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Temperament, Speech and Language: An Overview

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Abstract

The purpose of this article is to discuss definitional and measurement issues as well as empirical evidence regarding temperament, especially with regard to children's (a)typical speech and language development. Although all ages are considered, there is a predominant focus on children. Evidence from considerable empirical research lends support to the association between temperament, childhood development and social competence. With regard to communication disorders, extant literature suggests that at least certain elements of temperament (e.g., attention regulation, inhibitory control) are associated with the presence of certain communication disorders. However, the precise nature of this association remains unclear.

Three possible accounts of the association between temperament and speech-language disorder are presented. One, the disability model (i.e., certain disorders impact psychological processes leading to changes in these processes, personality, etc., Roy & Bless, 2000a) suggests speech-language disorders may lead to or cause changes in psychological or temperamental characteristics. The disability account cannot be categorically refuted based on currently available research findings. The (pre)dispositional or vulnerability model (i.e., certain psychological processes directly cause the disorder or indirectly modify the course or expression of the disorder, Roy & Bless, 2000a) suggests that psychological or temperamental characteristics may lead to or cause changes in speech-language disorders. The vulnerability account has received some empirical support with regard to stuttering and voice disorders but has not received widespread empirical testing for most speech-language disorders. A third, interaction account, suggests that “disability” and “vulnerability” may both impact communication disorders in a complex, dynamically-changing manner, a possibility that must await further empirical study. Suggestions for future research directions are provided.

Keywords

temperament; speech; language; speech-language disorder; emotion; children; SLI; stuttering; voice disorders

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Introduction

Purpose

The purpose of this article is to review issues and empirical evidence regarding temperament, especially those that may relate to children's (a)typical speech and language development. The issues and empirical evidence discussed will be selective rather than exhaustive, thus providing the reader with an informed, reasonably balanced overview of temperament in general, and specifically as it relates to the development of speech and language. By so doing, we hope to encourage further reading, expanded empirical study and therapeutic explorations of possible associations between temperament and (a)typical speech-language development.

The present review will focus on early childhood, when speech and language are developing, as it is during this time period that the environment, temperament and their interactions are particularly salient. Given the developing, evolving nature of speech and language during early childhood, changes in children's communication abilities may be associated with facilitating and/or inhibiting influences of environmental events and/or temperamental influences. This review will mention instances in which early childhood temperament seems associated with or predictive of later childhood, teenage or adult temperament, social and/or speech-language development but, on the whole, will focus on early childhood development.

One difficulty in studying temperament is that there is no single definition with which all agree. Although most approaches consider the concept of temperament to be an umbrella for groups of specific traits, the bases for selecting those traits differs. Thus, the present review begins with a discussion of various definitions of temperament, highlighting points of agreement and disagreement among theorists. A second challenge is that various perspectives include importantly different aspects or dimensions of temperament, with some emphasizing a single unifying dimension and others distinguishing multiple dissimilar aspects. To address these challenges, several major approaches to temperament definition and description are reviewed.

Building upon that review is a brief synopsis of theoretical perspectives on temperament as related to development during the early years of life. This synopsis is followed by a description of methodologies for measuring temperament, including caregiver reports, behavioral observations and psychophysiological measures. Next, a consideration of various perspectives on the relation between temperament and speech-language development is presented, followed by consideration of findings linking temperament to specific speech-language disabilities including specific language impairment, stuttering, and voice disorders. Finally, suggestions are presented for future investigation of links between temperament and typical and atypical communicative development.

Definition

Goldsmith and colleagues (1987) suggested that most researchers interested in temperament assume that "...temperament is a rubric for a group of related traits and not a trait itself" (p. 506). Similarly, Zentner and Bates (2008) note that "...temperament has many faces, including genes, neurobiological substrates, endophenotypes and overt behavior patterns" (p. 29). Given these many "faces," it is not surprising that there are a variety of definitions of temperament, making reaching a consensus definition challenging.

Goldsmith and colleagues (1987) define temperament as individual differences in a person's emotional reactivity and regulation. Similarly, Rothbart and Derryberry (1981, cited in Rothbart, 2007) define temperament as "... individual differences in emotional, motor, and

attentional reactivity measured by latency, intensity and recovery of response, and self-regulation processes such as effortful control that modulate reactivity” (p. 207). Rothbart further cites Posner, Rothbart and Sheese (2007) as suggesting that “these differences are biologically based and are linked to an individual's genetic endowment” (p. 207). Indeed, as will be discussed later in this review, “heritability” is a salient part of many theories of temperament. Thus, children may not only inherit vulnerabilities for certain speech-language disorders but also proclivities for certain temperamental characteristics.

Although there are nuanced as well as substantive points of departure, one common thread among many definitions is the notion that temperamental traits are consistent across situations and moderately stable over time (Sanson, Hemphill & Smart, 2004). Definitional differences aside, Sanson, Hemphill, and Smart (2004) suggest that “...a consensus is emerging that the term ‘temperament’ refers to constitutionally-based differences in behavioral style that are visible from the child's earliest years” (p. 143). Consistent with this suggestion is the definition of Rothbart and Bates (1998) that temperament involves “constitutionally-based individual differences in emotional, motor and attentional reactivity and self-regulation...(that are) relatively stable over time” (p.109). It should be noted that constitutionally- or biologically-based components include genetic factors, but also include non-genetic elements such as prenatal, environmentally-based variables (e.g., prenatal drug exposure), birth complications, and perinatal influences present in the child's early rearing environment. Salient among temperamental characteristics are the constructs of activity, affectivity, attention and self-regulation. Major elements of temperament, unlike personality (the latter to be briefly discussed immediately below), are thought to be present early in life. However, as Buss and Plomin (1987) suggest, ...their biological origins do not render them fixed for life. They “...are expected to vary under the effect of developmental events and environmental forces” (p. 514), interacting with biological elements. Thus, while temperament is thought to be “open” to environmental influences, it is also thought to have a biological basis. Zentner and Bates (2008) suggest the need to also consider “...acquired components of temperament” (p. 29). For example, some behaviors salient in infancy (e.g., visual exploration) are predictive of other behaviors in later development (e.g., novelty seeking in adolescence) (Shiner et al., 2012). Whether or not these acquired components are better considered to be elements of personality, resulting from the interaction of temperament and experience over time, remains unclear.

