Chapter 3
An Evolutionary Perspective, Sociophysiology, and Heritability

Empathy can lead to the evolution of fairness.

—(Karen Page & Martin Novak, 2002, p. 1101)

Abstract

- For a better grasp of empathy, we need to understand its evolutionary roots and its sociophysiological functions.
- During the course of evolution, human beings have been endowed with an innate capacity to express and understand emotions from nonverbal cues, which contributed to survival and is conceptualized as primitive empathy.
- Evidence showing infant's reactive crying, facial mimicry, physiological synchronicity in interpersonal interactions, and universal expression of emotions indicates that aspects of interpersonal behaviors cannot be attributed to social learning.
- Twin studies suggest that heritability is also a significant component of empathy more often when a measure of emotional empathy (rather than cognitive empathy) is used.

Introduction

In Chap. 2, I described human beings as social creatures that evolved to be connected with other human beings because social groupings provided increased defense against predators (Plutchik, 1987). Empathic engagement, particularly at the time of distress, was viewed in that chapter as a special kind of social support system. In this chapter, I discuss empathy as having an evolutionary root with a sociophysiological function and a heritability component. Long before they developed the capacity for verbal communication and invented language, our ancestors could relay their feelings, intentions, and expectations by nonverbal means, such as facial expressions, imitation, motor mimicry, and bodily postures. Nonverbal empathic communication has a longer history in the course of human evolution than

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does verbal communication. Thus, if the brain has areas for verbal communication and language (e.g., Broca's and Wernicke's areas), it must have areas for nonverbal communication and understanding of emotions. Because empathy implies understanding of feelings, emotions, and inner experiences, any means of communicating these concepts would be relevant to studies on the capacity for empathy.

Empathic exchanges, according to Buck and Ginsburg (1997a, p. 481), involve "a genetically based, spontaneous communication process that is fundamental to all living things and that includes innate sending and receiving mechanisms (visual, auditory, or chemical displays, and pre-attunements to such displays); empathy involves communicative genes." If one assumes that empathy is based on an *innate* mechanism and involves "communicative genes," then it must have an evolutionary root, a neuroanatomical structure, and a sociophysiological function.

An Evolutionary Perspective

Evolution lays out the historical path along which humankind has traveled to reach the present point. To understand human behavior, we must understand its evolution. According to the notion of evolution espoused by Charles Darwin (1965, 1981) human beings have evolved during a long evolutionary history of struggle for existence that resulted in the survival of the fittest. During that long history, emotions and their expressions and social cognition evolved for their adaptive advantages in dealing with the fundamental task of survival (Ekman, 1992).

Allport (1924) suggested that the expression of emotion originated from experiences *common* to all human beings. Similarly, Ekman (1992) proposed that our cognitive appraisal of situations that evoke emotions (e.g., those that threaten our survival) is primarily determined by our ancestral past. Carl Gustav Jung (1964) proposed the notion of "collective unconscious" as a transpersonal residue of experiences inherited from one generation to the next. These views imply the existence of a common evolutionary root in the expression of emotion and in cognitive appraisal that are vehicles of empathic communication.

In her thought-provoking article on the biological perspective of empathy, Leslie Brothers (1989) proposed that the capacity for empathy improves fitness for survival. The capacities our ancestors developed to read emotions from nonverbal clues (e.g., facial expression, bodily movement, tone of voice) provided a means of distinguishing foes from friends and danger from safety. The ability to understand social signals conveyed by facial expressions and bodily movements provides a competitive advantage over adversaries and protects against being deceived by them (Brothers, 1989).

Obviously, people who were armed with the capacity to understand other people's states of mind could escape danger more easily than others who lacked that skill; thus, they were more fit for survival. People who failed to develop the capacity for empathy because of genetic predisposition, inappropriate psychosocial experiences, a nonfacilitative rearing environment, or arrested neurological development were less likely to survive. Natural selection, therefore, favored empathy (Humphrey, 1983; Ridley & Dawkins, 1981). Parallel to sensitivity in detecting social signals, human beings developed the skills of deception and manipulation to conceal their emotions and intentions from predators. Studying these evolutionary adapted skills can enhance our understanding of empathy in interpersonal exchanges.

