Facial Emotion Processing

in Children with Autism Spectrum Disorders

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Autism Spectrum Disorders (ASD) are neurodevelopmental disorders characterized by social communicative difficulties and restricted behaviors and interests. Facial emotion processing has been the focus of much attention in investigations of the foundations of social impairment in ASD, but so far it remains a puzzle. Although an explicit, cognitive basis for facial emotion processing has been emphasized, fewer studies have addressed automatic processing of facial emotions in ASD. To help clarify the entire picture of facial emotion processing, observing the responses involving automatic processing is important. Automatic face processing is believed to be mediated by the subcortical brain system, including the superior colliculus, pulvinar, and amygdala (Johnson 2005; Ohman et al. 2007; Pessoa and Adolphs 2010), which also modulates the cortical face processing. Rapid detection of threatening faces reflects facilitated attention orientation and enhanced perception, which are modulated by automatic face processing (Ohman et al. 2007). In this thesis, therefore, I focus on the Anger Superiority Effect (ASE) to tackle the question. ASE refers to the phenomenon in which angry faces are detected more rapidly than emotionally positive facial expressions, such as happiness, and has proven useful for assessing human function of rapid attention orientation toward threatening stimuli. It has been studied using a visual search paradigm that requires participants to search for a discrepant angry or happy face in a crowd of distractor faces (i.e., the Face-in-the-crowd task). Previous studies have revealed that adults with ASD show ASE, but its effect is less robust than in TD individuals (Ashwin et al. 2006; Krysko and Rutherford 2009). This suggests that alternative, less effective mechanisms that might be acquired later in life might underlie the ASE in individuals with ASD. In this thesis, therefore, I particularly focus on examining whether the basic mechanisms for quick allocation of attention toward angry faces is predisposed in individuals with ASD. Furthermore, I also examined the developmental processes for this function and the underlying mechanisms enabling it.

First, I addressed the question of whether ASE is predispositionally preserved in individuals with ASD by focusing on young children. Children with and without ASD were required to touch a discrepant item (either an angry or a happy face), among

distractors (neutral faces) displayed on a monitor, as quickly and accurately as possible. Results revealed absence of ASE only in children with ASD, suggesting that predispositional mechansms for rapid attention allocation towards angry faces may not be preserved in ASD. However, further analysis focusing on development suggested that children with ASD seem to acquire functional ASE during development, although the effect was not as robust as that in TD children. Subsequent studies were conducted to explore the mechanisms underlying ASE. Particularly, face-processing styles employed by TD and ASD children were focused on. Effects of spatial frequency and face inversion were tested; in addition, face-processing manner employed by children during detection of emotional faces was directly examined by employing a recognition task in combination with a face-in-the-crowd task. Results consistently revealed the evidence that different mechanisms underlie ASE in ASD and TD children. In particular, children with ASD appeared to rely on local features of faces during a detection of angry faces, rather than configural face-processing employed by TD children. Finally, roles of local features on the rapid attention orientation and their relationship with other domain – configural/local perceptual processing- were investigated: Results suggested that local features of angry faces are sufficient to activate the systems for rapid attention allocation in children with ASD, especially for those who show more local-biased perceptual characteristics.

In conclusion, this study showed the absence of ASE in young children with ASD. However, they appeared to acquire an alternative mechanism for enabling the ASE: perceiving emotions from the local features of faces. From these results, I propose the following scheme to explain the properties of emotion processing used by ASD individuals for attention allocation to threatening faces: Individuals with ASD, in contrast to TD individuals, lack the predispositional mechanisms to allocate attention quickly to threatening faces. This is probably because the systems for the rapid attention orientation towards biologically significant stimuli (i.e., the interaction between the cortical and the subcortical pathways) do not function normally due to difficulties in face recognition during early stages of development. However, ASD individuals develop an alternative strategy as they grow up for perceiving facial emotions: focusing on faces' local features. This strategy may activate the neural networks connecting emotion-related facial features to quick attention allocation to threatening faces. Extracting local features and perceiving emotions would thus be fundamental to quick attention allocation toward threatening faces in ASD individuals.