Personality is thought to emerge or develop from temperament co-acting with experience (Rothbart, 2007). As Rothbart (2007) suggests, “Temperament and experience together ‘grow’ a personality” (p. 207). As such, the resulting personality reflects the person's cognitions about others, self and the physical and social world, including variables such as attitudes and values. Or as Henderson and Wachs (2007) indicate, “While temperament may provide the foundation for the later emergence of personality, temperament per se does not include complex processes such as attributions, self-concept, or conscious self-presentation, concerns that are central to the expression of personality” (p. 398).

Perspectives on Temperament

For readers seeking comprehensive information about the evolution of theory and knowledge about temperament that has accumulated over the past 35-plus years, many excellent reviews are available (e.g., Goldsmith, et al., 1987; Kagan & Snidman, 2004; Henderson & Wachs, 2007; Rothbart, 2011; Rothbart & Bates, 1999; Sanson et al., 2004; Strelau, 1983,1998; Zenter & Bates, 2008; Zentner & Shiner, 2012). There are also reviews pertaining to more specific topics such as gender and temperament (Else-Quest, Hyde, Goldsmith & Van Hulle, 2006), and behavioral genetic perspectives on temperament (Saudino, 2005). The present review focuses on several prominent, long-standing theories of

temperament, and discusses their possible relations to (a)typical speech-language development.

Prior to presenting specific temperament models, we will consider some ideas or perspectives that cut across or relate to several formal models of temperament. To do this, we will briefly discuss some of the more common perspectives regarding the association between children's temperament, experiences (i.e., environmental influences) and their social-communicative development. In short, as shown in Figure 1, such “meta” considerations highlight the fact that the influence of temperament on social-communicative development can be viewed from several vantage points (for further review of such considerations, see Sanson, et al., 2004).

First, Figure 1 (A) illustrates what may be termed the *environmental* perspective. This perspective essentially focuses on the environment, rather than the child's temperament, as the primary contributor to the child's social-communicative development. It places emphasis on exogenous influences on the child's social-communicative development (e.g., caregiver child-raising practices, experiences at school). This type of model was popular until the ground-breaking report of the New York Longitudinal Study (Thomas, Chess, Birch, Hertzog, & Korn, 1963), which began in the mid-1950s and continued over several decades.

Second, Figure 1 (B) shows the *temperament* perspective. Beginning with the work of Thomas, Chess and colleagues, and subsequently that of Rothbart, Bates and colleagues, Buss and Plomin, Kagan and colleagues, as well as others, the child's role in his or her own social development became increasingly acknowledged and emphasized. This perspective considers temperament to directly impact social-communicative development. As Sanson and colleagues (2004) point out, this perspective has, at times, placed most of the emphasis on the child's temperament, while de-emphasizing environmental influences (essentially the converse emphasis of the environmental perspective).

The third perspective (Figure 1 (C)) suggests that *environment and temperament moderate one another*. From this perspective, temperament and environmental factors are not main effects predicting developmental outcomes; rather, they combine to influence a child's social-communicative development in ways that could not be predicted from the influence of either alone. That is, temperament and experience interact in developing social-communicative behavior, but neither takes causal precedence. For example, a child with a relatively fearful temperament, interacting with an environment of gentle rearing practices, might have a different social-communicative outcome than if his or her rearing environment had been stricter or more confrontational (Kochanska, 1993, 1997).

Fourth, are *mediated* effects (Figure 1 (D)), whereby temperament indirectly impacts a child's social-communicative development through the influence of experiences or, conversely, experiences modifies the child's temperament and subsequent social-communicative development. In the first instance, child temperament may elicit differential caretaking behaviors from parents and teachers, thereby changing the child's experiences. For example, consider the case of inhibited and uninhibited temperaments (Kagan, Reznick, & Gibbons, 1989). The third author was once scolded (by another developmental psychologist) for responding to her two children differently one morning as the children dawdled over breakfast. She admonished her son (a bold child) more severely, whereas to her daughter (a more timid, fearful child), she spoke gently. Her response to the reproof was to say, “If I spoke to him that gently he would not even notice the scolding. If I scolded her that harshly, she would dissolve into a puddle of tears and breakfast would be over.”

Temperament may also serve as a mediator of environmental effects. In this case, experience may act to change a child's temperament and thus influence social-communicative

development. The same author described above developed strategies of gently encouraging her timid daughter to engage the social environment more actively or boldly in safe, familiar contexts and then supporting her in responding positively to gradually more demanding contexts. Her daughter eventually overcame her timidity and became more outgoing and less fearful. In Western cultures in which inhibition is less valued, children are more likely to change classifications from inhibited to uninhibited than from uninhibited to inhibited as they age from infancy to preschool (Kagan, Snidman, & Arcus, 1988), perhaps illustrating the role of cultural values on changes in temperament toward a more highly valued style.

A fifth perspective (Figure 1 (E)) is that of *goodness-of-fit* between temperament and environment (e.g., Seifer, 2000). Sanson et al., (2004) describe this perspective, noting that, in the ideal case, "...high compatibility between temperament capacities and contextual requirements facilitates healthy development" (p. 145). Researchers and clinicians who are familiar with theoretical perspectives regarding stuttering will recognize the similarities between the "goodness of fit" concept and the demands and capacities model of stuttering (Adams, 1990; Starkweather, 1990). Likewise, as Zentner and Bates (2008) suggest, "...sometimes problems arise not so much because of children's temperaments, as because of lack of fit between the child's temperamental characteristics and the caretaker's responses" (p. 29).

It is unclear whether *moderated*, *mediated* or *goodness-of-fit* effects (or none of these) predominate; however, these various perspectives help us consider that non-temperamental factors, whether singularly or in concert with temperamental variables, impact a child's social-communicative development. Similarly, it is uncertain how temperament, in concert with environment, impacts concurrent speech and language development. Indeed, the pendulum of opinion regarding primary influences on children's speech-language development has also varied from environment-centric to child-centric perspectives. We will return to these considerations later when we attempt to account for influences, inside and outside the child, on speech-language development. First, specific models of temperament are presented.

