Communication Apprehension as Temperamental Expression: A Communibiological Paradigm

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Over the past two decades, a large amount of research focusing on correlates and consequences of communication apprehension has accumulated. Despite this massive research effort, few viable models of the development of the trait have been proffered. Also during the past twenty years, psychobiologists have made impressive strides toward the explanation of human behavior by identifying underlying neurological processes, especially in affective domains. In this essay, we propose a theory of communication apprehension, anchored in the trait-oriented work of psychobiology as articulated in the temperament literature. Drawing from the extensive work of both psychobiologists and communication apprehension researchers in our field, we contend that communication apprehension represents individuals' expression of inborn, biological functioning, which has been shown to be antecedent to social experience and, therefore, independent of social learning processes. In formulating our theoretical framework, we (1) present a temperament-based conceptualization of communication apprehension, (2) integrate neurologically-based temperament functions into three fundamental propositions based on communication apprehension research, and (3) discuss the implications of our theoretical position. **Key words:** Communibiology, Temperament, Communication Apprehension, Traits, Personality

Two decades ago, McCroskey (1977) defined communication apprehension as "an individual's level of fear or anxiety with either real or anticipated communication with another person or persons" (p. 78). Deeply rooted in a trait conceptualization of affect, communication apprehension refers to the predisposition to "avoid communication if possible, or suffer from a variety of anxiety-type feelings when forced to communicate" (McCroskey, Daly, & Sorensen, 1976, p. 376). Summaries of research (e.g., Daly & McCroskey, 1984; McCroskey, 1977) reveal that since the initial development of the construct, literally hundreds of studies have established numerous correlates and consequences of communication apprehension viewed as a trait. However, relatively little progress has been made regarding etiological factors. Speculation concerning such factors has focused on social learning processes, particularly in the form of a learned helplessness model. Empirical support for that model is scant. Put simply, after nearly thirty years of research, a coherent explanation for why some people develop a predisposition to avoid communication or consistently experience anxiety reactions when social interaction is unavoidable remains to be offered. Recent work in personality theory and research promises to overcome this deficiency.

Personality theorists have increasingly turned their attention to the role of biology in human behavior. In the past ten years, these scholars have generated a rapidly growing body of research on biological processes underlying human behavior (Bates & Wachs, 1994; Eysenck, 1991; Eysenck & Eysenck, 1985; Gray, 1991; Kagan, 1992; Strelau, 1994; Thomas & Chess, 1977; Wachs, 1992; Zuckerman, 1991a, 1991b, 1995), especially as related to affective responses to social stimuli (Aggleton &

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Mishkin, 1986; Collins & Depue, 1992; Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Davis, 1992; Farb, Aoki, Milner, Kaneko, & LeDoux, 1992; Fowles, 1980; Fox, 1991; Fox, Bell, & Jones, 1992; Gray, 1982, 1990, 1991; Grillon, Ameli, Woods, Merikangas, & Davis, 1991; Kagan, 1992; Kagan, Resnick, & Sidman, 1988; LeDoux, 1986; LeDoux, Cicchetti, Xagoraris, & Romanski, 1990; Reiman, Fusselman, Fox, & Raichle, 1989; Reiman, Raichle, Butler, Herscovitch, & Robins, 1984; Rolls, 1990; Sears & Steinmetz, 1990; Smith & DeVito, 1984; Steinmetz, 1994; Steinmetz & Thompson, 1991; Zuckerman, 1995; Zuckerman, Kuhlman, & Camac, 1988). This work has almost exclusively been conducted under the rubric of "temperament," which Bates (1989) defines as "biologically rooted individual differences in behavioral tendencies that are present early in life and are relatively stable across various kinds of situations and over the course of time" (p. 4).

Although a temperament paradigm has a long standing tradition in the study of human behavior (e.g., Buss & Plomin, 1975; Diamond, 1957; Eysenck, 1967; Thomas, Chess, & Birch, 1968), in recent years, neurological activity and biochemical signatures of biological links to behavior patterns, typically referred to as *traits,* are increasingly being mapped by psychobiologists. Importantly, as Bates's (1989) definition suggests, research has increasingly indicated that these biologically-based traits have prenatal origins, usually detectable during infancy (e.g., Bates, 1987, 1989; Buss, 1989; Buss & Plomin, 1984; Calkins & Fox, 1992; Chess & Thomas, 1989; Eaton, 1983; Fox, 1991; Gray, 1991; Gunnar, 1990; Kagan, Resnick, & Sidman, 1988; Kagan & Sidman, 1991; Matheny, Riese, & Wilson, 1985; Nelson, 1993, 1994; Porter & Collins, 1982; Riese, 1987; Rothbart, 1989; Rothbart, Derryberry, & Posner, 1994; Strelau, 1994; Stifler & Fox, 1990; Thomas & Chess, 1977; Thomas, Chess, & Birch, 1968; Torgerson & Kinglen, 1978; Wachs, Morrow, & Slabach, 1990) and, therefore, are antecedent to socialization processes.

On the basis of their review of the rapidly accumulating body of research literature linking genetically inherited thresholds of neurobiological structures to personality traits, Beatty and McCroskey (in press) posited a trait-based communication paradigm, which they refer to as *communibiology.* Adapted to the theoretical treatment of communication apprehension, the basic propositions are: (1) All psychological processes–including cognitive, affective, and motor–involved in social interaction depend on brain activity, which, thereby, necessitates a neurobiology of communication traits; (2) Brain activity precedes psychological experience; (3) The neurobiological structures underlying temperamental traits and individual differences, such as those associated with communication apprehension, are mostly products of genetic inheritance; (4) Environment has only a negligible effect on trait development; and (5) Differences in interpersonal behavior are principally a consequence of individual differences in neurobiological functioning.

Recently, Beatty and McCroskey (Beatty, in press; Beatty & McCroskey, in press; McCroskey & Beatty, in press) have suggested that in light of the strong evidence supporting these propositions, communication scholars should whenever possible explicate the neurobiological processes responsible for trait functioning. Accordingly, identifying the neurobiological mechanisms responsible for consistent patterns of cognition, affect, or behavior is useful because establishing the biological mechanisms responsible for trait-induced behavior supports the claim that communication traits are not merely attributions. On the other hand, evidence that the internal processes inferred from observation of behavior or self-report measures are

inconsistent with known biological facts tends to discredit claims about the validity of proposed traits or interpersonal processes.

