

WHAT IS A TRUSTWORTHY FACE?

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Introduction

One of the problems whose urgency straddles many disciplines – from evolutionary ecology and the neurosciences to cognitive psychology and economics – is how brains come to decisions. Recent developments in theoretical thinking and empirical investigations show that most decisions are reached quickly on the basis of incomplete information. Neuroeconomics [Note 1] claims that probabilism and game theory rather than step by step rational inferencing rule perception and behavior (e.g., Glimcher 2003). The evolution of neuronal systems that take short-cuts to anticipate information and risk behaving in a manner that is only probably adaptive makes sense in view of the fact that time is of the essence when it comes to survival. Delays in reacting will most of the time lead to failure or even death whereas instant reactions that bet on a positive outcome in view of limited information can be statistically more adaptive. Perceptual illusions are well documented (e.g., Hoffman 1998) and the early ethologists (e.g., Lorenz 1978) showed again and again how animal behavior can be effectively triggered by incomplete but selective information, a knowledge that had been pragmatically acquired long ago by hunters and fishermen. Evolutionary biology and evolutionary ecology (e.g., Rubenstein and Wrangham 1986) have made it possible to further theorize the process of decision making, and data provided by the cognitive neurosciences have fostered models that felicitously, albeit controversially, integrate partial advances achieved in these various disciplines (e.g., Gigerenzer and Selten 2001). Behaving in a particular manner in a particular situation rests upon the trust that the information available is correctly extrapolated. But since time constraints considerably limit the amount of information available, brains must gamble, so to speak, on a particular outcome that is, in the shorter or longer term, their own survival. This process is at the root of the evolution and development of semiotic processes, that is, the emergence of adaptive behavior to increasingly limited information. As it pays off to be fast, shorter and shorter short-cuts are bound to evolve. The conceptual framework for such a perspective on semiotic processes is what contemporary evolutionary biologists call an “arms race” (e.g., Dawkins 1986). The capacity to behave adaptively on the basis of scant information is indeed a marked advantage. But an opportunistic adaptive response to such a competence is to evolve deceptive strategies whose cost-effectiveness corresponds to the reduced information basis of the decision making process of the competitors, in intra-specific or inter-specific contexts. Another adaptive strategy is to confuse competitors through the encryption of signals (e.g., Baker 2001), thus further increasing the ambiguity of the information available.

Friend or Foe?

The most basic decision that an organism must reach is to determine whether another organism is friend or foe, prey or predator. No organism can afford a lengthy processing of multimodal information before taking the best course of action. This is,

however, a major challenge because so many deceptive strategies have evolved. Camouflage as well as the exploitation of other semiotic resources such as the loudness of acoustic signaling, have been thoroughly documented by evolutionary biologists. But the most interesting research, from the point of view of this conference, is undoubtedly the investigation of intra-specific communication in social species. Groups of chimpanzees (e.g., de Waal 1989), baboons (e.g., Kummer 1995) and macaques (Zeller), for instance, have been systematically observed over long periods of time and their social interactions have been described on the micro-analytical level. The dynamic of approaching or avoiding, grooming or aggressing, mating or chasing away, cooperating or competing, forms a continuous social dynamic made of tensions and attractions and implying a high degree of anticipation in the processing of information concerning moods and intentions. All these processes can be heuristically reduced to an on-going mutual assessment of how trustworthy are individuals, based on past history, knowledge of mutual relationships holding between members of the group, as well as some hardwired behaviors such as those which were called “innate releasing mechanisms” by the founders of ethology (Lorenz 1978).

The Primate Face

The face of mammals is not only the part of the body that takes in energy and information, but also the display board on which identity, moods and intentions are read by con-specifics. Acoustic information is also usually produced through the nose and mouth area, but visual information is what counts most within a safe interactive distance. The face of primates is particularly rich in identity features and neuromuscular resources. So crucial is the identification of individuals in primate societies that specialized circuits and modules on the brain have evolved to specifically handle facial information. So much vital information is available on the face that it is the part of the body which is the most constantly monitored and scrutinized during on-going social interactions within a group or during encounters with strangers, with particular attention paid to the eyes as recent monitoring of the parsing of the face has shown [*Journal of Vision* 5, 1 (58-70)].