Theoretical Approaches to Temperament

This review of theoretical approaches to temperament resembles more of a framework, as Rothbart and Bates' (1998) said about their review, "...for thinking about theoretical, empirical and clinical approaches" (p. 105). To provide representative coverage, we have selected the work of five generative theorists as follows: (1) Thomas, Chess and colleagues' (1968, 1977), (2) Buss and Plomin (1975, 1983), (3) Goldsmith and Campos (1982, 1996), (4) Rothbart and colleagues (1981, 2007; Rothbart, Ahadi, Hershey & Fisher, 2001), and (5) Kagan and colleagues (1994, 2004). The first four are considered the original "Big Four" theories of temperament (Shiner et al., 2012). The fifth, Kagan and colleagues, provides a more in-depth view of selected aspects of temperament using multiple research methodologies. Other theorists have contributed to this area, for example, Bates (1989), Cloninger (1987), Gray (1991) and Strelau (1983), and will be cited where appropriate. Examination of Table 1 reveals that "temperament" is not a unitary construct, as all theorists include a variety of dimensions that are often posited to be unrelated to each other.

Thomas and Chess (e.g., Thomas, Chess & Birch, 1968)

Most researchers in the area of temperament would credit Thomas, Chess and colleagues for ushering in the modern-day approach to temperament by shifting sole focus from the child's environment to the child, thus firmly inserting the child into the matrix of variables explaining social-communicative development. They noted that "temperament is always expressed as a response to an external stimulus, opportunity, expectation or demand"

(Goldsmith, et al., 1987, p. 509). In the New York Longitudinal Study (NYLS), begun in 1956, nine temperamental dimensions were identified—based on a classification scheme developed by Herbert Birch—that were found to be present in infancy and continue throughout life. The nine included rhythmicity of bodily function, activity level, approach to/withdrawal from new stimuli, adaptability, sensory threshold, predominant quality of mood, intensity of mood, expression, distractibility and persistence/attention span. According to Thomas and Chess, these nine dimensions combine to form superordinate categories of “easy, or flexible,” “slow-to-warm-up or cautious” and “difficult, active or feisty” from the perspective of ease of care giving. (Not all researchers agree about what constitutes a difficult temperament). Thomas and Chess (1977) suggested that “Temperament can be equated with the term ‘behavioral style’. Each (temperamental dimension) refers to the how rather than the what (abilities or content) or the why (motivation) of behavior” (p. 9). As with most ground-breaking work, subsequent research has refined the dimensions suggested by Thomas and Chess, noting redundancies among dimensions. From the results of the NYLS, Chess and Thomas formulated a theory of goodness of fit between parental expectations and child temperament, which became the focus of their therapeutic interventions (as child psychiatrists).

Buss and Plomin (e.g., 1983)

Using criteria emanating from other areas of psychology, they defined three temperamental traits or dimensions—emotionality, activity level, and sociability (see Table 1)—reduced from four original dimensions because factor analyses did not support the factor of impulsivity. According to Buss and Plomin, these traits are observable as behavioral differences among primates, appear early in life (i.e., infancy), are heritable (i.e., have relatively clear connections to physiological and biological processes) and are stable from early to later ages. The criterion of continuity is especially salient. If a trait appeared and disappeared during infancy, Buss and Plomin downplayed its import for later child development; however, if it remained from infancy through later ages, whether in whole or in part, they considered the trait salient to all periods of development. Consistent with this criterion, the present authors speculated that temperamental dimensions that are present prior to, throughout and after speech-language milestones emerge, may be most likely to impact overall development, emergence of, and changes in speech/language abilities and skills. We believe that, to be most useful, such dimensions should be accessible for descriptive as well as experimental study of the association between children's temperament and their speech-language development.

Goldsmith and Campos (1982, 1987)

Placing emotions and their regulation at the center of their conceptualization of temperament, these theorists studied individual differences in the probability of experiencing and expressing negative and positive primary emotions (such as anger, sadness, fear, joy, and disgust, though other emotions such as jealousy, shame, or envy are also possible candidates). Although the nature of emotion regulation goes far beyond the purview of this review, it should be noted that Campos, Frankel and Camras (2004) suggested that emotion and its regulation may be inseparable. In contrast, as we will see later in this overview, some scientists within the field of speech-language pathology have considered emotional reactivity and emotion regulation, although related, to be separable, with empirical findings supporting this notion, at least during certain situations or tasks.

Rothbart and colleagues (e.g., Rothbart & Bates, 2006; Rothbart, 2012)

Similar to that of Goldsmith and Campos, Rothbart's definition of temperament suggests that it involves biologically- or constitutionally-based individual differences in emotional reactivity and self-regulation. Rothbart suggests that autonomic, affective and

neuroendocrine processes are salient to the study of reactivity or biological arousal. Thus, Rothbart and colleagues conceptualize a strong connection between overt behavior and neurobiological processes. Rothbart's, like Kagan's (see below), approach to dimensions of temperament (e.g., effortful control or the capacity to inhibit a dominant response in favor of a subdominant one) suggests her belief in the importance of Buss and Plomin's "continuity" criteria, in that she follows itemperamental dimensions from infancy through early childhood and beyond. Furthermore, her approach is hierarchical in that several specific aspects of temperament, particularly reactivity and regulation, combine to define the higher-order constructs of surgency/extraversion, negative affect and effortful control. Finally, her approach is developmental in the sense that specific aspects of temperament that are salient in identifying reactivity and regulation change over childhood.