In this essay, we propose a theory of communication apprehension anchored in the principles of psychobiology, as articulated in the temperament literature. Drawing from the communication apprehension literature and the extensive research of psychobiologists, which includes neurology, neuroanatomy, and endocrinology, we view trait communication apprehension principally as individuals' expression of inborn, biological characteristics, that are antecedent to social experience and, like many other personality traits, do not depend primarily on learning processes. As such, individual differences in communication apprehension are mostly traceable to differences in biological functioning. In formulating our theoretical position, we reconceptualize trait communication apprehension as the manifestation of neurotic introversion in contexts requiring social interactions, reexamine three fundamental theoretic propositions in light of temperament-related neurobiological functioning, and discuss the implications of our theoretic framework.

Temperament-Based Conceptualization of Trait-Like Communication Apprehension

In a sense, the prospect of a neurobiological theory of communication apprehension is hardly novel. The relevance of biology to communication behavior is clear in Bates's (1989) observation that among psychobiologists "there is general agreement that temperament is manifest largely in the context of social interaction" (p. 4). Interpersonal scholars, too, have recognized the potential contribution of biology to our understanding of interaction (e.g., Beatty, in press; Beatty & McCroskey, in press; Cappella, 1991, 1993; Horvath, 1995; Knapp, Miller, & Fudge, 1994). In their predictions regarding trends in interpersonal research, Knapp, Miller, and Fudge (1994) anticipate communication scholars' "paying more attention to the growing body of work by geneticists that addresses issues of behavior" (p. 7).

Reconceptualization of Communication Apprehension

Mindful of the rapidly accumulating evidence already cited, which points to biological origins of social traits, it makes sense to view communication apprehension from this perspective. An important empirical development in personality research precipitated our rethinking of the communication apprehension construct and was foundational to the reconceptualization presented in this essay. Over the past decade, personality researchers have reduced the large number of identified personality traits to between three and five basic dimensions. By far, the most parsimonious and replicated personality structure has been developed by Hans Eysenck (1986, 1991). As determined by factor analysis, the numerous existing trait measures can be reduced to a three-dimensional structure of personality, consisting of psychoticism-emotional control (P), extraversion-introversion (E), and neuroticism-emotional stability (N). Some theorists (e.g., Zuckerman, 1995) refer to these as the "BIG THREE" factors of personality. They are clearly relevant to interpersonal communication theory. As Eysenck (1986) puts it, "[T]hese really embody the three ways in which individuals can interact: hostility and aggression (P), cooperativeness and sociability (E), and fearful avoidance (N)" (p. 14).

Eysenck's paradigm is informative in respect to the nature of communication apprehension for several reasons. First a large number of empirical studies indicate

that the ratio of genetic inheritance to environmental contribution is estimated to be 80/20 in the three basic personality dimensions Eysenck posits (Eaves & Eysenck, 1986; Eysenck, 1991; Eysenck & Eysenck, 1985; Stelmack, 1990; Stelmack & Geen, 1992; Zuckerman, 1995) and components of those dimensions (Bouchard, 1993; Lykken & Tellegen, 1996; Horvath, 1995; Rushton, Fulker, Neal, Nias, & Eysenck, 1986). Second, psychobiologists have made considerable progress in identifying and mapping genetically inherited individual differences in the thresholds of neurobiological structures responsible for the behavior we observe and interpret as P, E, and N (Eysenck, 1991; Eysenck & Eysenck, 1985; Fowles, 1980; Gray, 1991; Nelson, 1994; Rothbart & Derryberry, 1994; Steinmetz, 1994; Stelmack, 1990; Strelau, 1983). Third, two of Eysenck's basic dimensions of personality, extraversion and neuroticism, are the primary subcomponents of communication apprehension.

Communication apprehension as a blend of introversion and neuroticism. Eysenck's dimensions of introversion and neuroticism are conceptually entangled with the conceptualization of communication apprehension. First, McCroskey and his colleagues initially defined communication apprehension as a predisposition to "avoid communication, if possible, or suffer a variety of anxiety-type feelings when forced to communicate" (McCroskey, Daly, & Sorensen, 1976, p. 376). Within Eysenck's framework, avoidance of social interaction represents a manifestation of introversion. The "anxiety-type feelings" included in the definition of communication apprehension represent manifest neuroticism, the opposite of emotional stability. In fact, after reviewing the literature, Eysenck and Eysenck (1985) concluded that shyness "appears to involve some features of introversion (keeping in the background, preferring one's own company) and of neuroticism (feelings of inadequacy and worry, emotional arousal)" (p. 316).

Although Eysenck and Eysenck (1985) refer to shyness, the inference we draw from their comment regarding communication apprehension has considerable empirical support. For example, Daly (1978b) factor analyzed twenty-five separate measures of social anxiety and found that all but one loaded on a single factor. On the basis of those findings and an average correlation of .75 among those measures, Daly concluded that measures under the various rubrics of including communication apprehension, sociability, social anxiety, audience sensitivity, and exhibitionism all measure the same construct. Importantly, McCroskey's measure of communication apprehension, the PRCA, posted the highest loading in Daly's (1978b) study, which, thereby, warranted our continued reference to *communication apprehension* rather than social anxiety or any other construct label.

A brief trace of the development of the communication apprehension construct links neurotic introversion with communication apprehension. During the initial stages of his work, McCroskey thought that what later became known as communication apprehension was mostly introversion (personal communication, cited in Beatty & Behnke, 1991), and throughout his work, he refers to the "pathological" (neurotic) features of extremely high trait communication apprehension (McCroskey, 1984; McCroskey & Beatty, in press). Furthermore, previous reviews of literature reveal that neurotic introverts (Eysenck & Eysenck, 1985) and individuals high in trait communication apprehension (McCroskey, 1977) demonstrate identical proclivities regarding academic achievement, occupational choice, dating behavior, and social interaction in general. We propose that scores on trait communication apprehension measures, such as the various versions of the PRCA, represent a blend

of introversion and neuroticism, both of which are manifestations of genetically inherited thresholds for the activation of neurobiological systems. In other words, the distorted perceptions, avoidance tendencies, behavioral disruption, and unpleasant affect associated with high trait communication apprehension represent manifestations of neurotic introversion.

Correlations between CA and indices of E and N. A review of published studies provides substantial support for the view that communication apprehension represents both introversion and neuroticism. According to Eysenck, nine narrower traits give rise to the concept of extraversion (sociable, lively, active, assertive, sensation-seeking, carefree, dominant, surgent, and venturesome). Five of these traits (surgency, adventurousness, dominance, sociability, and assertiveness) had been studied in regard to communication apprehension before Eysenck advanced his three-dimensional model of personality. In every study, significant correlations were found between CA and the component of extraversion, and except for dominance, the observed coefficients have been strong. Note also that all of the studies conducted prior to 1982 utilized a version of the PRCA that was dominated by items referring to anxiety while delivering a speech, and for the most part, correlations were not corrected for attenuation.