Evolutionary adaptation is linked not only to the physiological activities but also to such social behaviors as mate selection (Buss, 2003), reproductive strategies (Buss, 1995; Buss & Schmitt, 1993), parental investment (Trivers, 1972) (see Chap. 10 for more detailed descriptions of these notions), and prosocial behavior, altruism, and empathy (Buck & Ginsburg, 1997a; Ridley & Dawkins, 1981). During the history of human evolution, capacities have gradually evolved to achieve the ultimate purpose of life—survival or preservation of genes. Dawkins (1999) proposed that the engine of the survival machine is driven by the "selfish gene," which determines whether to protect, fight, or flee to increase the probability of survival. All of these actions require understanding of others' intentions. However, Buck and Ginsburg (1997b, p. 19) argued that "some genes are selfish, and function to support the survival of the individual organism, but other genes are social functioning to support the survival of species."

Buck and Ginsburg's notion was supported by Hamilton (1964) who, in discussing the evolutionary concept of exclusive fitness, proposed that human beings are not programmed exclusively and egoistically to protect their own individual genes but are programmed inclusively and altruistically to protect the survival of others who share similar characteristics. The capacity for empathy evolved to serve that purpose.

In support of this notion, de Quervain and colleagues (2004) used positron emission tomography (PET) to study the neural basis of *the social brain* with regard to intrinsic rewards for prosocial behaviors (e.g., cooperation and observing social norms) and punishment for violating them. The researchers found that people derive intrinsic satisfaction from punishing norm violators, which suggests that such altruistic punishment for the sake of the group's survival has been a decisive force in the evolution of human social behavior. A reward-related region of the brain, the dorsal striatum, has been implicated in the processing of rewards that accrue for socially desirable behavior (de Quervain et al., 2004), including inclination for empathic engagement.

The idea of a "non-selfish" gene that protects the survival of the group suggests that the unit of observation for the purpose of survival may be the group of individuals with common characteristics, rather than the individual. Perhaps this is a reason why empathic engagement becomes stronger with similar rather than dissimilar individuals. The chance of group survival increases with prosocial and altruistically motivated behaviors. The evolutionary basis of empathy, according to Hoffman (1978), can be linked to altruistic behavior in helping others to survive, sometimes even at a cost to the self.

Altruistic behaviors have puzzled evolutionary scholars who believe that the purpose of the struggle for existence is preservation of the individual's genes. However, the notion of a "non-selfish" gene can explain the underlying motivation for altruism.

For example, sacrificing one's own life for the good of the country (patriotic behavior) was dramatically illustrated by Japan's kamikaze pilots during World War II. Political suicidal missions can also be explained by the concept of a "non-selfish" gene aiming at group rather than individual survival. Empathy may have a role in such self-sacrificing behaviors, rooted in the understanding of pain and suffering of others who share some common features.

The issue of whether unconscious (or conscious) efforts to survive are selfishly and egoistically directed toward the preservation of individual genes or are selflessly and altruistically directed toward maintaining the group's genes has been hotly debated by evolutionary scholars. Although the details of such a debate are beyond the intended scope of this book, we should always remember that we are the product of millions of years of evolutionary adaptation for the purpose of either individual or group survival. Empathy is a by-product of this evolutionary adaptation.

Nonverbal Means of Empathic Communication

Through the process of evolution, the human brain has evolved to send and receive messages through nonverbal cues, such as facial expressions, motor mimicry, bodily gestures, change of facial skin color, sweating, and trembling as well as through vocal sounds, such as voice pitch, crying, and laughter, so that happiness, friendliness, and well-intended behaviors could be distinguished from sadness, disagreement, and hostile intent (Adolphs, Tranel, Damasio, & Damasio, 1994; Siegel, 1999). As a result of this evolutionary process, according to Darwin (1965), basic affects, such as happiness, sadness, anger, fear, and disgust, and the nonverbal means of expressing them can be understood and communicated easily regardless of language or cultural barriers.

The ability to send and receive communicative signals in interpersonal encounters is a means of survival. In interpersonal behavior, described by Westerman (2005, p. 22) as "a person's contributions to doing something with other people," expression of emotions plays a major role. The ability to understand other people's emotions from external signals, such as facial expressions and bodily gestures, also is a core ingredient in inferring other's inner feelings and intentions, thus facilitating to form an empathic relationship (Ekman & Friesen, 1974; Zahn-Waxler, Robinson, & Emde, 1992). Empathy can be conveyed through lexical as well as kinetic means of communication (Mayerson, 1976). It has been suggested that behavioral or nonverbal cues, because of difficulty to conceal them, may be even more effective in conveying emotional messages than lexical or verbal communication which can be easily faked (Bayes, 1972). Nonverbal means of communication, according to Mehrabian (1972), include observable actions such as facial expressions; emotional expressions; hand and arm gestures; postures; bodily positions; various movements of the body, head, hand, and legs; eye contact and gaze aversion; as well as subtle aspects of speech such as speech errors, slip of the tongue, pauses, long silence, speech rate, and deliberate choice of words. Better understanding of these nonverbal cues in interpersonal or clinical encounters can enhance empathic engagement.