Kagan and colleagues (e.g., Kagan & Snidman, 2004)

If the former theorists provided the foundation for scientific approaches to temperament, Kagan and his colleagues have provided considerable portions of the superstructure of our present-day understanding of temperament. Focusing on one dimension of temperament, behavioral inhibition or high reactivity (i.e., avoidance and/or distress when confronted with novelty, change or difference, as well as wariness of strangers), Kagan and his colleagues have employed multiple methods to obtain converging lines of evidence regarding classification of children as behaviorally inhibited or uninhibited (each typically defined as the upper and lower tails of the distribution). In keeping with Buss and Plomin's continuity criteria, Kagan and colleagues have studied behavioral inhibition longitudinally by means of direct behavioral observations, psychophysiological measures and cortical activity. Results of these studies led Kagan and colleagues to identify approximately 20% of infants as "high reactive" (i.e., frequent motor activity/crying at unexpected appearance of unfamiliar stimuli) and about 20% of infants as "low reactive" (i.e., minimal motor activity and crying in response to unfamiliarity), with the rest in the "typical" or "average" range. Following infants from 4 months to 14 and 21 months and then observing them at 4.5 years of age, Kagan, Snidman, and Arcus (1998) reported that only a modest proportion of children maintained a consistently inhibited or uninhibited phenotype at all ages. Approximately 20% of infants changed their 2-2.5 year classification from one extreme to the other by age 7, with more changing from inhibited to uninhibited (Kagan, Reznick and Snidman, 1988). Most shifts, however, were from the extremes into the typical range. Besides behavioral observations, Kagan and colleagues (Kagan, Reznick & Snidman, 1987, 1988) also explored the physiological associates of behavioral inhibition. They found that more of the inhibited (when compared to uninhibited) children showed activation in one or more physiological circuits that usually respond to novelty and/or challenge. Specifically, these circuits involved the hypothalamic-pituitary-adrenal axis, the reticular activation system and the sympathetic branch of the autonomic nervous system.

Following this line of investigation, Blackford and colleagues (e.g., Blackford, Allen, Cowan & Avery, 2012; Blackford, Avery, Cowan, Shelton, & Zald, 2011; Clauss, Cowan & Blackford, 2011) conducted neural imaging studies of individuals with inhibited temperament. They report that (a) inhibited individuals, when compared to uninhibited individuals, exhibit a larger amygdala but smaller dorsal anterior cingulate gyrus responses when expecting to see a face depicting fear (Clauss et al., 2011); (b) inhibited individuals have increased amygdala responses when viewing both novel and recently familiarized faces, whereas uninhibited individuals only exhibit increased amygdala responses in response to novel faces (Blackford et al., 2011); and (c) inhibited individuals' amygdala and hippocampal responses do not habituate (decrease) across repeated presentations of faces, whereas uninhibited individuals' amygdala and hippocampal responses habituate to repetition. Consistent with Kagan's speculation, Blackford and colleagues' neural imaging

findings suggest that inhibited individuals are wary of social situations and fail to habituate after repeated exposure to novel social stimuli. Further, their apparent sensitivity-to-change and slowness-to-habituation does not appear to be adequately regulated by inhibitory control from the dorsal anterior cingulate cortex.

Where does the above brief review of theory relative to temperament lead? While there is both divergence and convergence of opinion, most of the above approaches suggest that temperament (1) starts in infancy, (2) has a biological basis, and (3) is moderately stable from infancy onward (particularly in the context of a stable environment). Some theorists assign more or less import to specific contributions, but, in general, there is considerable commonality among these theories. The utility of theories of temperament, individually or in combination, requires assessment using a finite number of reliable methods, a topic to be discussed immediately below.

Temperament: Methods of Measurement

Several measurement methods have been used to study temperament. Caregiver questionnaires have been most widely used. (For pros and cons of caregiver questionnaires/reports, see Kagan, 1998; Rothbart & Bates, 1998). Direct behavioral observations also have been used (e.g., Kagan, 1998), as have physiological methods such as salivary cortisol (e.g., Gunnar, 1994). Temperament also has been recently studied through various neural imaging procedures such as fMRI (e.g., Blackford et al., 2012) and EEG/ERP (e.g., Marshall & Fox, 2007). Each method provides a different perspective, with the “ideal” approach likely to involve the concurrent use of several methods to provide converging lines of evidence.

Caregiver rating scales

To date, caregiver rating scales have been the primary tool used to measure children's temperament. These scales examine children's general social functioning and include the *Behavioral Style Questionnaire* (McDermitt & Carey, 1979), *The Children's Behavior Questionnaire* (Rothbart, Ahadi, Hershey & Fisher, 2001), the EAS Temperament Survey for Children: Parental Ratings (Buss & Plomin, 1984), and the *Dimensions of Temperament Survey-Revised* (Windle & Lemar, 1986). Some authors (e.g., Eisenberg, Fabes, Bernzweig, Karbon, Poulon & Hannish, 1993) also have reported composite measures of children's social tendencies based on parent, teacher and observer reports.

One of the main strengths of parent-report rating scales is that they are based on (a) numerous caregiver observations of children (b) over a relatively lengthy period of time and (c) averaged across a variety of situations and contexts. This “averaging” effect, or “long-term” perspective, seems quite appropriate for the measurement of temperament, a set of behavioral characteristics thought to be *relatively stable* over time. However, this means of measurement also has a downside in that it is not particularly sensitive to how temperament may be uniquely or differentially expressed within and across contexts. Strelau (1983) and others have suggested that parents/caregivers may be biased informants, rendering their responses to questionnaires about their children somewhat questionable. Likewise, Kagan (1998) raises concerns about the accuracy of parent reports. In contrast, Henderson and Wachs (2007) suggest that “While parent report measures do contain some subjective parental components, available evidence indicates that these measures also contain a substantial objective component that does accurately assess children's individual characteristics” (p. 402). The use of non-parental observers (e.g., empirical investigators), to corroborate or validate parental reports, is one means for addressing parental bias. As Rothbart and Bates (1998) note, however, “mother and observer reports may each be reliable and potentially valid, but... tap *different* (emphasis added) portions of the variance of infant behavior” (p. 124).