Using a sixteen factor measure of personality, McCroskey, Daly, and Sorensen (1976) observed significant correlations between CA and surgency (−.52), adventurousness (−.54), and dominance (−.33). Daly (1978) reported a significant correlation between CA and a measure of sociability (−.59). McCroskey, Beatty, Kearney, and Plax (1985) found a strong correlation between assertiveness and CA (−.70).

While published studies document interrelationships between communication apprehension and indicators of extraversion, many also link communication apprehension to indices of neuroticism. Within Eysenck's personality structure, nine traits are indicative of neuroticism (anxious, depressed, guilt, low self-esteem, tense, shy, irrational, moody, and emotional). As with extraversion, studies that directly examine the relationship between communication apprehension and these constituent traits have revealed strong associations. In a study mentioned previously, McCroskey, Daly, and Sorensen (1976) found a positive correlation between communication apprehension and general anxiousness (.50), as well as a negative correlation between CA and emotional maturity (−.33). Beatty and his colleagues (Beatty, 1987, 1988a, 1988c; Beatty & Andriate, 1985; Beatty, Balfantz, & Kuwabara, 1989; Beatty & Behnke, 1980, 1991; Beatty, Dobos, Balfantz, & Kuwabara, 1991; Beatty, Forst, & Stewart, 1986; Beatty & Friedland, 1990; Behnke & Beatty, 1981; McCroskey & Beatty, 1984) have consistently reported moderate to high correlations (.40 to .60) between various measures of CA and anxiety reactions in response to communication demands. In a series of studies, McCroskey, Daly, Richmond, and Falcione (1977) discovered significant correlations between CA and self-esteem (−.52 to −.72). Studies examining the relationship among measures of shyness, reticence, social anxiety, and communication apprehension have consistently revealed substantial correlations among such measures. Daly (1978b), for instance, detected substantial statistical associations among twenty-five separate measures of social-communicative anxiety, including one measure of tension that correlated with CA (.82). With respect to rationality, Beatty (1988b) found that in comparison to low and moderately apprehensive speakers, those classified as highly apprehensive were less rational in their preparation and implementation of speech introduction strategies.

Direct Evidence for Communication Apprehension as Neurotic Introversion

Because neuroticism and introversion are so heavily influenced by genetic inheritance (Eysenck and Eysenck [1985] conclude the ratio of genetics to environment to be approximately 80/20, with improvement in the measurement of introversion and neuroticism tipping the balance toward an even greater genetic contribution), the conceptualization of communication apprehension as a blend of these two personality traits suggests a genetic origin of communication apprehension. More precisely, the genetically inherited thresholds for stimulation of the neurobiological circuitry underlying introverted and neurotic reactions, which have been mapped by psychobiologists, are implicated as the neurobiological structures giving rise to trait communication apprehension. Clearly, the correlational studies just reviewed, which link certain aspects of introversion and neuroticism to communication, are suggestive of such a connection. A factor analytic study by Heisel et al. (1997) provides more direct evidence. They reported that all twenty-four items from McCroskey's (1982) PRCA-24, all ten items from Eysenck's (Eysenk & Eysenck, 1985) extraversion measure, and nine of the ten neuroticism items (Eysenck & Eysenck, 1985) loaded on one unrotated factor. Moreover, attempts to force separate factors for CA, extraversion, and neuroticism were unsuccessful.

In an effort to test further our contention that communication apprehension represents a blend of introversion and neuroticism, we acquired additional data. Specifically, McCroskey's (1982) Personal Report of Communication Apprehension-24 and Eysenck's (Eysenck & Eysenck, 1985) ten-item measures of extraversion and neuroticism were administered to 73 (42 female, 31 male) randomly selected adults. Items from the three measures were randomly selected adults. Items from the three measures were presented in random order to minimize order effects. Estimates of the internal consistency of the measures indicated that the reliabilities were satisfactory for all three measures (alpha coefficients: PRCA-24 = .97, introversion = .89, neuroticism = .87).

Correlations between PRCA-24 scores and introversion ($r = .83$, $p < .01$) and neuroticism ($r = .74$, $p < .01$) indicated substantial support for the relationships inferred from the extant research. A regression model in which introversion and neuroticism were used to predict PRCA-24 scores accounted for 74.9 percent of the variance ($F = 104.96$, $df = 2,70$, $p < .01$). Although introversion and neuroticism correlated at .67 ($p < .01$), both contributed significantly to the explained variance (introversion, beta = .60, $t = 7.48$, $p < .05$; neuroticism, beta = .34, $t = 4.28$, $p < .05$). Disattenuated correlations for PRCA-24 × introversion and PRCA × neuroticism were .90 and .80, respectively, with the disattenuated multiple correlation equal to .93. Overall, these results provide strong support for the conceptualization of communication apprehension as a blend of introversion and neuroticism.

Advantages of a Temperament-Based Conceptualization of Communication Apprehension

Communication apprehension was conceptualized in the early 1970s when the dominant paradigm of human development relied on environmental influences as the basis for etiological accounts of traits. Despite the lack of empirical research, communication apprehension emphasized variants of learning theory as the explanation for the development of communication apprehension (see McCroskey, 1984). As McCroskey (1977) put it, "We believe that CA is a learned trait, one that is

conditioned through reinforcement of the child's communication behaviors" (p. 80). However, four points are important: (1) Only three published studies (Ayres, 1988a; Beatty, Plax, & Kearney, 1985; Daly & Friedrich, 1981) tested learning models of communication apprehension; (2) the studies showed small effects for environmental variables, the range of variance explained by regression models consisting of multiple predictors was between 3 and 19 percent; (3) the upper limit of predictive power required seven predictor variables; and (4) the specific contributions of predictors essential to learning explanations of the pathological or neurotic feature of communication apprehension (e.g., aversive consequences for communicating) were usually nonsignificant and accounted for negligible variance (less than 4 percent) in trait communication apprehension. Although it is possible to augment learning theory by positing additional mechanisms that would differentiate people who not highly verbal from those who are also fearful, such a model has yet to surface.

