Understanding the Encyclical Letter Lumen Fidei from a Visual Neuroscience Perspective: Can Faith Alter Perception?

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Abstract

The papal encyclical *Lumen Fidei* (the Light of Faith) discusses faith in the metaphoric context of a light that illuminates every aspect of human existence implying the transformation of perception. This paper explores the validity of this metaphor from the perspective of visual neuroscience. Can faith alter visual perception? The visual neuroscience literature describes the influence of higher-order cognition on visual perception indicating that we perceive the world in terms of our existing semantic knowledge. The outcome of studies involving culture and religion suggest that cultural traditions and religious perspectives do indeed have a direct influence on visual processing. The validation of the metaphor is theologically relevant because it contextualizes faith in ordinary human experience.

Keywords: Catholic faith, religion, neuroscience, visual system, Lumen Fidei

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During the Easter Vigil, the most solemn celebration in the liturgical year, the deacon leads the entrance procession carrying a large-sized paschal candle. The temple is in darkness. The procession stops three times as the deacon sings loudly: "Light of Christ." The proclamation is, of course, a reference to the resurrected Christ, visually represented in the candle's dancing flame. The profound meaning of this ancient Christian ritual is that a relationship with God through Christ affects perception just like light affects visual perception.

The articulation of religious experiences is characteristically metaphorical. Metaphors, in the religious context, are analogical approximations that allow conveying a deeper meaning of a spiritual experience that would otherwise be difficult or perhaps impossible to communicate. Naturally, the light of Christ is a metaphor. At the same time, the light metaphor is particularly apt for it captures well a core aspect of human religious experience: the transformation of perception.

The idea that faith is a transformative light that produces a particular way of perceiving the world is well articulated in the encyclical letter *Lumen Fidei*. This papal letter was written by Pope Benedict XVI and published, with minor revisions, by Pope Francis at the beginning of his pontificate (Francis, 2013, section 7). The title, which following a well-established tradition, consists of the first two words of the document in Latin, mean "The Light of Faith." Consistent with its title, one of the main tenets of this church document is that the light born out of faith (understood as an encounter with God) is "a light which touches us at the core of our being and engages our minds, wills and emotions, opening us to relationships lived in communion (Francis, 2013, section 40).

Accordingly, the authentic encounter with God is understood as triggering a transformative process of "sharing in Jesus' way of seeing things" (Francis, 2013, section 19). This life-long process of μετανοῖεν (Greek *metanoia*, mind transformation) that engages "the entire person, body and spirit, interior life and relationships with others" (Francis, 2013, section 40) is not confined to religious things but rather permeates life as a whole. The "light of faith is unique, since it is capable of illuminating every aspect of human existence (Francis, 2013, section 4).

Is the change in world perception that according to *Lumen Fidei* is produced by the light of faith descriptive as well of physiological visual processing, or is it just a metaphorical way of speaking unrelated to empirical experience? The goal of this paper is to explore the contention that the light of faith metaphor emerges from a physiological phenomenon: the effect of faith on perceptual attention, categorization, and memory storage of perception.

Visual Perception

The processing of visual information in the human brain happens through hierarchical sequences involving discrete functionally-specialized cortical areas (Grill-Spector & Malach, 2004). Refracted light projects into the eye's retina where photoreceptor cells transduce it into electrical signals. The signals travel through the optical nerve mostly to the lateral geniculate nucleus (LGN) in the thalamus. The LGN forwards most of these signals to the primary visual cortex (also known as visual area 1 or V1) in the occipital lobe. V1 neurons form a precise retinotopic map of the image in the retina through highly-tuned receptive fields. In other words, individual V1 neurons respond (fire action potentials) to a small set of stimuli such as contrast and orientation.

The gradual progression of the visual signal from V1 forward is divided into two pathways or streams known as the dorsal and ventral pathways because of their location in the brain. The dorsal pathway extends forward from V1 into the parietal lobe and is involved in spatial processing including object location and visually-guided action. The ventral pathway extends forward from V1 to extrastriate areas (V2, and V4), and to different areas in the inferior temporal lobe. The ventral stream processes object and form recognition.