Behavioral observations

Behavioral observations are another common means of studying temperament in home, clinic and/or experimental settings. Such procedures avoid issues of parental bias and can address the issue of how temperament is expressed in a specific context. Conversely, by controlling for context, generalizability of findings may be limited to the context in which they were obtained. One of the more widely-used experimental procedures, Lab-TAB (Goldsmith & Rothbart, 1996), allows direct observation of the child's behavior in a variety of experimentally-presented tasks. One major challenge to such testing is the need to obtain reasonable degrees of inter-judge coding reliability, a non-trivial, labor-intensive task. One benefit is the ecological validity of directly observing the child's behavior under conditions thought to facilitate or inhibit expressed temperament. For further review of this methodology see Rothbart and Goldsmith (1985).

Psychophysiology

Psychophysiological associates of children's temperamental expression can be measured in several ways including *electroencephalography* (EEG/ERP) (e.g., Henderson, Fox, & Rubin, 2001; Marshall and Fox 2007; Kagan & Snidman, 1999), *salivary cortisol* (e.g., Dettling, Gunnar, & Donzella, 1999; Gunnar, Seabanc, Tout, Donzella & van Dulmen, 2003; for further review, see Dickerson & Kemeny, 2004), *skin conductance level* (e.g., El-Sheikh, Kouros, Erath, Cummings, Keller, & Staton, 2009), fMRI (e.g., Blackford, et al., 2012) and *respiratory sinus arrhythmia* (e.g., Doussard-Roosevelt, Montgomery, & Porges, 2003; for further review, see Porges, 2007).

As with most psychophysiological procedures, participant cooperation, especially with preschoolers, can be a challenge. However, modern-day high-density EEG electrode nets have been used to study frontal alpha asymmetry (for review, see Coan & Allen, 2004) in preschool-age children who stutter (Arnold, Conture, Key, & Walden, 2011), providing one viable means to objectively assess emotional processes in children. As with behavioral observations, reduction/analysis of the data is labor-intensive, requiring considerable experience and expertise to perform.

Psychophysiological measures do not require parent and observer responses to assess temperament, provide relatively continuous measurement during a variety of conditions, and are, thus, more objective measures. However, the need for participant cooperation and restricted movement/activity, especially when studying young children, poses challenges (e.g., by limiting the types of stimuli and protocols that may be used). Importantly, the relation that these psychophysiological measures have to caregiver reports and/or behavioral observation is not always clear. Also, given that most psychophysiological measurement must take place in clinical or experimental settings, generalization of findings may not be made to other contexts.

One advantage of psychophysiological measures is that they provide additional objective means for examining temperamental/emotional processes during the very early stages of speech and language development, a period during which most children have had little experience with their communication difficulties. Thus, finding psychophysiological differences between young children with versus without a speech-language disorder would help address the “directionality effect” (Treon, 2010), that is, whether emotions lead to speech-language disorders or speech-language disorders lead to emotions. Arguably, concurrent use of all three—caregiver report, behavioral observation and psychophysiology—would provide the best view of temperamental/emotional processes and their association with speech and language development and disorders.

Temperament and Speech-Language: General

Figure 1 presents several perspectives of the relation between children's temperament and their social-communicative development. The same perspectives may be applied to the relations between children's temperament and their speech-language development and/or disorders. As Salley and Dixon (2007) state, "Following the assumption that temperament contributes to language development, we must ask how it would do so" (p. 131). In this section we will discuss direct and indirect means by which temperament may impact speech-language. We will then present representative empirical findings regarding the association between temperament and speech-language development. In a subsequent section, we will present empirical findings regarding the association between temperament and speech-language disorders.

Rieser-Danner (2003) suggested that temperament may have both direct and indirect influences on language. A direct influence, as discussed by Salley and Dixon (2007, p. 131), might consist of "...children's difficult temperaments... limit[ing] the extent to which they can process linguistically relevant information during language acquisition events." Salley and Dixon further suggest that, "...when children are very high in negative affectivity, a relatively greater burden is placed on their behavioral control systems, which must regulate this negative affectivity. The end result is fewer resources available for linguistically relevant activities such as paying attention to word-referent associations when learning novel labels" (pp. 131-132). If the latter explanation is true, then one would expect that greater inattention would be associated with lower receptive or expressive vocabulary, a relation we will examine in the section discussing temperament and speech-language disorders.

An example of a theoretical position that emphasizes direct influences is that of Bloom and Capatides (1987; Bloom, Beckwith, and Capatides, 1988). They found that infants and toddlers who spent more time in positive or negative emotional states were delayed in early language learning relative to children who spent more time in affectively neutral states. They proposed that emotions and early language are alternative modes of expression for very young children. Furthermore, more time spent in neutral states allows the reflective stance that would appear supportive for early language learning. Of course, this emotion-leads-to-language-delay account does not preclude the possibility that language-delayed children may also become anxious, frustrated or upset because of their difficulties communicating. Amplifying this idea, Karrass and Braungart-Rieker (2003) provided some evidence that aspects of parenting, particularly maternal responsiveness to their children (e.g., affective warmth), can moderate relations between a child's temperament and his/her language development. Little, however, is known about how parenting and temperament interact relative to atypical speech and language development.

Regarding *indirect* (mediated) influences, Salley and Dixon (2007) suggest that "...the kind and duration of interpersonal exchanges entered into by temperamentally difficult children may be different than those entered into by easy-going children, and these interpersonal relationships may have differential consequences for language acquisition" (p. 132). For example, a shy, reticent child may have reduced experiences communicating, decreasing the time the child has to implement and practice newly-developed speech-language skills. Importantly, a child may be impacted by both direct and indirect influences. It also is possible that temperament has little or no impact on children's speech-language development and/or disorders; however, as we shall see subsequently, research findings suggest otherwise.

Typical speech-language planning and production can be divided into syntactical (grammar), lexical (words) and phonological (sounds) sub-domains. One area, vocabulary, or lexical

acquisition and storage, has been studied frequently (e.g., Dixon & Shore, 1997; Dixon, Salley, & Clements; Dixon & Smith, 2000; Kubicek, Ernde, & Schmitz, 2001; Morales, Mundy, Delgado, Yale, Neal, & Schwartz, 2000; Noel, Peterson, & Jesso, 2008). In general, results from these empirical studies suggest that children with stronger expressive and receptive vocabularies, when compared to those with weaker vocabularies, exhibit greater adaptability, more positive moods, less emotionality, greater soothability and longer attention spans. Dixon and Smith (2000) reported that temperamental adaptability and soothability, mood and smiling/laughter, and persistence and duration of orientation, were all positively associated with language development. These authors also suggested that temperament influences language through attention and positive emotionality. Thus, the role of attention in relation to children's speech-language disorders may be salient to typical as well as atypical speech-language development. Longer attention spans and greater abilities to regulate attention (both temperamentally-based "skills") may facilitate children's abilities to focus on linguistically-relevant events, thereby increasing their breadth and depth of vocabulary.

