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binary oppositions, such as political/criminal, legal/illegal, and good /bad. The role of ideology mediating both the perpetration of terrorist acts and the evaluation of such acts may also produce occasions for self-deception.

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**See Also:** Audience; Bush, George W.; Central Intelligence Agency, U.S.; Clausewitz, Carl von; Communication; Defense Academy for Credibility Assessment; Department of Defense, U.S.; Disasters; Disinformation; Espionage and Counterespionage; Government Propaganda; Iraq War; Language; Middle East; News Media: Print; Self-Deception; Sun Tzu; Torture.

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## Theory of Mind

Researchers have argued that a central cognitive process of deception is the ability to consider and make inferences about the mental states of others, including the beliefs, intentions, and knowledge that another may possess. Such an ability is commonly referred to as a "theory of mind." In having a theory of mind, others' mental states have causal consequences on one's own thinking and behavior; in turn, others' mental states can be directly influenced. This distinction between what one and another know allows deceivers to elicit false realities in the minds of others. However, such explicit mental state reasoning may also enact considerable cognitive costs. Given the ease in which people lie, and the real-time demands of communication, an explicit monitoring of what another knows, or is likely to believe, may be unnecessarily demanding for a liar. Very young children and nonhuman animals are capable of misleading behavior despite the lack of sophisticated mental state reasoning capabilities. Thus, deception may only require a more implicit form of belief reasoning that involves simple belief attributions and perspective taking. Consideration will be given to this relationship between deception and theory of mind by touching on issues in evolutionary theory, cognitive development, and adult social interactions.

#### Evolutionary Emergence

Strategic deception is uniquely human, insofar that other species are thought to lack the capacity to model the mental states of conspecifics. Nevertheless, some nonhuman primates and birds (for example, corvids) have been documented as engaging in tactical forms of deception. The nature of such deception mostly involves information concealment rather than actively attempting to instill false beliefs in another. For example, corvids routinely cache (hide) food in one location in the presence of a competitor and will then recache in a new location when the competitor has moved. Such forms of deception suggest a sophisticated ability to navigate complex social environments and seem to require an understanding that, at the very least, others have unique visual perspectives and goals. It has been suggested that such actions correspond to precursors for theory

of mind reasoning, but others caution that such findings only demonstrate learned behavioral contingencies or rudimentary social reasoning and, as such, do not warrant claims of explicit mental state awareness.

### Developmental Considerations

The area in which deception and theory of mind has been most widely explored is that of child development. A great deal of focus has been on whether children's emerging propensities for deception, as well as the complexity of their lies, are related to their development of theory of mind. Existing evidence suggests that children's ability to engage in deception is directly related to the degree to which they understand that others are able to see something they cannot see (first level), to understanding the thoughts of others and possible inferences that can be drawn from this understanding (second level).

To evaluate various levels of belief reasoning, researchers typically employ tasks that examine children's abilities to attribute false beliefs to another. A common example is with an "unexpected change" scenario. Children are given a story in which a character witnesses an object being placed in a box. This person leaves the room, at which time the object is switched to a new location. When the main character reenters the room, children are asked where they think the person will go to retrieve the object. If a child understands that the person has a false belief about the object's location (because the person was absent when the object was switched), the child should indicate the original location. Many versions of this and similar tasks have been developed, varying in terms of the memory and language demands needed to complete the task, as well as the complexity of the mental states that need to be considered.

Studies suggest that over the course of development, as children tell lies of increasing difficulty, their ability to reason about others' mental states also becomes more sophisticated. Thus, children as young as 2 years of age may be able to engage in simple forms of deception (for example, denial), but their lies are also expected to be limited and lacking in variation. It is not until a sophisticated theory of mind is developed, around 3 or 4 years of age, that children are able to tell more complex

lies. As converging evidence for the central role of theory of mind, children who have autism, a condition associated with the inability to access and reason about the mental states of others, are suspected to have considerable difficulty with deception at all ages.

Although a theory of mind appears necessary for deception, there are also significant challenges to this view. One source of conflicting evidence is that children as young as 15 months old, who are unable to pass rudimentary false belief tests, are still able to lie. This has raised the question whether very young children are actually engaging in intentional deception. Rather, they may be responding in such a way that expresses a desire for how things ought to be. For example, when a young child breaks a toy and is asked who did it, an answer of "nobody" may reflect wishful thinking. For responses that are less ambiguous, such as "I don't know" or "the cat," these lies also may not count as genuine cases of intentional deception. Theory of mind advocates have argued that such responses arise from learned behavior-response contingencies that are tied to limited contexts. As a result, lies told by very young children should be highly predictable.

However, recent evidence suggests otherwise. With evidence drawn from naturalistic contexts, the range and types of lies told by young children are seemingly complex. One reason for this complexity is that the observed lies occur in communicative interactions, in which simple attributes about another's knowledge are easily realized. Merely being questioned ("why is the toy broken?") suggests a lack of knowledge by the speaker and an opportunity for the child to provide information that serves their own needs (avoid punishment). Explicit reasoning about another's mental states may not be necessary. Ongoing evidence from the interaction, in how a caregiver responds or behaves, provides further opportunities that allow the child to maintain or expand on their deception. Thus, deception may be a communicative act that is similar to any other type of information the child wants to express.