Humans, of course, are no exception. Close social interactions have been labeled “face-to-face communication”, and it is well known that facial appearance and behavior are the object of intense attention and care in all human cultures. However, the challenge of deciphering human faces comes from the fact that in addition to the hard-wired system of emotional displays, cultural inputs can modify the management of those neuromuscular resources that are under voluntary control and artificial modifications can be introduced in the form of mutilations, make-up and partial or total masking.

Students of the semiotic resources of the human face have focused on variously motile areas such as the eyebrows or the mouth and the dynamic configurations they form. Less attention has been paid to the chromatic contrast created by the white of the eyes and the teeth against the background of the surrounding dermal areas and the distinctive morphologies they create. Let us call the particular information produced by such contrasts the “leuco-signals” (from the Greek *leukos* = brilliant white). The hypothesis presented by this paper is that the leuco-signals play a crucial part in the ascription of various degrees of trustworthiness to the face in human interactions.

What is a Trustworthy Face?

The first information provided by a face is whether an individual's identity is known or unknown. If known, then the past experience associated with this individual will determine an appropriate course of action, or, at least, a course of action that is congruent with the memories that past interactions have left. If unknown, the face will tell the sex, age, ethnicity, particular features and current mood of this individual. Some first encounters are engaging, other ones are unsettling. The first information provided by a face can be ambiguous and create uncertainty or mistrust, and will require further information to be elicited during a testing period of time. But some other times there is an immediate feeling of trust and, in urban settings which abound in opportunities of meeting strangers, as well as through surfing the internet, many humans have fallen victims of such "trust at first sight". But "trust at first sight" is not necessarily misplaced. The hypothesis of this paper is that evolution has provided the human primate with a toolkit of trust assessment that is both fast and robust but operates by default, that is, by using an algorithm of the following form: if not *a, b, c, n...* then trust". The reason for which this form seems preferable to its converse (do not trust, unless *a, b, c, n...*) will be specified later.

A condition for such a fast and robust algorithm to be adaptive is that information must be as unambiguous as possible, that is, be of a binary nature and based on a maximal contrast. This is why it makes sense to look first at the leuco-signals as a source of such crucial information. The white of the sclera and the teeth maximizes the reflectance of light and can be perceived even in poor luminosity at a distance that is adaptive, that is, which allows time for avoidance or confrontation. An interesting example of a similar use of this chromatic resource is found at least in another species, *Panthera tigris* (e.g., McDougal 1977). Tigers have indeed a white tuft of hair on the back of their ears and flash leuco-signals by twisting their ears towards the front in order to warn off conspecifics whenever there is a danger of confrontation if the distance between them is further reduced.

Seeing the white part of the human face is the condition for being able to further decode the intention of a stranger, that is, to assess whether the patterns formed by contrast with the darker parts of the face yield crucial information on the mood and intention of this stranger. The visibility of the sclera provides information about the direction of the gaze, and the visibility of the teeth is a reliable indicator of tenseness or relaxation, friendliness or aggressiveness.

Trust and the Anticipation of Reward: A Falsifiable Hypothesis

Recent experiments in game theory, in which the interacting players' brains are monitored through non-invasive neuro-imaging, have shown that the anticipation of reward when they trust their partners in view of past behavior correlates with the activation of a well-defined area (Miller 2005; King-Casas et al. 2005). It is possible to extrapolate from these experiments an understanding of trust as an anticipation of reward that neutralizes the risk of loss in a transaction or significantly reduces the odds that the outcome will be negative. The bundle of information provided by the human face can be heuristically assessed in view of these experiments on several grounds. First, the

recognition of the identity of an individual comes with the past history of the transactions one has experienced with this particular individual. In addition, the congruence of this individual's facial expressions with one's expectation indicates the stability of the mood and intention that can be relied on in further transactions. Secondly, in the case of a new encounter with an individual who must be assessed on the spot, the facial expression as it is perceivable from a functional distance yields sufficient information based on the leuco-signals: degree of openness of the eyes with unambiguous disclosure of the focus of attention as it is indicated by the direction of the gaze, and degree of relaxation of the mouth with baring of the upper teeth which reveals a non aggressive approach. If, in a first encounter, no leuco-signals are displayed, there may be a risk of confrontation or at least a situation characterized by uncertainty triggering "instinctive" mistrust. A markedly aggressive mood is indicated by the baring of the lower teeth, a display that is more likely to be a warning or bluffing sign than a preparatory gesture toward attack.