Despite the emphasis on learning theories, McCroskey (1977) acknowledged the possible biological origin of the trait almost from the inception of the construct. In his most recent writing on the subject (McCroskey & Beatty, in press), McCroskey has become a strong advocate of the genetic model of communication apprehension. Indeed, a comparison of a temperament-based theory of communication apprehension to learning theories shows that genetic models are superior to learning models in terms of predictive power, explanation, and parsimony. In contrast to the small variances accounted for by learning models, reviews of studies of identical twins, for example, indicate that nearly eighty-percent of components of communication apprehension, introversion and neuroticism, is attributable to genetic inheritance (e.g., Eaves & Eysenck, 1986; Eysenck & Eysenck, 1985; Gray, 1991). Within the context of tracing the development of communication apprehension, a temperament-based model is desirable in terms of *predictive power.*

In addition to increasing predictive precision, a temperament-based theory of communication apprehension also provides a viable *explanation* for both the behavioral and emotional components of communication apprehension. The motivation to "avoid" and the tendency to experience strong negative affect inherent in the conceptualization of communication apprehension coincide with extant biologically-based models that account for approach/avoidance and pleasant/unpleasant emotions (e.g., Gray, 1991). Also, as mentioned previously, substantial progress has been made linking the precise neurobiological operations with personality traits. As Gray (1991) observed, "[T]emperament reflects parameter values . . . that determine, for any particular individual, the operating characteristics of our three emotional systems" (p. 23). Furthermore, "the major dimensions of personality . . . are created by individual differences in such parameter values" (p. 23). Indeed, links between specific genetically determined thresholds or parameters for the neurobiological structures that stimulate approach/avoidance in general (Gray, 1982, 1987, 1990, 1991) to extraversion (e.g., Eysenck & Eysenck, 1985; Gray, 1991; Stelmack, 1990; Stelmack & Geen, 1992) and neuroticism (Eysenck & Eysenck, 1985; Gray, 1991), in particular, have been established.

The work just mentioned pertaining to the genetic contributions to extraversion and introversion and the mapping of neurobiological parameters associated with those traits presents further explanatory problems for learning accounts of communi-

cation apprehension development. As notable scholars have concluded, learning theories have not offered viable explanations for the relatively sizable portions of shared variance in trait scores for identical twins who have been raised apart and the negligible effect for having been raised together (e.g., Bouchard, 1993; Eysenck, 1986; Lykken & Tellegen, 1996; Rushton et al., 1986; Zuckerman, 1994), stable behavioral dimensions of temperament detected at infancy (Chess & Thomas, 1989; Strelau, 1994), or stable anatomical and biochemical properties associated with various traits (Nelson, 1994; Zuckerman, 1995). Comparatively speaking, a temperament model of trait development provides a superior explanation of currently known facts.

Although most of the scholarly writing focusing on criteria for evaluating theories identifies simplicity or *parsimony* as a desirable quality (e.g., Reynolds, 1971), it only becomes relevant for comparing theories of comparable predictive precision (pp. 134–135). Although a temperament-based theory of communication apprehension development appears to be superior to learning theory in terms predictive power and explanatory value, it also offers a more parsimonious account of communication apprehension. As we will show, communication apprehension is primarily a function of two interrelated neurobiological systems, the thresholds of which are the products of genetic inheritance. In addition to simplifying the explanation for the etiology of communication apprehension, this review increases parsimony because in positing the neurobiological underpinnings of communication apprehension, we are identifying the neurobiological bases of the multitude of social anxiety "constructs" previously shown to be almost synonymous with communication apprehension.

Temperament-Based Augmentation of Three Fundamental Propositions

Twenty years ago, McCroskey (1978) first posited five propositions, which have since guided research into communication apprehension. In this essay, we limit our focus to three propositions that pertain to communication inhibition in the form of anxiety, avoidance, and withdrawal. Specifically, McCroskey (1976) argued that in comparison to people low in communication apprehension, people high in communication apprehension are more likely to experience anxiety when required to communicate, avoid situations demanding communication, and engage in less oral communication when such situations are unavoidable.

Following recent recommendations that communication scholars explicate trait constructs in terms of the neurobiological processes responsible for their observable and measurable qualities; as personality theorists have been doing for the past decade (Beatty, in press; Beatty & McCroskey, in press), we augment these fundamental propositions in light of the reconceptualization presented in this essay. The structure and style of our presentation is patterned after that appearing in the temperament literature (e.g., Zuckerman, 1995). Although clusters of brain structures are grouped into neurobiological systems according to their functions (e.g., avoidance behavior), following the lead of temperament scholars, we delineate the anatomical composition of those systems and associated biochemical activity. Several comprehensive and readable reference books are available to interested readers unfamiliar with the anatomical brain structures or neurological processes discussed in our analysis (e.g., Marieb & Mallatt, 1992).

Neurobiology of the Predisposition to Experience Anxiety in Situations Requiring Oral Communication

Perhaps the most well-established linkage in the communication apprehension literature is that between trait-like communication apprehension and self-reported anxiety pertaining to specific communication episodes (Beatty, 1987; Beatty, 1988a, 1988c; Beatty & Andriate, 1985; Beatty & Behnke, 1980, 1991; Beatty, Balfantz, & Kuwabara, 1989; Beatty, Dobos, Balfantz, & Kuwabara, 1991; Beatty, Forst, & Stewart, 1986; Beatty & Friedland, 1990; Booth-Butterfield, 1988b; McCroskey & Beatty, 1984). Studies have demonstrated that factors in communication situations have only a small effect on state anxiety, while trait communication apprehension is highly predictive of state anxiety (e.g., Ayres, 1990; Beatty, 1988a, 1988c; Booth-Butterfield & Booth-Butterfield, 1986).

Given the current body of literature that has accumulated regarding the neurobiology of traits, individual differences in communication apprehension can be attributed to a biological system that, for the most part, is genetically determined. The core of this system consists of temperament-related structures that generate and support particular emotional reactions and patterns of behavior. Although the neurobiological processes involved in the emotional expression of temperament are not completely understood, various subsystems of the limbic system (a subsystem of Gray's broader behavioral inhibition system, discussed in detail later) have been strongly implicated (e.g., Aggleton & Mishkin, 1986; Davis, 1992; Farb et al., 1992; Gray, 1982, 1987, 1990, 1991; LeDoux, 1986; LeDoux et al., 1990; MacClean, 1955; Nelson, 1994; Panksepp, 1982, 1986; Reiman et al., 1984, 1989; Rolls, 1990; Strelau, 1994; Steinmetz, 1994; Zuckerman, 1994, 1995) in the sixty years since Papez (1937) first recognized that parts of the limbic system were involved in emotional experience. The knowledge produced in these studies about the functional significance of the limbic system in motion and temperament has been the product of a variety of methodologies.