Facial Expression, Mimicry, Imitation, and Bodily Posture

The human face presents fascinating and meaningful clues about a person's physical and mental status. The facial muscles, controlled by the central nervous system, have the unique ability to produce a wide variety of expressions (Dawson, 1994; Siegel, 1999). Because facial expressions and bodily postures are the external manifestation of the internal world, they facilitate empathic communication, especially in clinician–patient encounters. For example, the degree of rapport between clinician and patient, according to Goldstein and Michaels (1985, p. 107), is correlated with the occurrence of "shared posture." Observing facial expression unconsciously triggers similar expression (and muscle tone measured by electromyography) in the observer (Dimberg, Thunberg, & Elmehed, 2000).

Experimental evidence suggests that the human brain is designed to be attentive to emotional signals emitted via facial expressions. For example, using the "still-face" procedure, Tronick, Als, Adamson, Wise, and Brazelton (1978) found that young children become distressed and withdrawn when their mothers assume an emotionless face, rather than revealing their emotions (see Chap. 4). Evidence also indicates that infants can imitate human facial gestures, such as sticking out the tongue, protruding the lips, and opening the mouth (Meltzoff & Moore, 1977, 1983). Also, emotional expressions can be mimicked (Field, Woodson, Greenberg, & Cohen, 1982; Kugiumutzakis, 1998). Thus, mimicry is a nonverbal means of communicating experiences, which occurs when one observes another person's expression and responds with a similar motor representation (Hess, Blairy, & Phillippot, 1999). For example, we all tend to assume the postural strains of athletes or dancers during moments when we are absorbed in observing their actions (Davis, 1985). Furthermore, most of us have either experienced or observed that while spoon-feeding their infants, mothers often open their own mouth *as if* they are spoon-feeding themselves! These examples suggest that mimicry is a nondeliberate imitation that serves the function of communication (Schaflen, 1964).

Mimicry and the ability to imitate facial gestures and to understand facial expressions have been conceptualized as a type of primitive empathy, rooted in the history of human evolution (Bavelas, Black, Lemery, & Mullett, 1986). Mimicry and imitation behaviors can be explained by the principle of ideomotor action postulated by William James (1890) and the perception-action coupling proposed by Preston and deWaal (2002) (see Chap. 13), suggesting that observing another person's behavior increases a tendency in the observer to behave similarly.

Because mimicry and its associated somatosensory outcomes can help us to understand another person's experiences (Wicker et al., 2003), its relevance to empathy is evident (Chartrand & Bargh, 1999). According to Davis (1985), appraising the concept of mimicry is important when analyzing the component of empathy. Mimicry and facial expression generate changes in the autonomic nervous system associated with feelings that correspond to the facial expression (Decety & Jackson, 2004). Basch (1983) proposed that unconscious, automatic imitation of another person's facial expressions (facial mimicry) and bodily gestures (motor mimicry) generates an automatic and synchronized response in the observer that leads to better understanding of experiences identical to those experienced by the observed individual.

Carr, Iacoboni, Dubeau, Mazziotta, and Lenzi (2003) proposed that individuals with a high degree of empathy compared with others exhibit more unconscious mimicry of other people's facial expressions and bodily postures. Chartrand and Bargh (1999) described this phenomenon as the "chameleon effect"—the mere perception of another person's behavior can automatically increase the likelihood of imitating the perceived behavior. Lakin, Jefferis, Cheng, and Chartland (2003) reported that chameleon effect is a kind of social glue that represents the evolutionary significance of nonconscious mimicry, and serves to foster interpersonal relationships. Chartrand and Bargh suggested that the chameleon effect is the mechanism behind motor mimicry that satisfies the human need for connection and affiliation. Furthermore, they reported that individuals with high empathy scores on the Interpersonal Reactivity Index (Davis, 1983) (see Chap. 5) exhibited the chameleon effect to a greater degree than others with low empathy scores. Chartrand and Bargh (1999) report that a number of researchers have conceptualized mimicry in terms of empathy.

