The Fusiform Face Area: Not Just for Faces?

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Research suggests that face perception is distinct from other forms of object perception, as faces are perceived in a more holistic manner. The Fusiform Face Area (FFA) is a cortical region in the human brain where researchers suggest that face perception may occur. A competing theory, the expertise hypothesis, suggests that the FFA processes within-category distinctions. In this paper, it is proposed that both theories are compatible. A possible explanation for the divergent findings that led to these two hypotheses might be that the FFA as currently defined is too broad. The current margins of the FFA may include a region specific to processing faces as well as regions that process other within-category distinctions of stimuli on which the individual is an expert. Therefore, it is possible that a region specific to face processing exists, but it may be more narrow than the FFA as currently defined. Further research is necessary to explore this alternative explanation.

Face perception in humans has been debated for decades (Gauthier, Tarr, Anderson, Skudlarski, & Gore, 1999; Yin, 1969). Unlike other objects, evidence suggests that faces are perceived in a more holistic manner, with emphasis placed on faces as a whole rather than their individual parts (Tanaka & Farah, 1993). Since it is thought that faces are processed differently than other objects, researchers have sought to locate a specialized cortical region in face perception (Kanwisher, McDermott, & Chun, 1997; Sergent & Signoret, 1992). First termed by Kanwisher and colleagues (1997), the Fusiform Face Area (FFA) is a cortical region in the human brain located in the fusiform gyrus where face perception is thought to occur. However, the precise function of the FFA is debated (Gauthier et al., 1999; Kanwisher et al., 1997). Many researchers have argued that the FFA is domain-specific, or solely processes items within a single domain. If the FFA is domain-specific, it should show maximal activity when processing anything pertaining to the face domain (Kanwisher et al., 1997; Schalk et al., 2017). An alternative view, the expertise hypothesis, proposes that the FFA is domain-general and processes discriminations between any stimuli in a homologous category (Gauthier et al., 1999). This process could apply to faces, as most faces are broadly similar and have minute differences that serve as identifiers, and this could also apply to other forms of discriminations where all objects within the category share a general resemblance. This paper will explore evidence in support of each view and examine whether they may be reconcilable.

A large body of evidence exists in support of the notion that face perception is an isolated, holistic process (Sergent & Signoret, 1992; Tanaka & Farah, 1993; Yin, 1969). Researchers have examined whether face perception occurs in a different manner than object perception, as this would suggest that they involve separate mechanisms (Tanaka & Farah, 1993). In a study conducted by Yin (1969), participants studied images of faces and objects. They were then shown upside down

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versions of the images they had studied, as well as new images, and were asked to identify which images they had seen before. Participants had more difficulty recognizing inverted faces than other inverted objects (Yin, 1969). This suggests that face perception and object perception are processed differently, as more time was required for face perception than object perception. Similarly, Tanaka and Farah (1993) found that people are better at identifying facial parts when a whole face is presented compared to when facial parts are presented in isolation. When viewing images of objects, no advantage was shown for identifying parts in a whole image compared to in isolation (Tanaka & Farah, 1993). The differences observed between face and object perceptions suggest that face perception is more holistic than object perception, which implies that the two are not processed in the same manner.

Further evidence for the theory that face perception is an isolated process originates from agnosias, which are disorders in visual perception. Patients with prosopagnosia, a cognitive disorder characterized by the inability to recognize faces, still have seemingly intact object recognition (Sergent & Signoret, 1992). The opposite phenomenon was observed in a patient named C.K., who has visual object agnosia and cannot recognize objects, yet has intact face perception (Moscovitch, Winocur, & Behrmann, 1997). Notably, Moscovitch and colleagues (1997) found that Patient C.K. was able to recognize a face when it was comprised of objects but could rarely identify the contents of its composition. This finding reinforces that Patient C.K.’s face perceptual processes are intact despite his lack of object perception. Evidence of intact face perception in the absence of object perception, as well as the reverse, supports the theory that face perception is an isolated process from object perception.

The theory that face perception was an isolated process led to the discovery of the FFA, which is thought to be the site where face perception takes place (Kanwisher et al., 1997). Using an fMRI, Kanwisher et al. (1997) observed that an area in the brain (now termed the FFA) was more active when presented with face stimuli than with assorted objects. By identifying an isolated cortical region that responds maximally to face stimuli and not object stimuli, Kanwisher et al.’s (1997) research suggests that faces are perceived separately from objects.

The causal relationship between the FFA and face perception was tested by Schalk and colleagues (2017) by electrically stimulating the FFA in a patient with electrodes already implanted. When the FFA was directly stimulated, visions of illusory faces appeared superimposed atop of objects in the patient’s visual field (Schalk et al., 2017). Since the face visions were a direct outcome of FFA stimulation, it may be inferred that they are causally related. This further supports the theory that the FFA specializes in face perception. However, it is possible that FFA stimulation may produce other visions when stimulated under different conditions, and further supportive evidence is needed before it can be concluded that there is a causal relationship between the FFA and face visions.

Additionally, in patients with Williams syndrome, which is characterized by extreme fascination with faces, the FFA is twice as large as in typically developed controls, both in absolute size and relative to the fusiform gyrus (Golarai et al., 2010). This suggests that the symptom of facial fascination may be related to the increase in FFA cortex, which reinforces the belief that face perception occurs in the FFA.

