the analysis of the main experiment due to technical errors.

Material

Two hundred fifty-two stimuli were constructed. Each consisted of a solid black circle (8.8 cm in diameter) featuring a centered, quadratic, rhombic cutout, and 86 to 88 basic graphic elements (small black triangles) arranged within the rhomb according to a grid and resulting in a graphic pattern. The basic elements were arranged such that geometric figures like triangles, squares, rhombs, horizontal, vertical or oblique bars were created. Using this collection of basic elements, the overall luminance was identical for all stimuli. Half (130) were symmetric, a maximum of two mirroring operations giving four possible symmetry axes were permitted. The other half of the stimuli were non-symmetric. Figure 1shows three examples of the stimuli.

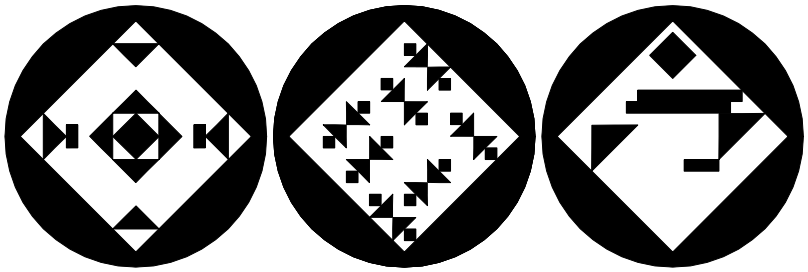

Figure 1. Stimulus examples. Three graphic pattern ranging from most beautiful (left) to least beautiful (right).

Apparatus

The experiment and analyses were run on standard PC computer equipment. An electrically shielded and sound-attenuated experimental chamber was used. A 25-channel EEG was recorded using cap-mounted Ag/AgCl Electrodes.

Procedure

This study was conducted in two parts. The first part, the Phase 1 test, served to familiarize the participants with the stimulus set, while they were judging the patterns during EEG-recordings with regard to they aesthetic value and symmetry for the main experiment

Phase 1 test. Participants responded to 252 stimulus patterns in randomized order. They were instructed to judge each according to the display's aesthetic value. Here, the word "beautiful" was explicitly mentioned. They were instructed to create three bins: one of at least 75 beautiful patterns, one of at least 75 not beautiful patterns, and a third category of "indifferent" pictures. This last bin could contain no elements, if that was preferred

Main experiment. The types of judgment (aesthetic, symmetry) and symmetry status of the stimuli were fully crossed over four blocks and stimuli were pseudo-randomly assigned. A block consisted of 63 trials.

During the main experiment, participants were instructed to judge the patterns with regard to symmetry and aesthetic value contingent on a pre-cue during the recording session ("Ä" for aesthetic, "S" for symmetry).

Electrophysiological recordings

The electroencephalogram (EEG) was continuously recorded from 25 sites (Fp1, Fpz, Fp2, F7, F3, Fz, F4, F8, FC5, FC6, T7, C3, Cz, C4, T8, CP5, CP6, P7, P3, Pz, P4, P8, O1, Oz, O2) according to the extended 10-20 system. The EEG was recorded referenced to an electrode placed on the tip of the nose. The ground electrode was placed at FC2. Additionally, electrical activity at both mastoids was recorded. Electroocular activity was recorded from two bipolar channels. The vertical EOG was recorded from the right eye by supra- and infra-orbital electrodes. The horizontal EOG was recorded from electrodes on the outer canthi.

Results

Judgment analysis

As predicted, symmetry was found to be the most important stimulus feature determining participants' aesthetic judgments. Six participants relied on symmetry cues as the sole positive substantial factor influencing their judgments. Moreover, individual beta weights of symmetry cues ranged from .34 to .89 revealing considerable variation of cue use, that is the importance of symmetry cues for individual judges differed. These inter-individual differences were leveled by the group model.

The number of elements in a pattern, a measure of complexity, was the second-most important feature for positive aesthetic judgment, the number of large oblique bars was the second most important cue for two subjects, this time as a negative judgment cue.