Imitation of another person's behavior is a different type of mimicry that generates a tendency to repeat an observed action (Meltzoff & Prinz, 2002). Imitation of an action implies striving to achieve the goal of that action (Baldwin & Baird, 2001). This indicates that in observing a behavior, either positive or negative, the underlying intention is also inferred which is perhaps more important in prompting imitative behavior. This explains why role models in health professions education and practice are important motivators of professional behavior. In his theory of violence, Berkowitz (1984) postulated that violence shown in public media contributes to imitating aggressive and criminal behaviors which can be explained by the principle of ideomotor action (James, 1890), and the perception-action model (Preston & de Waal, 2002) (see Chap. 13).

One indicator of recognizing emotions early in life is the observation that newly born infants will cry in response to the sound of another infant's cry (Sagi & Hoffman, 1976; Simner, 1971). This reactive crying does not occur in response to either a loud sound or a vocal sound that lacks the affective components of the other infant's cry, or even to the recorded crying of the newborn infant itself. According to Hoffman (1978), the human infant's reactive crying is based on a built-in mechanism that is an early precursor of empathic understanding.

Sociophysiology

The link between human physiology and social interaction has attracted the attention of scholars for a long time. For example, more than half a century ago, Boyd and DiMascio (1957) studied the concept of the "sociophysiology" of social behavior and found a relationship between emotions expressed in clinical interviews and autonomic physiologic responses, such as heart rate, skin resistance, and facial temperature. The notion of "interpersonal physiology" in clinician–patient interactions was first introduced in a study by DiMascio, Boyd, and Greenblatt (1957), who found that patients' and therapists' heart rates and skin temperatures were synchronized during clinical interviews. Goldstein and Michaels (1985, p. 68) reported that synchronization typically occurs between individuals who have "good rapport" with one another. Accuracy in perception of negative emotions was found to be a function of physiological synchrony between the perceiver and the target person (Levenson & Ruef, 1992). It is suggested that empathy can emerge as a result of the autonomic nervous system, which tends to simulate another person's physiological state (Ax, 1964). In other words, an empathic engagement reflected in good interpersonal rapport facilitates physiological synchronization during clinical interviews.

In another early experiment, investigators noticed that the physiological responses of healthy young soldiers were different when interacting with an officer (who was a psychiatrist) compared with a person who was an enlisted man (Reiser, Reeves, & Armington, 1955). The researchers concluded that the sociophysiology of the relationship in clinician–patient encounters could be a function of the client's view regarding the care provider's prestige or status (Reiser et al., 1955). In their study, Chartrand and Bargh (1999) found that greater time in contact with elderly people was associated with poorer memory, and more forgetfulness, indicating that even mental status of others can be adapted by frequent observations.

In a review article, Adler (2002) proposed that the experience of an empathic relationship in clinical encounters reduces the secretion of stress hormones and concluded that "the immediate effect of a caring relationship flows from the physiologic consequences of feeling cared about, because the neurobiology of such a relationship promotes an endocrine response pattern that favors homeostasis and is the antithesis of the fight–flight response" (p. 878).

A physiological feedback loop is set in motion during clinical interviews that is a reflection of mutual understanding. Observing emotion in another person has been reported to result in a similar display of emotion in the observer (Lanzetta & Englis, 1989). Similarly, emotional distress in one person can automatically trigger similar distress in another person when the two are interacting (Eisenberg, 1989). A study of physiological changes, such as heart rate, during interpersonal interactions revealed that a clinician's interpersonal style (e.g., praising or criticizing) can influence the patient's physiological reaction (Malno, Boag, & Smith, 1957). For example, these investigators observed that patients' heart rates rose significantly when the clinician had had a "bad" day. The results of a study indicate that physiological synchronicity (e.g., in heart rate and muscle activity) between people can lead to more accurate perceptions of their feelings (Decety & Jackson, 2006).

Maurer and Tindall (1983) observed that patients' perceptions of the therapist's empathic understanding increased when therapist's arm and leg positions were congruent (mirror image) of the patients. Mimicry, imitation, and body posture synchronization serve as an adaptive function to facilitate interpersonal interaction (Chartrand & Bargh, 1999). Schaflen (1964) observed that the more people in group share similar viewpoints, the more they tend to mimic one another's postures. It is also reported that patients perceive more empathic engagement when the clinicians mimicked their body posture; and the effect is reciprocal if the clinician and client are acquainted with each other (La France, 1979). It has also been observed that students' ratings of their teacher's involvement in class activities improved when there is more postural synchronicity between students and their teacher (La France, 1982).

