

SUGGESTED READING

Rubin, K. H., & Asendorpf, J. B. (Eds.). (1993). *Social withdrawal, inhibition, and shyness in childhood*. Hillsdale, NJ: Erlbaum.

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See also: Shyness

SOCIAL NEUROSCIENCE

Neuroscientists and cognitive scientists have collaborated for more than a decade with the common goal of understanding how the mind works. The focus of this work has been relatively restricted, however, as more complex aspects of the mind and behavior that involve conspecifics and their products (e.g., norms, culture) have fallen outside of the purview of cognitive neuroscience. Social neuroscience emerged in the early 1990s to address these kinds of questions at the information-processing, neural, and computational levels of analysis (Cacioppo & Berntson, 1992).

The notion of a social neuroscience is not as oxymoronic as it might first seem. Evolutionary forces operating over thousands of years have sculpted the human genome to be sensitive to and succoring of relationships with others. Affiliation and nurturant social relationships, for instance, are essential for physical and psychological well-being across the lifespan (Cacioppo, Berntson, Sheridan, & McClintock, 2000). Disruptions of social connections, whether through ridicule, separation, divorce, or bereavement, are among the most stressful events that people endure (Gardner, Gabriel, & Diekmann, 2000), and social isolation is as large a risk factor for broad-based morbidity and mortality as are high blood pressure, obesity, and sedentary lifestyles even after statistically controlling for known biological risk factors, social status, and baseline measures of health (House, Landis, & Umberson, 1988). The case of Phineas Gage in the late 1800s vividly established the importance of the frontal cortex for orchestrating normal social discourse (MacMillan, 1999), and various other cortical and subcortical nuclei involved in social cognition have now been identified (Adolphs, 1999).

Social neuroscience has emerged as a pullulating scientific perspective for several additional reasons. Theoretical insights into the mechanisms underlying social processes, as well as ways of testing otherwise conflicting theoretical accounts of social behavior, have come from theory and research in the neurosciences (Berntson, Boysen, & Cacioppo, 1993; Clark & Squire, 1998). Reciprocally, the study of social processes, including work on social factors as moderators of various specific mechanisms, has challenged exist-

ing theories in the neurosciences, resulting in refinements, extensions, or complete revolutions in theory and research in the neurosciences (Glaser & Kiecolt-Glaser, 1994). In addition, just as genetic constitution affects a wide array of social behaviors, the social environment has also been shown to shape genetic expression, neural structures, and biochemical processes (Liu et al., 1997).

In an early review, Cacioppo and Berntson (1992) coined the term *social neuroscience* and outlined several organizing principles for multilevel integrative research. The first, the principle of multiple determinism, specifies that a target event at one (e.g., a molar) level of organization can have multiple antecedents within or across levels of organization. For example, both research on individual differences in the susceptibility of the endogenous opioid receptor system and on the role of social context have contributed to our understanding of drug abuse.

The second, the principle of nonadditive determinism, specifies that properties of the whole are not always readily predictable from the properties of the parts. In an illustrative study, the effects of amphetamine on behavior of nonhuman primates were indeterminate until each primate's position in the social hierarchy was considered (Haber & Barchas, 1983). The inclusion of this social factor revealed an orderly relationship, such that amphetamines increased the dominant behavior in primates high in the social hierarchy and increased submissive behavior in those low in the social hierarchy.

The third, the principle of reciprocal determinism, specifies that there can be mutual influences between microscopic (e.g., biological) and macroscopic (e.g., social) factors in determining behavior. For example, not only has the level of testosterone in nonhuman male primates been shown to promote sexual behavior, but the availability of receptive females influences the level of testosterone in nonhuman primates (Berntstein, Gordon, & Rose, 1983). The implication of this and the preceding principles is that multilevel analyses spanning neural and social perspectives contribute to scientific investigations of complex human behavior and foster more comprehensive accounts of cognition, emotion, behavior, and health.

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SOCIAL PSYCHOPHYSIOLOGY

Social psychophysiology is characterized by the use of non-invasive procedures to study the relationships between actual or perceived physiological events and the verbal or behavioral effects of human association. The field represents the intersection of social psychology and psychophysiology. Social psychology, the older of the two spawning disciplines, is directed toward understanding the reportable and behavioral effects of human association, whereas psychophysiology employs noninvasive procedures to study the interrelationships between physiological events and a person's reportable or overt behavior. Social psychology, generally partitioned into conceptual areas of research (e.g., attitudes, aggression, altruism), is replete with abstract theories based largely on verbal data. Psychophysiology, in contrast, is generally partitioned into anatomical areas of research (e.g., cardiovascular gastrointestinal) and is laden with sophisticated physiological measures, instrumentation, and observations with uncertain psychological significance. Social psychophysiology has emerged from these disparately focused disciplines for the purposes of under-

standing the psychological significance of physiological events and explaining complex behaviors in biological terms.

The perspective on human behavior epitomized by social psychophysiology is quite old. It dates back to at least the third century B.C. Articles bearing the imprint of a social psychophysiological perspective began appearing in the psychological literature in the 1920s with reports about the changes in the breathing of poker players when they were bluffing and about the galvanic skin responses (GSRs) of students finding themselves possessing attitudes shared by few peers. The first summary of empirical research in social psychophysiology was published by Kaplan and Bloom in 1960. The review dealt with the physiological concomitants of social status, social sanction, definition of the situation, and empathy. An optimism was expressed that the field of social psychophysiology had come of age. At about the same time, John Lacey published a critical and cogent review in which he argued that there was little consistency in the literature on which to build bridges between psychophysiological data and psychological constructs.

Nevertheless, investigations of the reciprocal influence of social and physiological systems began to broaden in scope and increase in number. In 1962 Schacter and Singer published their influential two-factor theory of emotions: that the sensations derived from a large and unexpected increase in physiological arousal could be experienced as widely different emotions, depending on the circumstances covarying with these sensations. Leiderman and Shapiro represented a different vein of research: Evidence was presented for the dramatic impact that social factors such as conformity pressures have on physiological responding.

The attractiveness of psychophysiological procedures was tempered, however, by three formidable barriers: (1) the paucity of conceptual links between the psychophysiological data and social psychological constructs; (2) the technical sophistication and expensive instrumentation required to collect, analyze, and interpret psychophysiological data in social psychological paradigms; and (3) the inevitable pitting of social psychological and psychophysiological procedures against one another in studies of construct validation. Three distinct strategies developed for dealing with those barriers. One strategy was simply to dismiss physiological factors as irrelevant, at least at present, to the study of social cognition and behavior, and to dismiss social factors as too molar to contribute to an understanding of psychophysiological relationships. A second strategy was to view the physiological factor important in the study of social processes as being a diffuse, perceptible change in physiological arousal. This view provided the rationale for conducting research with little or no psychophysiological recording equipment and expertise, as it followed from this reasoning that any single physiological response, or even sensitive measures of interoceptive sensations, reflected a person's physiological arousal at any given moment (cf. Cacioppo & Tassinary, 1990).