Other studies that challenge the role of explicit theory of mind are those that dissociate mental state reasoning from the ability to lie. For example, researchers have compared the deception aptitude of children who show delays in mental state

reasoning with those who show no delays. Important for analysis, the groups are otherwise equivalent, including on measures of general intelligence and demographics. The reason that one group of children shows specific delays is that they were born deaf and therefore have not yet mastered certain language skills that are hypothesized to be critical for a theory of mind. These skills include the use of mental state verbs and certain syntactical structures for expressing propositional attitudes (for example, "The girl believed that he was going to the store"). As expected, compared to the hearing group, the deaf children performed poorly on the false belief tests yet showed no differences with the hearing children in understanding and employing deception.

### Adult Social Interactions

According to impression management theories, deceivers typically monitor the linguistic and nonverbal behavior of others for signs of suspicion. This requires an awareness of the social impressions that they are having on others. Presumably, this also requires an understanding that others' also possess and are drawing from a theory of mind that is unique from that of the deceiver. To prevent suspicion, as any good poker player can attest, deceivers need to act or speak in such a way that conforms to what others are likely to perceive as being honest.

In studies examining the neural processes involved in impression management during deception, distinct brain regions, such as the right temporoparietal junction (RTPJ), tend to show greater activation. This region is also involved in nondeceptive tasks in which people must predict and explain the behaviors of others based on what they might believe. However, RTPJ activation is not solely dedicated to theory of mind processing, as it is also implicated in what is known as attentional reorienting. Such domain-general processes may thus support theory of mind reasoning in distinguishing one's own mental state from another and, in the case of deception, in switching between deception and truth during communicative exchanges.

The above neuroimaging example suggests that deceivers may actively reason about others' mental states. Although plausible, more evidence is still needed given the relative lack of research

in this area. An alternative explanation is that deceivers may be drawing from an implicit theory of mind that is more cognitively efficient, requiring only simple belief attributions about another. Such an account is better suited to the demands of actual communication in which people rapidly and seamlessly exchange information in a coordinated fashion. Extensive reasoning about what another understands during communication is seen by many as being incompatible with the real-time dynamics of social interaction. Furthermore, the cognitive demands of explicit mental state reasoning, coupled with the demands of having to overcome a truth bias, might also disrupt deceivers' linguistic and nonverbal behaviors to a point where deception is easily detectable. Existing



*David Oppenheim is deep in concentration at the 2010 World Series of Poker in Las Vegas, Nevada, June 1, 2010. The ability to consider and make inferences about the mental states of others, invaluable to lie detection experts, deceivers, and poker players alike is commonly referred to as "theory of mind."*

research suggests otherwise, with detection rates in interpersonal interaction often being no better than chance. Thus, given the frequency and ease in which people lie, the possibility of a more implicit theory of mind is likely warranted.

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**See Also:** Childhood, Lying in; Children, Development of Deception in; Evolution and Natural Selection; Impression; Lying, Intentionality of; Lying as Ability or Skill; Mental Effort in Lying; Neurophysiology.

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## Thermal Imaging

Thermal imaging is the technique that depicts the temperature variations of the environment using thermal imaging cameras. Thermal imaging has

been suggested to function as a lie detection tool. A liar's fear of getting caught is assumed to bring about a surge of blood flow, thereby increasing facial temperatures. Studies found that 69 to 92 percent of liars and 60 to 92 percent of truth-tellers could be correctly classified through thermal imaging technology, indicating thermal imaging has potential as a lie detection device. Many issues remain to be resolved, however, in particular the concern that thermal imaging will erroneously regard the truth-tellers arousal (for example, fear of flying, stress of being interviewed) as a sign of deceit.

Originally, thermal imaging was developed during the Korean War to enhance vision during nighttime and to detect enemy objects. Later on, it gained a wide application in a variety of fields, such as security, firefighting, industry, medicine, and science. Thermal imaging cameras measure the invisible infrared radiation emitted by objects and convert it into colored-pixel images, called thermograms. As the infrared radiation emitted by an object is a function of its surface heat (that is, the higher an object's temperature, the greater the intensity of radiation it emits), the color gradients of the image reflect variations in temperature. Thermal imaging makes it possible to see one's environment better, with or without daylight. Warmer objects, such as humans or animals, thereby easily stand out from typically cooler backgrounds.

### Accuracy as a Lie Detection Tool

In 2002, Ioannis Pavlidis and colleagues proposed thermal imaging as a lie detection tool in a brief communication in *Nature*. Departing from the assumption that liars experience anxiety about being caught, liars are expected to show a fight-or-flight reaction. This reaction is the response of the sympathetic nervous system to a stressful event, preparing the body to fight or flee, and is characterized by an increased blood flow to the brain and muscles. The increase in blood flow leads to a heightened body temperature, which can be picked up by a thermal imaging camera. Prior research indeed showed that a startle response elicited by an auditory noise is accompanied by heating of body temperature, particularly around the eyes. By focusing on thermal patterns around the eyes, Pavlidis and colleagues could correctly classify 75