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Neural computation as a tool to differentiate perceptual from emotional processes: The case of anger superiority effect

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ABSTRACT

Research findings in social and cognitive psychology imply that it is easier to detect angry faces than happy faces in a crowd of neutral faces [Hansen, C. H., & Hansen, R. D. (1988). Finding the face in the crowd – An anger superiority effect. *Journal of Personality and Social Psychology, 54*(6), 917–924]. This phenomenon has been held to have evolved over phylogenetic development because it was adaptive to quickly and accurately detect a potential threat in the environment. However, across recent studies, a controversy has emerged about the underlying perceptual versus emotional factors responsible for this so-called anger superiority effect [Juth, P., Lundqvist, D., Karlsson, A., & Ohman, A. (2005). Looking for foes and friends: Perceptual and emotional factors when finding a face in the crowd. *Emotion, 5*(4), 379–395; Purcell, D. G., Stewart, A. L., & Skov, R. B. (1996). It takes a confounded face to pop out of a crowd. *Perception, 25*(9), 1091–1108]. To tease apart emotional and perceptual processes, we used neural network analyzes of human faces in two different simulations. Results show that a perceptual bias is probably acting against faster and more accurate identification of anger faces compared to happy faces at a *purely perceptual level*. We suggest that a parsimonious hypothesis related to the simple perceptual properties of the stimuli might explain these behavioral results without reference to evolutionary processes. We discuss the importance of statistical or connectionist analysis for empirical studies that seek to isolate perceptual from emotional factors, but also learned vs. innate factors in the processing of facial expression of emotion.

1. Introduction

Recently a number of theorists have proposed that the human emotion system evolved to quickly and accurately respond to signs of threat in the social environment (e.g., Hansen & Hansen, 1988). As a perceptual cue, facial expressions convey crucial information about possible social threat. This would suggest that the human emotional system is biased toward more efficient detection of angry facial expressions in the social environment (for instance, in a crowd of other faces). In an initial demonstration, Hansen and Hansen (1988) showed that experimental participants were particularly efficient at detecting an angry facial expression in a crowd of neutral faces. However, enthusiasm for this so-called "anger superiority effect" was tempered by follow up work of Purcell et al. (1996), which showed that the specific angry face used in the Hansen and Hansen studies possessed (anger-unrelated) attention-grabbing features, and that when the confound was controlled, the anger superiority effect disappeared. Since then, Öhman, Lundqvist, and Esteves (2001) reexamined the anger superiority effect using perceptually controlled schematic faces (drawn schematic faces varying only at the level of the eyebrows, eyes and mouth), and found evidence supportive of the basic phenomenon.

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Because the anger superiority effect has not been demonstrated convincingly with real human faces, these differing findings have raised the possibility of a perceptual bias in favor of the detection of happy faces that competes with the faster and more accurate recognition of angry faces embedded among neutral expressions. Indeed, in a more recent study, Juth et al. (2005), using pictures of human faces (Fig. 1), found that happy faces were more quickly and accurately detected than angry faces.

Furthermore, this happiness superiority effect was reversed for schematic faces, raising once more the possibility that a natural perceptual bias (that is not present in controlled schematic faces) overrides the emotional factors involved in the anger superiority effect. In other words, drawn schematic faces do not have any perceptual variance: there is only one angry and one happy face to constitute the matrices. This is not the case for real faces; each real face, even in a set expression the same emotion, is different. Such is true, for instance, of the human faces used by Juth et al. (2005) which were nonetheless carefully controlled for perceptual factors such as color, lighting conditions, background or clothing. Thus, a perceptual bias related to the simple statistic variability of real human faces constituting the different emotional categories may exist and raises the question of the possibility of generalizing a possible anger superiority effect in the processing of real-life facial stimuli. In other words, happy faces might be statistically more differentiated than angry faces from a crowd of neutral faces and therefore detected more efficiently. This phenomenon is illustrated in Fig. 2 in order to explain precisely what do we mean by "pure perceptual factors".