Neurobiologists use the term *limbic system* in reference to the region of the brain that is composed of a ring of tissue comprising the medial wall of the limbic lobe, the olfactory cortex, the hippocampal formation, the cingulate and subcallosal gyri, and several subcortical areas, including the septum, amygdala, hypothalamus, epithalamus, anterior thalamic nuclei, and a portion of the basal ganglia. (For a detailed description of each and its location in the brain, see Adams & Victor, 1993.) The limbic system is extraordinarily complex and comprised of complicated circuitry connecting its components through intricate feedback loops. (For detailed review of these connections regarding emotional expression and temperament, see Steinmetz, 1994.) In addition to the linkage of each part of the limbic system with emotion, the interactions among them are significant. As Steinmetz (1994) notes, "[T]he limbic system has all of the connections that are necessary to bidirectionally mix [sic] the cognitive aspects of emotions (i.e., via neocortical connections) with the more autonomic, physiological, or motor aspects of emotion (i.e., hypothalamic and brain stem connections)" (pp. 28–29).

While these brain structures are common to all humans, psychobiologists have observed individual differences in the sensitivity of the limbic system to stimuli (e.g., Buss & Plomin, 1984; Eysenck, 1991; Gray, 1982, 1990, 1991; Kagan, Reznick, & Sidman, 1988; Nelson, 1994; Steinmetz, 1994; Strelau, 1994; Thomas & Chess,

1977). These differences in limbic system sensitivity roughly correspond to anxiety proneness in social situations. Kagan and his associates (1988), for instance, maintain that in comparison to children who display uninhibited temperaments, inhibited children possess "lower thresholds of reactivity in the limbic system" (pp. 671–672). As Gray (1991) refers to "parameter values" of emotional systems, Strelau (1994) points to individual differences in arousability as an important criterion for classifying people along trait continua (e.g., introverts versus extroverts, neurotic versus emotionally stable, high anxiety individuals versus low anxiety individuals, and withdrawal tendency versus approach tendency).

These lower threshold or higher reactivity parameters appear early in infancy (e.g., Kagan, Reznick, & Sidman, 1988; Kagan & Sidman, 1991) and represent "sensitivity of neurons' postsynaptic receptors or sensitivity in their synaptic transmission, the amount of neurotransmitters being released, the reactivity of the neural structures (including receptors) to different kinds of stimuli, all taking part in determining the individual differences in the traits" (Strelau, 1994, p. 135). Indeed, scholars have found substantial differences in the biochemistry of people across a variety of traits (see Zuckerman, 1995).

Perhaps the most detailed model of the neurobiology of temperament and emotion was proposed by Gray (1982, 1987, 1990, 1991). Although scholars continue to refine the model, it continues to serve as an important conceptual framework for temperament research (Bates & Wachs, 1994). One aspect of Gray's model particularly relevant to communication apprehension is a set of neurological circuits linking the structures related to the hippocampus, the subiculum, and septum that forms the *behavioral inhibition system* (BIS). The BIS functions holistically in responding to novel stimuli and those associated with punishment and the cessation of reward. Arousal is among the various consequences of an activated BIS because it interconnects with the limbic system. According to Gray (1991), anxiety proneness is attributable to individual differences in BIS reactivity. Individuals prone to anxiety have overactive BISs, whereas low anxiety individuals have underactive systems.

In light of the preceding discussion, we reformulate the predisposition to experience anxiety in social settings demanding oral communication as follows: Individual differences in the reactivity of behavioral inhibition systems accounts for differences in communication apprehension. Our theoretical position, however, accommodates instances in which people low in communication apprehension experience communication anxiety: Individuals low in trait communication apprehension experience (state) anxiety reactions when the stimuli are sufficient to activate the BIS. On the other hand, those high in communication apprehension experience anxiety reactions more frequently as a result of lower tolerances for stimulation.

Although differential levels of sensitivity to communication-related stimuli underlying communication apprehension levels can be inferred from the self-report studies cited earlier, physiological evidence also exists within the extant communication literature that confirms the relative sensitivity of people high in the trait. Studies have shown that in highly stressful communication situations, such as giving a graded speech to a live audience, heart rates (one index of the limbic system) are substantially elevated but not significantly correlated with communication apprehension scores (e.g., Beatty & Behnke, 1991; Behnke & Beatty, 1981). At least three published studies, however, establish that the heart rates of persons high in commu-

nication apprehension are significantly higher than those low in the trait under relatively mild speaking conditions (Beatty & Behnke, 1991; Beidel, Turner, & Dancu, 1985; Booth-Butterfield, 1987), suggesting that the limbic systems of communication apprehensives are more easily stimulated than are those of persons low in the trait. An early study by Myers (1976) demonstrated that merely visualizing public speaking performance was sufficient to produce a sharp peak in galvanic skin response for highly apprehensive people. Beatty and Behnke (1991) conducted an experimental study that provides direct evidence for arousal sensitivity associated with communication apprehension levels. They manipulated speaking task intensity and observed significant differences (as well as a large effect) between high and low apprehensives' heart rates under-low stress speaking conditions but no significant difference in the high-stress condition. Consistent with these findings, Tardy and his associates (1991) noted that persons high in social anxiety displayed higher levels of cardiovascular reactivity when compared to people low in the trait.

Behnke, Beatty, and Dabbs (1982) correlated communication apprehension scores with tympanic temperature, which correlates highly with temperature of the hypothalamus, during public speaking. Although the correlation was near zero during the performance, communication apprehension and temperature were moderately and significantly correlated for the anticipatory period just prior to the performance, which indicates hypothalamus activation for apprehensive speakers. This finding is important in light of the central role of the hypothalamus in the limbic system, especially in processing emotion-related arousal (e.g., Zajonc & McIntosh, 1992).

In addition to lower thresholds for limbic system activation, BIS activation is also associated with enhanced attentional focus on negative or threatening features of the social environment (Gray, 1991). Individual differences in attentional focus, including the ability to sustain or redirect attention, are central to most conceptualizations of temperament (e.g., Ball & Zuckerman, 1992; Chess & Thomas, 1989; Derryberry & Rothbart, 1988; Fowles, 1980; Gray, 1982, 1990, 1991; MacLeod & Mathews, 1988; Nelson, 1994; Strelau, 1994). Importantly, the concept of regulation of cognitive focus has also served as an important construct in theories of emotion and stress, variously described as "emotion-focus versus problem-focus" (Folkman & Lazarus, 1980), "self-focus versus task-focus" (Sieber, 1977; Wine, 1971), "negative versus positive" focus (Derryberry & Rothbart, 1988; McLeod & Mathews, 1988).

Although the notion that preoccupation with self and negative focus are associated with anxiety is not a new one (e.g., Wine, 1971), relatively recent research has shown that anxiety-prone individuals have greater difficulty shifting away from negative information in their environment than do those less prone to anxiety (MacLeod & Mathews, 1988). In addition, individuals predisposed to negative affect report lower levels of attentional control than do others (Derryberry & Rothbart, 1988). Although we can speak metaphorically about "attention focus," "appraisal" and so forth, considerable progress has been made in identifying the neurobiological circuits driving these cognitive processes.