However, many researchers argue that the FFA does not solely process faces, and more broadly specializes in differentiating between stimuli in a homologous category (Bilalić, 2016; Gauthier et al., 1999). This theory is referred to
as the expertise hypothesis (Gauthier et al., 1999). Evidence suggests that when expertise is acquired in a domain, the FFA is recruited to make within-category distinctions of items in that domain (Gauthier et al., 1999). To acquire expertise in a domain, an individual must acquire considerably more skill in distinguishing between objects in that domain than a novice (Gauthier et al., 1999). Proponents of the expertise hypothesis suggest that the FFA only appears to specialize in faces because humans have been distinguishing between faces since infancy and can be viewed as experts in this domain (Damon, Quinn, Heron-Delaney, Lee, & Pascalis, 2016). According to this hypothesis, if people are shown objects on which they have visual expertise, they should be using their FFAs to process these objects, even if they are not faces (Gauthier et al., 1999).

In support of this hypothesis, Gauthier et al. (1999) conducted an experiment where participants were divided into two groups, labeled experts and novices, and were shown images of faces and novel abstract shapes called Greebles. Prior to this task, the researchers taught the expert group to differentiate between Greebles, while the novice group had no exposure to Greebles. When the expert group viewed either faces or Greebles, their FFAs were activated, whereas the FFAs in the novice group were only activated when viewing faces (Gauthier et al., 1999). It was concluded that the FFA could process entities other than faces once a certain level of expertise was attained (Gauthier et al., 1999). Thus, past studies’ findings of FFA activation only when faces were presented may have resulted from participants’ lack of expertise with the object stimuli.

However, Greebles are visually similar to faces, and Kanwisher (2000) proposed that FFA activation was observed because the FFA was processing Greebles as if they were faces. Even though Greebles are visually similar to faces, Kanwisher’s (2000) proposal does not account for the lack of FFA activation in novices, and later research supported Gauthier and colleagues’ (1999) conclusion that the FFA may process any stimuli where expertise is acquired. Additional research revealed FFA activation is also present in experts viewing stimuli with no resemblance to faces, such as chess masters viewing chess boards and radiologists viewing X-rays, which supports the expertise hypothesis (Bilalić, 2016; Bilalić, Grottenthaler, Nägele, & Lindig, 2016). Taken together, these studies show that FFA activation occurs when differentiating between objects in a domain of expertise (Bilalić, 2016; Bilalić et al., 2016).

Since numerous researchers have found results in support of both hypotheses, this suggests that the two hypotheses are reconcilable. It is possible that face and expertise processing reside in nearby yet distinct cortical regions. Research has indicated that the BOLD signal detected on fMRI in previous studies may have been misattributed to the FFA. It is possible that the BOLD signal may have instead occurred in a nearby cortical region that was too close for the fMRI to detect a difference in location (Rhodes, Byatt, Michie, & Puce, 2004). In a study conducted by Barton (2008), patients with prosopagnosia were asked to make within-category identifications of faces and food, which can be considered domains of expertise since most people have frequent exposure to both stimuli. Results indicated that most patients were unable to discriminate between faces and between foods (Barton, 2008). However, one patient, whose lesion was the most localized in the FFA, was able to discriminate between food and not faces (Barton, 2008). Since the patient with the most localized lesion could not perceive differences between faces but could make other within-category discriminations, there may be a cortical region specific to perceiving faces close to
another cortical region specific to perceiving objects of expertise. Similarly, in a study conducted by Rhodes and colleagues (2004), when butterfly and moth experts viewed faces, butterflies, and moths, different cortical regions were activated. Both areas of activation were within the same region of the fusiform gyrus and contained some overlap, but were considered separate areas overall, with the FFA responding stronger to face stimuli (Rhodes et al., 2004). Taken together, these results suggest that there are separate but proximate areas of the fusiform gyrus for face perception and for the perception of objects of expertise. It seems plausible that the boundaries of the FFA are narrower than previously thought, and past studies that found other within-category discriminations in the current boundaries of the FFA misattributed the functions of two distinct cortical regions to one region. If future research supports these findings, this could account for the mixed evidence in the current body of literature that supports both an isolated area for face perception and the expertise hypothesis.

**Conclusions and Future Directions**

It is possible that a specialized cortical region for face perception exists proximate to a cortical region that specializes in expert stimuli perception. It appears likely that face perception has its own specialized cortical region, as a large body of evidence supports the theory of an isolated process for face perception (Schalk et al., 2017; Yin, 1969). Although past literature has supported the expertise hypothesis, it is possible that objects in homologous categories are processed in a nearby cortical region and results in support of the expertise hypothesis may have been misattributed to the FFA (Bilalić, 2016; Rhodes et al., 2004). However, more research is necessary to investigate which hypotheses are correct and whether they may be reconciled.

As neuroimaging techniques become more sophisticated, future research should be conducted to determine whether the previously hypothesized margins of the FFA include a region that processes other within-category objects in addition to a region that processes faces. Future research could also benefit from investigating other possible explanations as to why mixed evidence exists in support of the competing hypotheses. As well, future research should investigate the extent to which other cortical regions play a role in face perception and the perception of objects with expertise.

**References**