Turning to syntactical processing (reception) and production (expression), Slomkowski, Nelson, Dunn, and Plomin (1992) reported that the temperamental factor of affect-extraversion (high interest in persons, cooperativeness and happiness and low fearfulness) at age two was significantly correlated with producing (expressing) and processing (receiving) language at age seven. Relatedly, children's latency to the first spontaneous utterance in a conversation has been used as one index of behavioral inhibition (Kagan, Reznick, & Gibbons, 1989). Thus, the relation between language and temperament appears to have empirical support. The question of directionality of effect remains—that is, do temperamental variables lead (a)typical language behavior, does (a)typical language behavior lead to temperament or do they bi-directionally influence one another? Further study is needed to address these questions.

Temperament and Speech-Language: Specific Disorders

Following from the above general review of temperament, we now consider how various aspects of temperament may relate to speech-language disorders. In 1991, Conture stated that, "No one knows whether and/or how a child's temperament interacts with his or her abilities to develop speech and language. If speaking abilities and individual differences in emotionality, activity, and sociability do interact in children, the possible permutations are endless" (p. 381). As the following discussion will suggest, empirical evidence has begun to unravel the possible permutations

Specific Language Impairment (SLI) and Temperament

Paul and Kellogg (1997) were among the first to assess the association between temperamental characteristics and childhood language problems, specifically, "late talking." They reported that 2-year-old children identified as being slow in expressive language development, when studied in the first grade (at about six years of age), were rated (by parents and clinicians) on a standardized temperament assessment instrument as significantly lower on approach (i.e., more likely to withdraw) than peers with normal language history. This suggests that children with delayed language exhibit greater shyness, aloofness, and/or reduced outgoingness than their peers whose language development is more typical. Further, approach/withdrawal scores were reported to be significantly correlated with average sentence length in spontaneous speech.

Fujiki, Brinton, colleagues, and students, have provided a large body of evidence regarding the association between emotional, social, and temperamental variables and specific language impairment (SLI; e.g., Fujiki, Brinton, & Clarke, 2002; Fujiki, Brinton, Issacson,

& Summers, 2001; Fujiki, Brinton, Morgan, & Hart, 1999; Fujiki, Brinton, Robinson, & Watson, 1997; Fujiki, Brinton, & Todd, 1996; Fujiki, Spackman, Brinton, & Hall, 2004). Specifically, these researchers have reported that elementary school children with SLI, when compared to peers with normally developing language skills, exhibit (a) lower social skill, as well as lower quality and quantity of peer relationships (Fujiki, Brinton, & Todd, 1996); (b) more reticent behavior and less impulse control/likability and prosocial behavior (Fujiki, Brinton, Morgan, & Hart, 1999); and (c) less accuracy at identifying surprise and disgust faces, as well as emotion expressed in music excerpts (Spackman, Fujiki, Nelson, & Allen, 2005). Further, boys with SLI, when compared to girls with SLI, as well as boys and girls with normally-developing language, exhibited lower ratings on emotional regulation (Fujiki, Brinton, & Clarke, 2002). However, SLI children and their normally developing peers did not differ in terms of reticent behavior (e.g., withdrawing from or negatively reacting to novel or different stimuli or situations) (Fujiki, Spackman, Brinton, & Hall, 2004). These findings raise the issue of directionality of effect. For example, did SLI lead to these emotional/social differences or vice versa? Interpreting such findings is a challenge, particularly when investigating older children. However, the work of Fujiki and colleagues clearly demonstrates an association between SLI and emotion, regardless of the direction of effect between language and emotion.

More recently, researchers have focused on the relation between attention and SLI. Studies have shown that children with SLI are more likely (than peer controls) to exhibit deficits in sustained attention, even in the absence of diagnosed attention disorders (Finneran, Francis, & Leonard, 2009; Spaulding, Plante, & Vance, 2008). Discussing their findings, Spaulding et al., (2008) suggested that “differences in performance on tasks involving sustained selective attention may be, in part, a function of the task's demands on limited attentional resources” (p. 29). These findings are consistent with those of Dixon and Shore (1997) who showed that children around 2 years of age with a more analytical/referential “linguistic style” demonstrated longer sustained attention (among other characteristics) when evaluated several months earlier.

Overall, it would appear that attentional, emotional and social differences are associated with SLI in children, possibly contributing to the difficulties these children have with communication. Given that many temperamental characteristics can be identified during infancy, prior to children's first words, it is unlikely that language abilities or difficulties “produce” the entirety of children's temperamental characteristics. The notion that language development is unlikely to play a causal role in temperament is consistent with Saudino's (2005) review of twin and adoption studies indicating that many aspects of temperament appear to have a genetic basis, at least to a moderate degree. The same could be said about differences in attention, a variable that may have significant impact on language development separate from, and/or in conjunction with, temperamental/emotional factors.

Stuttering and Temperament

Recently, Kefalianos, Onslow, Block, Menzies, and Reilly (2012) reviewed ten published empirical studies of the relation between temperament and early stuttering (for an earlier review of this topic, see Seery, Watkins, Mangelsdorf, & Shigeto, 2007). In general, they tentatively concluded that there may be some association between temperament and stuttering in preschool-age children. The tentative or guarded nature of their conclusion was based on several factors, including the modest number of studies ($n = 10$) in this area as well as inconsistencies among findings. Their review also revealed some consistencies. Specifically, using independent replication of findings as a guideline for “trustworthiness,” they reported that preschool-age children who stutter (CWS), when compared to preschool-age do not stutter (CWNS), exhibit (1) lower adaptability (three independent replications),

(2) lower attention span/persistence (three independent replications), (3) more negative quality of mood (two independent replications) and (4) higher activity level.