In addition to its already mentioned function in the limbic system, the amygdala influences information processing within the cortex (e.g., Wallace, Magnuson, & Gray, 1992). The anterior cingulate connects the amygdala to the cortex and the midprefrontal cortex functions together with the anterior cingulate gyrus to form the anterior attention network, which drives selective attention (Posner, 1990; Posner & Peterson, 1990; Posner & Presti, 1987; Vogt, Finch, & Olsen, 1992). As studies have

shown, anxious individuals demonstrate an attentional bias toward threatening information (Mathews, 1990) and appear to have difficulty directing their attention away from such information (MacLeod & Mathews, 1988). Critical to our theoretical position is that individual differences in attentional focus and fixation appear during early infancy (see Nelson, 1994). The negative attentional bias combined with inflexible attentional control, both of which are neurologically-based, interferes with individuals' ability to shift attention from negative features of the environment.

Linkages among attentional focus, anxiety proneness, and neurological functioning are important in differentiating individuals along the continuum of communication apprehension, particularly in respect to the stream of research findings documenting that apprehensive communicators maintain a focus on negative thoughts or threatening features of the social environment (e.g., Ayres, 1988b; Beatty, 1988a, 1988b, 1988c; Booth-Butterfield, 1988a; Daly, Vangelisti, Neel, & Cavanaugh, 1989; Miller, 1987; Smith & Sarason, 1975). We know, for example, that compared to their non-apprehensive colleagues, communication apprehensives have higher expectations of failure (Beatty, 1988a, 1988b; Miller, 1987), perceive the same audience feedback as more negative (Smith & Sarason, 1975), are more distracted from class lectures when anticipating an interaction with a stranger (Booth-Butterfield, 1988a), believe they know less about their speech topics (Daly et al., 1989), view themselves as generally inferior to audience members (Beatty, 1988c), and generally entertain more negative thoughts in communication situations (Ayres, 1988a).

Neurobiology of the Predisposition to Avoid Situations Requiring Oral Communication

McCroskey (1978) has referred to tendency to avoid communication as "the most central proposition in the theory relating to communication apprehension" (p. 194). Ample research has accumulated to support the contention that individuals high in communication apprehension generally avoid interacting with others (Beatty, 1987; Daly & McCroskey, 1975; McCroskey & Andersen, 1976; McCroskey & McVetta, 1978).

In addition to internal emotional feelings, biologically determined individual differences in approach-avoidance behavior patterns have also been viewed as essential properties of temperament (Buss & Plomin, 1984; Calkins & Fox, 1992; Chess & Thomas, 1989; Depue & Achene, 1989; Fowles, 1980; Gray, 1982, 1987, 1990, 1991; Kagan, Reznick, & Sidman, 1988; Kagan & Sidman, 1991; Panksepp, 1982, 1986; Stelmack, 1990; Stelmack & Geen, 1992; Strelau, 1983, 1994; Thomas & Chess, 1977; Zuckerman, 1991b, 1994). In the twenty-five years since the initial work on the communication apprehension construct, there has been a substantial increase in our understanding of the neurological networks involved in approach and avoidance patterns. Similar to the circuitry involved in attentional focus and regulation, these networks are evident in infancy and continue developing until late adolescence (Nelson, 1994), which accounts for observations of social approach and avoidance soon after birth (e.g., Buss & Plomin, 1984; Kagan, Reznick, & Sidman, 1988; Thomas & Chess, 1977).

As might be expected, there is considerable overlap between the neurobiological origins of anxiety and those of avoidance, which is reflected in the correlation between introversion and neuroticism reported earlier. In addition to increased arousal and negative attentional focus, activation of Gray's (1982, 1987, 1990, 1991) BIS inhibits ongoing behavior. If the reaction is strong enough, BIS activation is an

instigation for flight from the stimulus. In building his model, Gray integrated the aforementioned work pertaining to the emotional function of the limbic system with neurological functions involved in environmental scanning and memory-related processes to account for the generation of approach and avoidance behavior in response to particular stimuli. In recent years, other scholars have documented the role of the amygdala (discussed earlier in the context of the limbic system) in fear-related avoidance (Davis, 1992). Within a complex circuitry (composed of the approach-related cell groups of the basolateral nucleus, the central nucleus of the amygdala, the circuits of the orbitofrontal cortex, the bed nucleus of the strin terminalis, the lateral hypothalamus, the central gray region of the midbrain, and the multiple brain stem nuclei), the central amygdala monitors and identifies threatening signals through its connections with the thalamus and the cortex.

Consistent with our earlier discussion of thresholds, Gray (1982, 1987, 1990, 1991) contends that avoidance tendencies represent individual differences in BIS reactivity, which can be inherited and/or influenced by prenatal disturbances (e.g., mother's drug or alcohol use; see Chess & Thomas, 1989). Because stable extroverts possess underactive BISs and highly reactive BISs are associated with neurotic introverts, who initiate flight responses when the BIS is activated (Gray, 1991), individuals who are highly apprehensive about oral communication possess highly reactive. On the other hand, low communication apprehensives are those with underactive BISs.

Gray's description of the ways in which particular stimuli become salient BIS activating cues is an important contribution to our understanding of avoidance processes. Whereas state anxiety may be thought of as "on line" reaction, avoidance involves preemptive maneuvers which, to be maximally effective, must occur prior to peak arousal. A viable model of avoidance must somehow posit a theory of memory that accounts for the affective charge associated with a stimulus. According to Gray (1991), the conditions under which previous encounters with stimuli were encoded into memory is key to understanding how stimulus perception and affective memory are linked to avoidance. Steinmetz (1994) notes that "most of the neural structures that are likely to play important roles in determining emotions of temperament are also involved in learning and memory processing" (p. 35). Research shows that events processed during anxiety-laden states are recalled more vividly and intensely than those experienced during basal states (Brown & Kulik, 1979; Davis, 1992; Squire, 1987), an effect of the circulating hormones and other biochemical byproducts of negative affect. In formulating his model, Gray (1991) recognized that the septohippocampal system, a subset of the limbic system, was centrally involved in continuous analysis of ongoing events and predicting the next most likely event.

The overlapping functions of the various neurological structures is inconsequential when the environmental monitoring occurs during BIS inactivity. However, the involvement of the septohippocampal system in emotional experience skews environmental scanning and prediction in a negative direction for those with reactive BISs. This is so partly because "experience" encoded into memory structures on which predictions are based is both vivid and biased toward negativity and partly because aversive cues in the environment are selectively processed. The negative distortion of information processing imparted by threatening stimuli may, in part, explain Beatty, Behnke, and McCallum's (1978) finding that anticipated speech

performance produced increased trait-like communication apprehension scores. Given the present state of knowledge, it seems reasonable to suggest that the general tendency for communication apprehensives to avoid communication is mediated by highly reactive BISs, triggered and amplified by attentional fixation on threatening features of the social environment, and vividly recalled aversive experiences with communication.

