

The role of affective dimensions in the perception of facial expressions of emotion: Neuropsychophysiological, developmental, and neuroimaging examination of an affective predictive coding framework

ABSTRACT:

Background

There are long standing debates in theories of emotion between categorical models of basic emotions (e.g., fear) and models that propose more fundamental affective dimensions (arousal/valence) that may be combined in different ways to give rise to emotions. Neuroscientific research on Facial Expressions of Emotion (FEE) has typically favored basic emotions models, but recent evidence highlights that the affective properties of facial displays are relevant for understanding how the brain processes emotional facial stimuli.

Aims

The main goal of the project was to investigate the role of affective dimensions in the perception of and neural responses (EEG/ERP) to FEE, while retaining the concept of emotional categories as an important level of analysis. The Predictive Processing framework, that describes brain function in terms of predictions about the inputs that will be received according to existing prior representations, may provide a unifying model of emotional processing, combining categorical and dimensional aspects and overcoming some inconsistencies in the current literature, especially if considered in a developmental perspective.

Method

To fulfil this goal, there were several phases in this project. Over the course of the project, we developed novel theoretical accounts applying Predictive Processing models to Affective Neuroscience and Emotional Development. In terms of empirical studies, Phase 1 included three studies designed to assess how affective dimensions, such as arousal and valence, relate to (1) other facial features like the typicality of the face, (2) the presence of emotional or non-emotional content, and (3) emotional intensity. Phase 2 consisted of a cross-sectional study to assess the developmental evolution of FEE processing, covering over 100 children between 4 and 15 years old. We used self-reported affective ratings and event-related potentials (ERP) to examine the effects of emotional categories and affective properties of facial expressions.

Results

The general trend of the results across studies in Phase 1 suggested that the arousal/emotional intensity of facial displays is an important influence on electrophysiological responses in adults. This corroborates previous findings from our groups supporting that arousal, rather than emotional categories, drives early visual cortical responses to facial expressions. In Phase 2, the developmental results suggest that children are initially more sensitive to differences in the valence of facial expressions, while adolescents show a transitional pattern that resembles neither childhood nor adulthood.

Conclusions

The affective dimensions of valence and arousal of FEE appear to be crucial to understanding how the brain processes facial displays. Children, adolescents, and adults show different neurophysiological responses to these affective dimensions that seem to configure a developmental trajectory: children seem to be more sensitive to the valence of FEE while adults appear more responsive to the level of arousal of the expression, and adolescents seem to show an intermediate pattern of results. These findings are consistent with a Predictive Processing account, in which the accumulated experience across development gradually changes the neural systems subserving the perception of FEE.

Keywords

Facial expressions of emotion, Arousal, Valence, Development, Predictive processing, EEG/ERP

Published Work:

Pereira, M. R., Barbosa, F., de Haan, M., & Ferreira-Santos, F. (2019). Understanding the development of face and emotion processing under a predictive processing framework. *Developmental Psychology*, *55*(9), 1868-1881. doi: 10.1037/dev0000706

Ferreira-Santos, F. (2016). The role of arousal in predictive coding (Commentary). *Behavioral and Brain Sciences*, *39*, e207. doi: 10.1017/S0140525X15001788

Ferreira-Santos, F. (2015). Facial emotion processing in the laboratory (and elsewhere): Tradeoffs between stimulus control and ecological validity. *AIMS Neuroscience*, *2*(4), 236-239. doi: 10.3934/Neuroscience.2015.4.236

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