This bottom-up processing of visual signals begins to reveal how perception requires cognitive construction. Perceptual sensations are processed in a distributed system that somehow must be bound together into the cohesive precept that is consciously perceived (Robertson, 2003). Take for example the perception of faces which involves different areas in both the dorsal and ventral pathways. The dorsal stream processes face movements through the posterior superior temporal sulcus while the ventral pathway processes invariant facial features necessary for facial identification in the fusiform face area (Bernstein & Yovel, 2015). Yet, our conscious perception is unified (i.e., that's John walking across the room).

Even when it seems that only a single pathway is involved in a particular visual processing, visual signals are still distributed throughout functionally specialized areas like the parahippocampal place area for coding landscapes, the extrastriate body area which is involved in perceiving body parts, and the lateral occipital complex that processes the shape of abstract objects (Kanwisher & Dilks, 2013). The eventual integration of these separate processes in higher-order visual areas requires not only a hierarchical, bottom-up, feedforward process but also feedback from higher cortical areas and even horizontal exchange of visual information at the same hierarchical level throughout the process (Kornblith & Tsao, 2017; Lamme & Roelfsema, 2000).

In other words, the progressively more complex feedforward representations of the visual scene depend on top-down feedback from higher-order areas (Gilbert & Li, 2013). These top-down feedback signals are related to attention, expectations, memories and motor commands relevant to the task and behavioral context. The resulting effect is that feedforward signals "convey different meanings about the same visual scene according to the behavioral context" (Gilbert & Li, 2013, p. 350) because of feedback input.

The top-down feedback signals affect every step of the feedforward process, including early visual cortex, in order to infer or make sense of the incoming sensory information (Guo et al, 2007). For instance, the tuning of V1 neurons, modulated by top-down feedback, not only respond to local features in the external visual field, but project inferred probabilities onto the world by encoding signals according to information accumulated from experience. The subjective sense of perception is the result of both external stimuli and feedback from higher-order areas involving memory, attention, and expectations.

Concept cells are a good example of memory interaction with visual perception and how the brain constructs meaning from "relative little, noisy and ambiguous sensory information" **(**Quian Quiroga, 2016, p. 227). The hierarchical visual processing in the ventral pathway ends in the inferotemporal cortex which is involved in the identification of faces and objects. The inferotemporal cortex is connected to the medial temporal lobe (MTL), a brain area extensively implicated in long-term memory and that includes memory-related neural structures like the hippocampus as well as the perirhinal, parahippocampal, and entorhinal neocortical regions.

Quiroga (2016) and his team found that populations of cells in the medial temporal lobe fire together to represent memory-based concepts in response to visual stimuli. Interestingly, these sparse assemblies of neurons show a very high level of visual and multimodal invariance.

This means that concept cells respond to people, places, and objects as concepts rather than to specific visual features. For example, seeing a picture of a known person, independently of view angle or time scale (a ten year old picture or a recent one), hearing the person's name, or seeing it in writing, all seem to elicit the same neural response in the MTL cell population that represents the concept of that specific person.

Concept cells not only respond to specific persons, places, and objects but the same cells also respond to other concepts associated with those same persons, places, and objects. For example, concept cells that fire to a particular person may also fire to a place that is conceptually associated with that person or to other people who are meaningfully related in some way to that person. These associations are encoded in MTL by the partial overlapping of discrete populations of neurons. According to this model, the overlapping assemblies in MTL are not a representation of the full memory but an index to episodic and semantic memories stored in other parts of the brain. Other processes and neural structures (i.e., the angular gyrus) are implicated in processing and integrating these memories details (Bonnici, Richter, Yazar & Simons, 2016).

The firing of concept cells and related associations are contingent on the relevancy of the stimuli to the individual perceiver. In other words, the influence of higher-order cognition on visual perception implies that we perceive the world in terms of our existing semantic knowledge. Unlike a video recorder that captures and stores signals as they come, human perceptions are processed, stored and recalled according to their personal meaning. These meanings are personal but, at the same time, are culturally shared because of common experiences and language. In other words, because of the close relationship among language, semantic knowledge, and visual processing (Perry & Lupyan, 2017) as well as the close

relationship between language and categorical perception (Collins & Olson, 2014) humans share in common culturally-bound perceptions of the world.