Although communication apprehensives usually avoid communication, there are times at which competing motivations compel them to communicate. Beatty, Forst, and Stewart (1986), for instance, found that highly apprehensive speakers were willing to deliver a public speech for the required duration if their motivation to achieve in the class was high enough. Booth-Butterfield (1988b) reported similar findings. In Gray's (1982, 1987, 1990, 1991) scheme, a separate neurological circuit, the *behavioral activation system* (BAS), responds to stimuli associated with reward and those associated with termination of punishment. Anatomically, the BAS includes the basal ganglia, the neocortical areas that connect to it, the dopaminergic fibers that ascend from the midbrain, and the thalamic nuclei (Gray, 1991). Important to predictions regarding communication apprehension and avoidance are that (1) apprehensives might engage in communication when the BAS is sufficiently activated, and (2) individuals low in communication apprehension might not communicate if the BAS is not sufficiently activated or if the situational stimuli are sufficiently threatening to reach their thresholds for BIS activation (e.g., lack of preparation for a business presentation, which if poorly executed could lead to dismissal). In general, reactions to stimuli can be predicted from reactivity of these two neurological systems, but stimuli of extreme magnitude can activate less reactive systems. This aspect of Gray's (1991) model fits well with the notion that traits constitute predispositions but are not necessarily deterministic in respect to behavior. At least two published studies tend to suggest that motivation induction can produce transitory avoidance and inhibition patterns that deviate from predictions based on communication apprehension levels (Beatty, Forst, Stewart, 1986; Booth-Butterfield, 1988b).

Gray's (1991) model depicting the BIS and BAS as separate systems, not merely opposite poles of a continuum, makes sense of some communication apprehension research findings. The "reward" factor that emerged from Burgoon's (1976) unwillingness to communicate scale failed to correlate significantly with measures of communication apprehension both in her initial study and in later research (e.g., Daly, 1978b). Similarly, Daly (1978a) found a small and nonsignificant correlation between communication apprehension and attitude toward communication. Beatty (1988b) reported a small, nonsignificant correlation between communication apprehension and the value of extreme success in public speaking. However, Beatty (1988b) did find moderate negative correlations between communication apprehension and the value of moderate and small success, which indicates that high and low apprehensives probably do not differ regarding the value of great success but high communication apprehensives value moderate to small success less than do those low in the trait. In sum, the results of research based on self-reports seems to conform to the neurologically-based conceptualizations of the BIS and the BAS and, thereby, add confidence to the appropriateness of Gray's model for reconceptualizing the behavioral predispositions associated with communication apprehension.

Neurobiology of the Predisposition Toward Verbal Inhibition

Research shows that when highly apprehensive people are unable to avoid situations in which communication is expected, they tend to talk less than people low

in the trait (Beatty, 1987; Beatty, Forst, & Stewart, 1986; Jablin & Sussman, 1978; Jordan & Powers, 1978; McCroskey & Richmond, 1977; Sorensen & McCroskey, 1977). In addition, studies show that responses to measures of communication apprehension correlate in the expected direction with other measures assessing individuals' reports of (Daly, 1978b) and inclinations toward verbal behavior (e.g., McCroskey, Beatty, Kearney, & Plax, 1985; Mortensen, Arntson, & Lustig, 1976).

As described above, activation of the BIS inhibits ongoing behavior when triggered by novel stimuli, punishing stimuli, or those associated with loss of reward. When flight is impossible, inhibition results. In the context of social interaction, the inhibition would take the form of low verbal production. Therefore, we would expect highly apprehensive communicators to exhibit verbal inhibition in the presence of strangers, when negative feedback is expected, or when talking might result in loss of reward. As discussed earlier, low apprehensives are not expected to talk merely because the BIS is inactive.

Implications of a Temperament-Based Theory of Communication Apprehension

On the one hand, the neurobiological systems responsible for inhibition are only incompletely understood. Certainly, we recognize that many aspects of Gray's (1982, 1987, 1990, 1991) model, for example, require further elaboration and refinement. On the other hand, enough is known about the neurobiology of avoidance and negative affect to advance our thinking about communication apprehension substantially. In this essay, we reformulated the conceptualization of communication apprehension firmly anchored in neurobiological processes responsible for temperamental expression. The best available evidence clearly suggests that the origin of the brain structures and circuitry described in this essay are inborn characteristics of individuals. As such, environmental factors are seen as having an extremely limited role in the development of such traits as communication apprehension. In short, the environment presents stimuli to which individuals react, but temperament mediates the effects of stimuli on the individual's state: Environment, at best, only slightly affects trait development.

The consistent effects of context (public speaking, group, public meeting, dyad) on state anxiety (Booth-Butterfield, 1988b; McCroskey, 1984), we believe, are attributable to quantifiable differences in the stimuli within each context. For example, features of context, such as audience size, preparation time, and familiarity with partner, can be quantified. However, the state anxiety differences across apprehension levels within each context underscores the role of temperament-related response thresholds (McCroskey & Beatty, 1984). Communication apprehension as temperamental expression does not imply that only communication apprehensives generate avoidance responses. Rather, anyone's behavioral inhibition system can be activated. Our position is that people who are high in communication apprehension avoid communication more often and engage in less verbal behavior than do those low in apprehension simply because it takes quantitatively less stimulation to activate the behavioral inhibition systems of communication apprehensives. Further, state anxiety reactions for individuals high in communication apprehension represent the effects of environmental barriers to basic temperamental expression (i.e., avoidance).

Our theoretical position represents a significant departure from the social learning perspective that has dominated the communication apprehension literature for the

past twenty years. However, the advances in neurobiology in just the past decade in comparison to the meager power of social learning theories, seem to warrant the shift. A little over a decade ago, Hans Eysenck (1986) remarked, "[T]he evidence is quite clear-cut: genetic factors are more important than environmental factors" (p. 16). Our aim in presenting a reconceptualization of communication apprehension was two-fold: (1) to present the construct as reflective of the contemporary state of genetic and neurobiological knowledge and (2) to stimulate thinking and research. Of course, the conceptualization advanced herein is by no means complete, but then theories and paradigms are never complete. As Barnes (1982) notes, "In agreeing upon a paradigm scientists do not accept a finished product, rather they agree to accept the basis for future work, and to treat as illusory or elminable all its apparent inadequacies and defects" (p. 42). Any particular theory must be evaluated in terms of alternative theories. The conceptualization of communication apprehension presented in this essay is superior to alternative social learning models in terms of predictive power, comprehensiveness of explanation, and parsimony. Moreover, the temperament-based theory appears to provide a more satisfactory sense of understanding concerning the development of communication apprehension. Eysenck (1986) reminds scholars dedicated to the scientific pursuit of theories and the establishment of dominant paradigms that "the ordinary business of science is the puzzle solving activity involved in discovering anomalies such as those occurring in the best-regulated sciences" (p. 4).