When examined on a study-by-study basis, findings indicate that young CWS, when compared to young CWNS, are (a) more reactive to environmental stimuli (Wakaba, 1998), (b) more negative in their affect/emotions (Howell et al., 1987; Johnson, Walden, Conture, & Karrass, 2010; Ntouriou, Conture, & Walden, 2011), (c) less able to maintain attention and less adaptive to their environment (Anderson, Pellowski, Conture, & Kelly, 2003; Embrechts, Ebben, Franke, & van de Poel, 2000), (d) less able to disengage their attention when required (Bush, 2006) or shift attention (Heitman, Asbjørnsen, & Helland, 2004; Eggers, De Nil, & Van den Bergh, 2010), (e) more likely to exhibit problematic scores on attention scales based on caregiver report (Felsenfeld, van Beijsterveldt, & Boomsma, 2010), (f) less able to ignore changes in irrelevant background stimuli (Schwenk et al., 2007), (g) significantly less efficient in orienting of attention (Eggers, De Nil, & Van den Bergh, 2012; cf. Johnson, Conture, & Walden, 2012), and (h) lower in inhibitory control, as well as significantly higher in anger/frustration, approach and motor activation (Eggers, De Nil, & Van den Bergh, 2010).

Overall, these findings are consistent with the review by Kefalianos and colleagues review, which suggests that childhood stuttering may be associated with negative affect, poorer adaptability, and difficulties with attention. In contrast, two other studies of temperament and stuttering (Lewis & Goldberg, 1997; Williams, 2006) reported that CWS, when compared to CWNS, were (a) less negative and more adaptable (Lewis & Goldberg, 1997) and (b) more likely to exhibit the temperamental constellation of an “easy child” (Williams, 2006). Interestingly, the latter study also reported that CWS, when compared to CWNS, included a higher proportion of children with the temperamental constellation of “slow to warm up,” a finding consistent with others in this area (e.g., Anderson et al., 2003). In brief, various aspects of temperament appear to be associated with childhood stuttering, ranging from attentional processes, affect/mood, adaptability and reactivity to their environment, and inhibitory control.

Examined from the perspective of stuttering as a behavior (instances of stuttering), recent empirical studies have shown that, for preschool-age CWS, (a) decreased emotion regulation is associated with increased stuttering frequency (Arnold, Conture, Key, & Walden, 2011), (b) stuttering frequency increases when greater emotional arousal is associated with lower emotion regulation (Walden et al., 2012), and (c) the more they divert their attention from tasks that are not demanding of speech, the less they stuttered during subsequent production of narratives (Ntouriou, Conture, & Walden, 2012). Notably, the findings of both Arnold and colleagues and Walden and colleagues are consistent with findings of increased sympathetic arousal prior to stuttering in adults who stutter (AWS) (Caruso, Chodzko-Zajko, Bidinger, & Sommers, 1994; Weber & Smith, 1990).

Two recent psychophysiological studies of salivary cortisol (a “stress hormone”) and stuttering in children have been reported (Ortega & Ambrose, 2011; van der Merwe, Robb, Lewis, & Osmond, 2011). Ortega and Ambrose (2011), using reported (Gröschl, Rauh, & Dörr, 2003) cortisol means for morning, noon and evening sampling as a reference, found that school-age CWS ($n = 9$) exhibited significantly lower cortisol levels at two of the three sampling occasions (but still within normal limits), suggesting lower physiological stress reactivity. In a second study, van der Merwe et al., (2011) assessed salivary cortisol in 7 preschool-age CWS and 7 preschool-age CWNS. Findings indicated no significant between-group differences in salivary cortisol. The use of different comparison groups (i.e., use of published norms vs. control groups), small sample sizes and possible questions regarding

statistical power make this emerging line of investigation challenging to adequately assess at present.

In three recent psychophysiological studies of AWS, one (Guitar, 2003) reported significant differences between AWS and adults who do not stutter (AWNS) in mean amplitude of acoustic startle response. In contrast, Ellis, Finan and Ramig (2008) reported no such between-group difference in acoustic startle response and no within-group difference among adults whose stuttering is mild versus adults whose stuttering is moderate-to-severe for initial acoustic startle amplitude, mean startle response amplitude or onset latency. Furthermore, Alm and Risberg (2007) found that acoustic startle amplitude was not significantly associated with anxiety or reactive temperament even though “trait anxiety” scores (i.e., “an individual's general characteristic level of anxiety that is independent of specific threatening environments,” Menzies, Onslow, & Packman, 1999, p. 3) were significantly higher for AWS compared to AWNS. Indeed, numerous empirical studies of anxiety in AWS have been reported (e.g., Craig, 1990; Craig, Hancock, Tran, & Craig, 2002; Davis Shisca, & Howell, 2007), with one review (Craig & Tran, 2006) indicating that 13 out of 20 empirical studies reported that AWS are significantly more anxious than adults who do not stutter (for further review of this the relation of anxiety to stuttering, see Iverach, Menzies, O'Brian, Packman, & Onslow, 2011; Menzies et al., 1999).

It should be noted that paper-and-pencil questionnaires, whether based on caregiver reports or self-reports of adults, would not necessarily be expected to correspond with direct behavioral observations or psychophysiological measures of temperament. Each of these three “perspectives”—caregiver/self-reports, behavioral observations or psychophysiology, undoubtedly tap different aspects of temperament and encompass different time frames. For example, caregiver reports may be based on days, weeks, months and years of experience versus acoustic startle responses that are based on relatively few samples, with each of brief (ms/s) duration. In recent studies of the association between stuttering and temperament (or related processes), conducted with children, stuttering is considered a diagnostic entity (cf. Arnold et al., 2011; Walden et al., 2012). Thus, how these various attentional, behavioral, emotional or temperamental characteristics relate to instances of stuttering, the “in-the-moment” behavior, is not directly addressed.