Behavioral Performance

The results showed that 83.8% of all symmetry judgment responses were correct. There were 14.8% erroneous responses (1.4 % non-responses). Aesthetic judgment responses showed 0.7% non-responses. Mean correct RT, standard deviations and error percentages are given in Table 1. The descriptive symmetry judgments were performed faster than the evaluative aesthetic judgments.

	Judgment	
Answer	Symmetry	Aesthetic
Yes	1013 (317)	1221 (378)
	8.1%	
No	1044 (248)	1111 (298)
	6.6%	

Table 1. Mean judgment latencies (ms), Standard Deviations (in parenthesis) and Percent Judgment Errors (second row) for Correct Symmetry and Aesthetic judgments.

Electrophysiological Data

The waveforms for the nine participants in the main experiment, with conditions (not) aesthetic and (not) symmetric, started to differ at approximately 250 ms after stimulus onset. At frontal sites a more negative going phasic deflection was observed for the non-aesthetic condition. At parietal and occipital sites a sustained more negative going waveform developed for the symmetrical condition after 250 ms. An LPP with right hemisphere pronounciation developed for

all conditions peaking at around 600 ms (Pz). The right lateralization was larger for the evaluative aesthetic condition. See Figure 2 for Iso-potential contour plots for these effects.

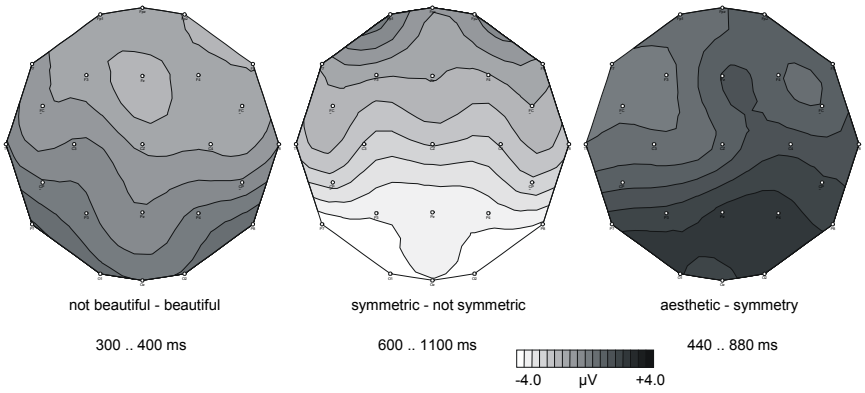

Figure 2

Discussion

Behavioral Performance

The symmetry judgment task was performed faster than the aesthetic judgment task. This was the case although participants had not performed the symmetry task during phase 1 test. The judgment latencies were in the time range that Mandler and Shebo (1983) reported.

Event-related Potentials

Morphological and topographical differences in the ERP waveforms between both tasks were predicted. ERP deflections reflecting evaluative processing might show frontal involvement and should reveal a more right hemisphere pronounciation. The descriptive symmetry judgment task, on the other hand, was predicted to have stronger occipital involvement reflecting processes of detailed visual analysis. A phasic negativity in the judgment condition "not beautiful" was observed relative to the other evaluative condition. This ERP deflection is taken to reflect an early evaluative subprocess. This early frontal effect is independent of the symmetry status of the stimulus. Descriptive symmetry analysis is reflected by the sustained posterior negativity. The descriptive task elicits sustained visual analysis, which does not occur under the aesthetic judgment task. Symmetry and aesthetic judgments clearly differed. Participants did not perform mere symmetry judgments in the aesthetics condition. The LPP lateralization effect constitutes a replication of the work by Cacioppo et al. (1994; Ito & Cacioppo, 1999). It reflects a stronger right hemisphere involvement of evaluative processes as compared to descriptive processes. All four conditions showed a judgment-related posterior positivity prior to the response.

In conclusion, the two different types of judgment differ in processing architecture, quality as well as temporal course. They are subserved, at least in part, by distinct neural generators. The systematic study of the architecture and temporal course of individual, evaluative aesthetic

judgment processes is possible and worthwhile if suitable methods are used. In this respect, judgment analysis and event-related brain potentials have proven to be useful tools, as well for research in psychological aesthetics in the tradition of Fechner (1876).

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