Kaplan and Bloom (1960, p. 133) proposed the idea that the empathic process involves not only placing oneself in another person's "psychological" shoes but also placing oneself in that person's "physiological" shoes as well. However, Szalita (1976, p. 145) suggested that in empathic engagement with patients, "it is good to be able to put yourself into someone else's shoes, but you have to remember that you don't wear them." In a study of couples examined by using functional magnetic resonance imaging (fMRI), Singer and colleagues (2004) found that couples who scored higher on the Empathy Scale (Hogan, 1969) (see Chap. 5) and the Empathic Concern Scale of the Interpersonal Reactivity Index (Davis, 1983) (see Chap. 5) showed more intense brain activity when they observed their partner experiencing pain.

These findings suggest that empathic resonance involves shared physiological–neurological activities between people who are interacting. The notion of shared physiology between interacting people is intriguing (Ax, 1964; Kaplan & Bloom, 1960; Levenson & Ruef, 1992), and it opens up a window for studying the "physiological dance" that takes place in empathic engagement. More research is needed to investigate the underlying mechanisms involved in the psycho-socio-physiology of social behavior and the relevance of shared physiologic responses to empathic understanding and sympathetic feelings (see Chap. 13 on neurological underpinnings of empathy).

Heritability

Mumford (1967) regarded empathy as a genetically determined quality that can be enhanced or inhibited by positive or negative life experiences, respectively (cited in Szalita, 1976). A standard approach to research on heritability is the "twin study." In this research design, genetically identical or monozygotic (MZ) twins (who share 100 % common genes) are compared with fraternal or dizygotic (DZ) twins (who share approximately 50 % of their genes). Heritability can be determined with regard to a particular trait when MZ twins are more highly correlated than DZ twins on the trait, assuming a similar rearing environment. In a sample of 278 MZ and 378 DZ twins, strong genetic influences were found in 78 % of the twins younger than 11 years of age and in 66 % of those aged 11 years or older concerning the heritability of social cognitive skills relevant to empathy (Scourfield, Martin, Lewis, & McGuffin, 1999).

In a study involving 114 MZ and 116 DZ twins, the researchers found a significant heritability component of 72 % on a derived index of empathic concern (Matthews, Batson, Horn, & Rosenman, 1981). In yet another study involving 94 MZ and 90 DZ twins, the investigators found modest evidence of heritability in empathy (Zahn-Waxler et al., 1992). In another study of 573 adult twin pairs of both sexes, empathy, as measured by the Emotional Empathy Scale (Mehrabian & Epstein, 1972) (see Chap. 5), had a relatively broad heritability estimate of 68 % (Rushton et al., 1986). In a study of 174 pairs of MZ twins, and 148 pairs of DZ twins, it was found that 42 % of prosocial behavior was due to the twins' genes, 23 % to twins' shared environment, and the remaining to the twins' non-shared environment (Rushton, 2004).

Knafo, Zahn-Waxler, Van Hule, Robinson, and Rhee (2008) studied the genetic and environmental influences on empathy among 409 young twins and noticed increased contribution of genes, but decreased effects of environment with age. The results of another study (Davis, Luce, & Kraus, 1994) using the Interpersonal Reactivity Index (Davis, 1983) (see Chap. 5) showed evidence of significant heritability for the scales of Empathic Concern and Personal Distress (indicators of emotional empathy of the Interpersonal Reactivity Index, Davis, 1983) but not for the Perspective Taking Scale (an indicator of cognitive empathy of the Interpersonal Reactivity Index). These findings generally suggest that indicators of the so-called emotional empathy, which is more akin to sympathy, are more likely to have a higher heritability component than the cognitive indicators of empathy.

Recapitulation

In this chapter, I presented an evolutionary perspective on precursors of empathy through nonverbal behavior such as facial mimicry, imitation, and body posture. Data from twin studies were also presented to suggest that the capacity for empathy could be heritable to some extent. Research findings on the sociophysiology of interpersonal behavior, linking empathy to unconscious mimicry, imitation, and postural synchronicity, were discussed to show that empathic relationship in general, and empathic engagement in patient care in particular, resembles a synchronized dance between the involved parties which is orchestrated by sociophysiological factors to harmonize the dynamic exchanges and optimize interpersonal communication.