

**Eye gaze information processing theory: A case study in primate cognitive neuroethology**  
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**Cognitive Neuroethology of Eye Gaze Information Processing Theory (EGIPT)**

The eyes of others represent an important social cue for humans and other animals; a cue that is often used to support inferences about the mental states of those whose eyes we observe. Is she *paying attention* to what I'm saying? Does he *know* that I was just smiling at his predicament? Does this person *find me attractive*? One important clue for answering such questions can be found in paying attention to where eye gaze has been directed. In essence, we use eyes to read minds.

This is not a new or startling observation; Da Vinci noted it centuries ago when he wrote that the eyes are the "windows to the soul." This commonplace observation generates a number of interesting questions in a variety of different areas of inquiry. *Philosophy*: What do we really learn from observing eyes? Can we ever be certain that our mental attributions are correct? *Neurobiology*: What brain mechanisms are at play when we perceive eyes and draw inferences about them? *Ethology*: What are the relevant eye gaze behaviors and how do they relate to the life of the organism? For example, what is the relationship between eye gaze behavior and social hierarchy? Or, how is it used to facilitate turn taking during conversation? *Evolutionary and comparative biology*: How did this capacity evolve? How do human skills with eyes relate to those of other animals? Do canids or non-human apes, say, draw similar inferences from eye gaze as we do? Finally, all of these questions are related to the concerns of *cognitive ethology*. How do animals use the eye gaze behavior of other organisms to reason about their unseen mental attitudes? For lack of a better term or acronym, I refer to our scientific understanding of the capacity to process information about mental states from the eye gaze behavior of other organisms as "eye gaze information processing theory" ("EGIPT," for short).

Eye gaze phenomena come in a variety of forms (Argyle and Cook 1976). We *follow gaze* when we look at the eyes of another and then gaze in the direction they are looking, usually to see what they are looking at. *Mutual gaze* is when two individuals look each other in the eye; that is they make "eye contact." There also seems to be an important difference between looking *at* another's eyes and looking *into* those eyes. (Consider the difference between a lover gazing into your eyes and your ophthalmologist doing the same thing.) *Gaze avoidance* is the behavior of avoiding making eye contact with another. Some cultures single out certain eye gaze phenomena as socially significant, such as the phenomenon of the "evil eye." Finally, not all eye-gaze reading requires making inferences about the *mental states* of others. It is possible to follow the gaze of another without also thinking about the other in mental terms; so, we often need to be careful to rule out simpler, non-mentalistic mechanisms when comparing the eye gaze perception of other animals to our own. Just because they seem as though they are doing the same thing as we are does not mean that they are in fact doing so.

My particular theoretical orientation is best described as "cognitive neuroethology." I see cognitive neuroethology as the natural synthesis of the recent flowering of interest in the mental lives of animals represented by cognitive ethology with the traditional concerns of neuroethology. Neuroethology is the branch of biology that attempts to elucidate the evolutionary and neurobiological basis of naturally occurring animal behavior (Ewert 1980; Camhi 1984). In other words, neuroethologists first attempt to identify natural behaviors and perceptual capacities in organisms and then investigate (1) how the nervous systems of those animals mediate those behaviors and capacities, and (2) how both the behavior and the brain mechanisms have *evolved*. ("Natural" in this context is meant to distinguish those behaviors that animals *in fact* perform in their native environments from those an organism can be induced to perform under artificial, laboratory conditions.)

Just as neuroethology was a natural outgrowth and addition to the science of ethology,