There are, of course, other features in the human face which help assess the moods and intentions of the interactants. But these features can be analyzed properly only at close range and if enough scanning time is available. The adaptive advantage of the leuco-signals is that they are salient at a distance with respect to the perceptual apparatus of *Homo sapiens* that is probably grounded in the natural selections which molded very early hominins when they adapted to the relatively open space of savannah habitats and adopted a hunting nomadic way of life which increases the probability of chance encounters. It may be relevant to observe here that exposure to sunlight favor both the production of vitamin D which is responsible for the enhanced whiteness of the teeth as well as the level of melanin in the skin, thus producing well defined patterns.

These tentative considerations could lead to precise empirical investigations of the role of the leuco-signals in anticipating the rewards which come with cooperation. In view of the experiments reported by Brooks King-Casas et al. (2005), the degree of trustworthiness of faces could be tested by varying the saliency and morphologies of the white configurations produced by the neuro-muscular control of the human face. Whether or not the attribution of trust correlates proportionally with varying leuco-signals can be given the form of a falsifiable hypothesis. A first, more intuitive, impressionistic investigation could consist in systematically paying attention to the amount and form of sclera and dental whiteness flashed by personalities in televised interactions. It probably would show that leuco-signals nicely correlate more than any other facial features with degrees of charisma and trustworthiness.

Concluding remarks.

Civility starts with sociality. All social species have evolved ways of monitoring moods and intentions within groups of related individuals and, as de Waal (1989) has shown, ways of defusing tensions and resolving conflicts while minimizing the costs involved. Hence the tendency toward ritualizing interactive behavior. Reading the face of conspecifics is an essential source of information for adjusting to situations and behaving appropriately. Reading fast confers a marked advantage. Conversely, managing facial expression is a crucial part of civil proficiency. A large proportion of the neuromuscular systems that make up the human face are under voluntary control, or can be brought under such control by cultural or professional training. This, of course, opens the way to

deception. The smile, with its characteristic flashes of leuco-signals, is one of the tools of civility and has been extensively studied both physiologically and culturally (e.g., Ekman and Friesen 1982 ; Fridlund 1994; Trumble 2004). But there are also in the human face cues that cannot be so easily controlled. Whether we truly trust a face or not may depend on these cues, such as the leuco-signals. Can the knowledge of these “leakages” help make better decisions? Probably not, since our brains seem to have evolved fast and robust decision making processes which are only statistically adaptive. On the other hand, occasional failures of judgment regarding the trustworthiness of a face may be the price we have to pay for an otherwise efficient tool of civility.

Notes:

1. Neuroeconomics is a new paradigm which is emerging at the interface of economics, game theory and the cognitive neurosciences. It may be defined as a transversal field of study that takes the form of interdisciplinary research programs that attempt to build biological models of decision making in economic environments. In this working definition, “economic environment” may be taken in the restricted sense it has in industrial or post-industrial contexts, or it may be extended to the exploitation and management of resources in the more general perspective of evolutionary biology and ecology. It overlaps to some extent with psychological research on motivation, the investigation of real time neural activities, and experimental economics. Neuroeconomics endeavors to bridge the theoretical gap between research on human choice behavior in the cognitive neurosciences and economic theory. Ultimately, it tries to understand the neural basis of judgment and decision making, social behavior and market economies. Several conferences have been devoted to the exploration of this new field in 2004 and 2005. Labs and study groups devoted to this research are found at Stanford University, New York University, the University of Muenster and Hong Kong University. Courses in neuroeconomics are taught at Stanford, Caltech, and George Mason University. Many individual researchers conduct research in this domain in their respective institutions. Further information and bibliographical references can be found at <http://www.richard.peterson.net/Neuroeconomics.htm> and at <http://www.swartzneuro.org/brains-rewards-2003.asp>
2. The ways in which masks and make-up transform or enhance some features of the human face provide crucial information on the semiotic system that regulates face-to-face interactions. I have conducted a comparative research on the artificial use of white patterns in the make-up of performers in several cultures. Typically, negative personas tend to entirely whiten their face so as to neutralize the possibility of perceiving a clear contrast between the sclera, teeth and facial skin. The reading of their leuco-signals is much reduced. On the contrary, positive characters who tend to be liked and trusted use white patches for enhancing the eyes and mouth areas of their face, thus producing an effect of permanent, unflinching leuco-signals (Bouissac 1999, 2001).

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