For instance, a study by Nisbett & Miyamoto (2005) found chronic differences in perceptual processing between people from Western and Eastern cultures. People in Western cultures tend to focus perceptual attention on salient objects independently from their context. On the other hand, in Eastern cultures people tend to attend to the object's context and its relation to it. Accordingly, this culturally-influenced holistic versus analytic processing of perception not only affects perceptual attention, but it affects categorization, eye movement, labeling syntax, and memory.

Faith and Culture

There is a very close relationship between faith and culture because human life and culture are inherently connected (Paul VI, 1965, section 53). In fact, the church understands its fundamental mission as a call for the profound evangelization of human culture (Paul VI, 1975, section 20). Faith is about the constant transformative encounter with God in the praxis of daily life (Francis, 2013, section 51). It is a way of being in the world with others. It is inherently other-oriented, community-based. "Being Christian is not the result of an ethical choice or a lofty idea, but the encounter with an event, a person, which gives life a new horizon and a decisive direction" (Benedict XVI, 2005, section 1). The encounter with God is personal but it is at the same time conditioned to the love of neighbor (Benedict XVI, 2005, section 16). Consequently, it is culturally bound. God chose the people of Israel as a group, as a people. Salvation is a "social" reality (Benedict XVI, 2007, section 14).

Clifford Geertz's (1973) classical definition of culture emphasizes its semeiotical character as a "historically transmitted pattern of meanings embodied in symbols" that humans

use “to communicate, perpetuate, and develop their knowledge about and attitudes toward life” (Geertz, 1973, p. 89). Geertz’s interpretative approach to the understanding of culture seeks to discover “the meanings at play in human social life through a hermeneutical reading of the symbolic mediations of meaning” (Koning, 2010). The culturally-shared meanings happen at all levels, from relationships in a very small group to the universal symbols and meanings shared by the whole of humanity. The evangelization of culture means to imbue these shared meanings at all levels with the attitudes, values, criteria, and priorities that happen as a result of perceiving the world informed by the attitudes, values, criteria, and priorities found in the Gospel.

Faith and Visual Processing

Hommel & Colzato (2010), noticing the similarity between religion and culture as systems of shared beliefs, values, rituals, and behaviors, reasoned that if culture affects perception, religion may as well. Indeed, faith-informed semantic knowledge, like other types of semantic knowledge (Collins & Olson, 2014), influences visual processing, as several of their studies confirm. For instance, the outcome of one study comparing Dutch neo-Calvinists and atheists, suggests that religious beliefs systematically bias attentional processing of global and local features of complex visual stimuli (Colzato, van den Wildenberg, & Hommel, 2008). The study design is founded on research that suggests that, in general, humans show an attentional preference for global rather than local shapes of multilevel stimuli. However, in this case, they found that the neo-Calvinists, influenced by the theologically-based concept of sphere sovereignty that emphasizes individual responsibility, showed a much less pronounced global precedence effect than atheist in the Netherlands.

In a second study reported in the same paper, Colzato et al. (2010) compared Roman Catholics in Italy and Orthodox Jews in Israel against non-religious people in those countries.

They found a significantly increased global preference effect in both of these religious groups compared to the non-religious participants. They attribute the stronger emphasis of global features in the visual processing of events to the fact that both Catholicism and Judaism emphasize social solidarity. They also found that the effect persisted for many years among baptized people who stopped practicing their faith.

Conclusion

Lumen Fidei's assertion that faith produces a light that affects perception of the world is obviously not founded on visual processing research. It is a metaphor that originates in the experience of faith itself: the relationship with God through Christ transforms perspectives, worldviews, and the perception of self and others throughout the life-long process of metanoia. Visual neuroscience just validates the metaphor. This validation is theologically important because it places faith in the context of ordinary human experience which is the locus of encounter with God. The effect of faith-informed semantic knowledge is not a special case of how people attend to and process visual events. It is just an integral part of human experience.

A future project for investigating the relationship between religious metaphors and visual processing may focus on the angular gyrus. The angular gyrus is implicated in processing metaphors, memory retrieval, attention control, and theory of mind (Bonnici, Richter, Yazar, & Simons, 2016; Cheke, Simons, Bonnici, & FitzGerald, 2018). Oftentimes, the neuroscience literature lacks a more specialized theological insight on religion. Future research involving religion and neuroscience may also benefit from greater interdisciplinary dialogue with theology.

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