One of the "anomalies" or "imperfections" of a theory of communication apprehension based on temperament concerns the apparent efficacy of various conditioning therapies in reducing communication apprehension (Allen, Hunter, & Donohue, 1989). If communication apprehension is primarily a result of fundamental neurobiological structures, how are therapeutic effects other than those induced though the administration of drugs possible? We see conceptual and methodological issues, which either together or separately might account for the observed effects. First, although the goal of reducing communication apprehension is without question a laudable one, the internal validity of research designs employed in the evaluation of treatment programs is jeopardized in several ways (Campbell & Stanley, 1963). Because participants are selected on the basis of extreme scores, regression toward the mean is likely, and even when control groups are employed, nonrandom selection and the administration of pretests make it difficult to sort out the true treatment effects from those resulting from testing and pretest by treatment interactions (demand characteristics).

Second, studies have demonstrated that the stability of items assessing apprehension about public speaking (e.g., PRCA) depends in part on the participants' level of experience delivering speeches (Beatty & Behnke, 1980; Beatty & Andriate, 1985), and communication researchers have long recognized that the conditions under which the PRCA is administered affects the scores (Beatty, Behnke, & McCallum, 1978; McCroskey, 1978). Although the construct is conceptualized as a stable trait, responses to the measure can be distorted. Items of communication apprehension measures require respondents to report how they usually feel during public speaking. When students have little or no experience with public speaking, which is likely the case for most who volunteer for treatment, their responses to relevant items may reflect expectations.

As research indicates, PRCA scores shift depending on the match between speakers' experience and expectations but stabilize around the third performance

(Beatty & Andriate, 1985). These shifts, while not dramatic, are statistically significant and represent error in the respondents' anticipated response to public speaking while completing pretest phases of treatment. Transitory or state anxiety, which we discussed as the response to stimuli strong enough to stimulate even moderate to high BIS thresholds, is reflected in participants' trait scores and depends on the responders' amount of public speaking experience or the conditions under which the measure is administered (Beatty & Behnke, 1980; Beatty, Behnke, & McCallum, 1978; Beatty & Andriate, 1985; McCroskey, 1978). Across the entire population of student speakers, these fluctuations tend to average toward the mean. However, some extremely high scores decrease from pretest to posttest because participants can respond more accurately to the trait measure with experience, but low scorers, whose apprehension increases when public speaking experiences violate their expectations, are not included in treatment studies. Thus, it is difficult to determine how much of the observed effects is attributable to treatment and how much is artifactual.

Studies employing true experimental designs, such as the Solomon Four Group Design, for example, rather than quasi-experimental designs (Campbell & Stanley, 1963), could lead to a more accurate estimate of the extent to which changes in average communication apprehension scores are solely attributable to treatment protocols. Although efforts to reduce communication apprehension are laudable and perhaps any improvement in the condition justifies the effort, we should not be surprised if results of experiments in which the potential threats to internal and external validity are controlled reveal substantially less impact of treatment on communication apprehension than implied in some of the extant literature.

Third, it may be that the moderate effects achieved by treatment represent parameters within which environment can influence communication apprehension. Certainly, a purely genetic model of communication apprehension is more parsimonious than a mixed model. However, virtually no temperament theorist claims that traits are exclusively genetic products. Neither do we. However, the genetic evidence suggests that the inherited biological makeup of individuals imposes limits on the change that can occur and that the bandwidth for environmental effects it not very wide. In practical terms, we must remember that the range of the PRCA-24, is from 24 to 120, with a mean and standard deviation of 65.6 and 15.3, respectively. If it were discovered that treatment programs could produce large effects (i.e., .5 of a standard deviation, Cohen, 1988), we could reduce an individual's score by less than eight points. Although the difference would be statistically significant, it represents a downward shift of one scale point (on the five option Likert-type format) for eight of the twenty four items. Individuals scoring between ninety-eight and one hundred and twenty on the PRCA would still be classified as high in communication apprehension after large treatment effects.

It may turn out, as personality theorists working from a biological paradigm would maintain, that the ratio of genetic to environmental contribution to the development of trait communication apprehension is 80/20, although personality theorists (Eysenck & Eysenck, 1985) also caution that our trait measures are imperfect, and with psychometric refinement, the ratio is likely to be tipped even further toward genetics. For instance, the validity coefficients for Eysenck's personality measures are about of the same magnitude as the correlation coefficients for on those measures obtained in the studies of identical twins (Eysenck & Eysenck, 1985).

It may also turn out that scientific studies demonstrate that treatment programs

reliably produce moderate reductions in communication apprehension. As the material reviewed in this essay indicates, the effects reported in social learning studies and treatment evaluations generally fall within this range. However, it is becoming increasingly clear that biology is by far a larger influence and should be the centerpiece of etiological theories of trait communication apprehension. In fact, the communibiological paradigm of communication apprehension expressed in this essay provides a conceptual framework for understanding treatment effects that have been observed. As Allen, Hunter, and Donohue's (1989) meta-analysis shows, programs relying on single treatment strategies (e.g., skills training only) are much less effective than those composed of combined strategies. The greater efficacy of multiple strategies makes sense given our conceptualization of communication apprehension as neurotic introversion. That is, techniques, such as systematic desensitization, are designed to reduce anxiety, a neurotic feature of communication apprehension, whereas such strategies as skills training and cognitive restructuring basically develop skills and attitudes about communication that model those of extroverts. Our conceptualization, therefore, provides a theoretical framework for explaining the effects that might be observed in scientific studies of single and multiple treatment strategies.

Although ironing out the twenty percent of variance currently unexplained by a temperament-based conceptualization of communication apprehension will require "the ordinary business of science," it is a less complicated task than explaining the eighty percent not accounted for by learning theory. From this vantage point, the effects of environment (whether learning or treatment), not those of genetics, should be seen as the anomalies; temperament should be considered the dominant influence. Any theory in our discipline possessed of such predictive and explanatory value should be given serious consideration. We can think of no instance in which greater predictive power and more explanatory precision were required before acceptance of a paradigm as a viable alternative analytic framework.

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