In the example provided in the left part of the graph, the statistical distribution of exemplars from two categories (for instance, category A for happy and category B for neutral faces) are well-differentiated. There is a little overlap between the two categories, meaning that the average similarity between the two categories is low. In contrast, the right part of the graph illustrates two categories that are more difficult to differentiate by a statistical or connectionist network in the perceptual space provided by two

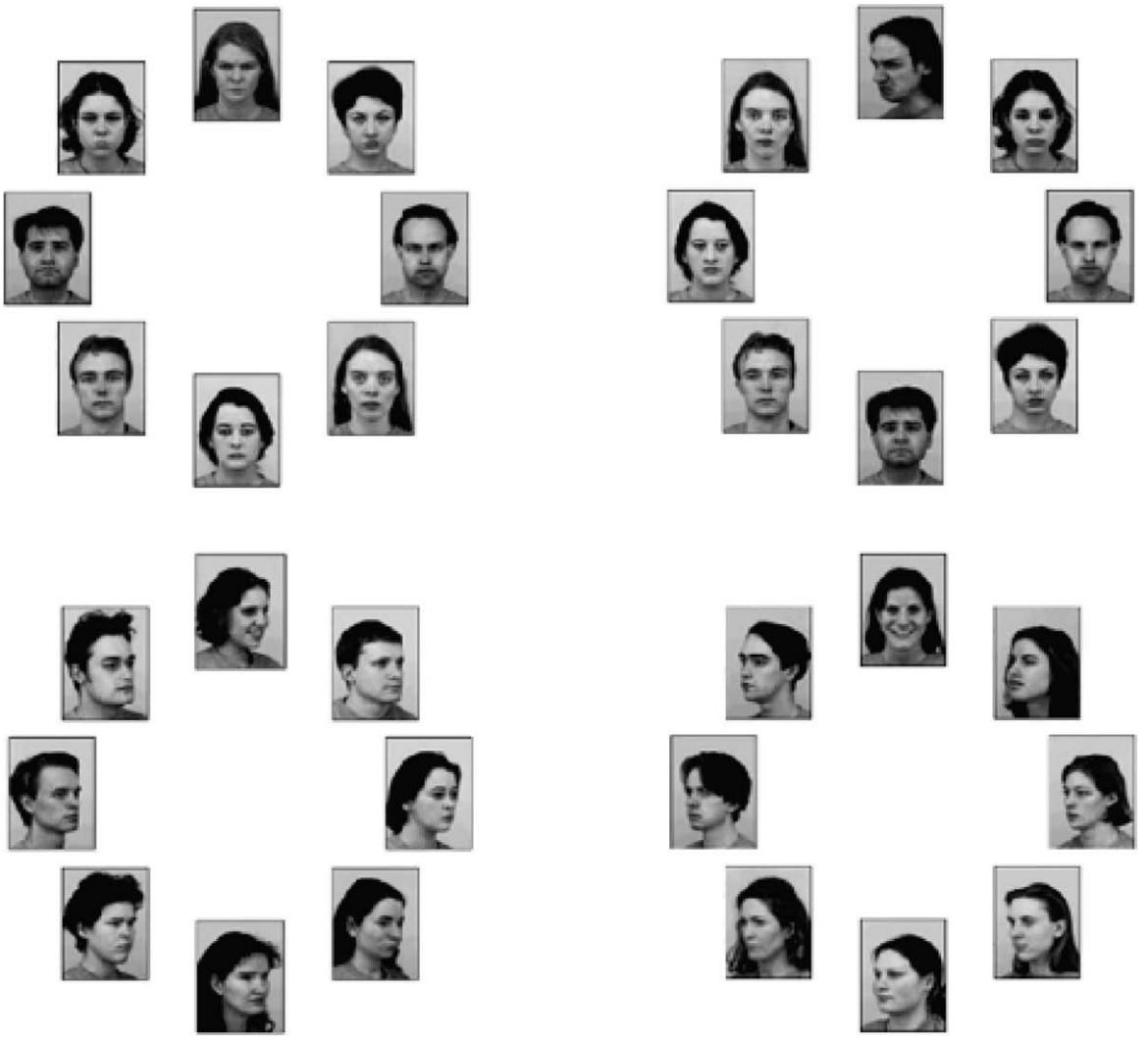

Fig. 1. Four examples of the photographic facial arrays that were used by Juth et al. (2005).