Overall, the above findings suggest that some temperament characteristics and/or emotional behavior differentiate CWS from CWNS, and that some of these differences are associated with changes in stuttering frequency for CWS. CWS also seem to have challenges with attentional regulation, but this will need to be further explored with various age-appropriate experimental tests of attention (for salient examples of such “child friendly” experimental approaches to the study of emotion and stuttering, see Eggers, 2012; Gershon, 2012; Heitman et al., 2004; Johnson et al., 2012). It remains unclear, however, whether emotional reactivity, particularly when left relatively uncontrolled or unregulated, appreciably interferes with speech-language planning and production, especially when the latter is developing, rather than established.

Voice disorders and Temperament

Green (1989) stated that “Conflicts concerning the possible psychological characteristics associated with vocal nodules and other voice disorders have arisen, partially because of an overreliance on clinical intuition or the usage of inadequate and varying research methodologies” (p. 307). Similarly, Roy and Bless (2000b) state that, with regard to voice disorders, “There is currently no clear evidence of whether personality or psychological processes should be considered causal, correlational or consequential” (p. 738). In another paper, however, Roy, Bless, and Heisey (2000a) concluded that “it appears that the personality differences between groups should not be viewed strictly as a consequence of

coping with voice problems.” (p. 541). Fortunately, as will be discussed below, subsequent empirical study has led to a better understanding, as well as improved theoretical accounts of the association between psychological processes and voice disorder (Eggers, De Nil, & Van den Bergh, 2009; Green, 1989; Roy & Bless, 2000; Roy, Bless, & Heisey, 2000a,b).

Findings based on caregiver reports of psycho-social characteristics of children with vocal nodules, when compared to children without vocal nodules, indicate that they exhibit significantly higher scores on scales for acting out, distractibility, disturbed peer relations, and immature behavior (Green, 1989). More recently, Eggers et al (2009) used a Dutch version (Van den Bergh & Ackx, 2003) of Rothbart, Ahadi, Hershey, and Fisher's (2001) parent-report instrument (*Children's Behavior Questionnaire*, CBQ) to study typically-developing children, CWS and children with vocal nodules. Among findings based on their exploratory factor analyses, Eggers and colleagues reported a similar, highly congruent three-factor temperament structure for CWS, CWNS and children with vocal nodules. For children with vocal nodules, when compared to the other two talker groups, the strongest of the three factors was “negative affect” (which was derived from the scales of Anger/Frustration, Sadness, Falling Reactivity/Soothability, Fear and Discomfort). These findings led them to conclude that the difference in negative affect found for children with vocal nodules reflected a real difference in this temperamental variable for these children, rather than between-group differences in underlying temperamental structure common to all children.

Roy, Bless, & Heisey (2000b), using self-report measures of personality and psychological adjustment, reported that the majority of adults with functional dysphonia were classified as “introverts” and the majority of adults with vocal nodules were classified as “extroverts.” Roy and colleagues took their findings to suggest that personality features and emotional maladjustment may contribute differentially to these two voice problems. In a related study, using the self-report Multidimensional Personality Questionnaire (MPQ) with these same participants, Roy, Bless, and Heisey (2000a) found that these two groups of individuals (i.e., with functional dysphonia and vocal nodules) differed significantly from each other, individuals without voice problems and other voice-disordered groups. Specifically, individuals with functional dysphonia tended to be introverted, stress-reactive, alienated, and unhappy. In contrast, individuals with vocal nodules tended to be socially dominant, reactive to stress, aggressive, and impulsive. Again, these authors took their findings to support a trait, predisposition, or vulnerability account of these types of voice disorders. Of course, as with SLI and stuttering, there is still the possibility that voice problem lead to changes in psychological processes.

Roy and Bless (2000a) developed a formal theory to account for the association between psychological processes, functional dysphonia and vocal nodules (i.e., the “dispositional bases of vocal nodules and functional dysphonia”). One part of this theory suggests that traits of high neuroticism and low extraversion (i.e., “neurotic introverts”) contribute to the development of functional dysphonia. Another aspect of the theory is that high neuroticism and high extraversion contribute to the development of vocal nodules.

Overall, compared to the two other speech-language disorders covered in this review, there has been less empirical study of the association between emotional processes and voice disorders, especially regarding temperamental characteristics. However, what empirical evidence that does exist suggests a quite robust set of empirical findings that points to an association between psychological processes and voice disorders. Although a voice-disorder-leading-to-psychological-processes “directionality of effect” cannot be categorically rejected, some of the findings in this area provide the strongest empirical support for the notion that psychological processes contribute to voice disorders. In

particular, the Roy and Bless (2000a) model may be used to inform further modeling of the association of emotional processes to speech-language disorders.

Temperament and Speech-Language Disorders: Possible future research directions

Several lines of future research could be envisioned to advance our understanding of the relation between temperament and childhood speech-language disorders (for further overview of future study of temperament in general, see Rothbart, 2012). First, the relation of temperament to both typical, as well as atypical, speech and language development may be explored by means of widely-used caregiver reports, instruments based on different models of temperament, for example, the Behavioral Style Questionnaire (BSQ, McDevitt, & Carey, 1978), based on the New York Longitudinal Study (Thomas & Chess, 1977), or the Children's Behavioral Questionnaire (CBQ), based on the Rothbart's (1989) developmental model (for similar comparison among extant findings see Kefalianos et al., 2012). Such studies will provide evidence regarding which model and attendant characteristics best accounts for (a)typical speech-language development. One other related avenue of investigation would be to employ these caregiver reports, properly adapted, for use with other individuals associated with the child, for example, parents, daycare/preschool providers, teachers, and the children themselves (the latter when age permits). Because these reports have primarily come from parents, future empirical study will need to modify them for use with others, for example, daycare, preschool or school teachers (similar to what has been done in psychology relative to the development of emotional reactivity and regulation in school-age children, e.g., Walden, Harris, & Catron, 2003). That this can be done is supported by replicated studies of the self-reports of preschool-age children who do and do not stutter regarding emotional and related processes (Clark, Conture, Frankel, & Walden, 2012; Vanryckeghem, & Brutten, 2007; Vanryckeghem, Brutten, & Hernandez, 2005).

Second, on the basis of such study (similar to the investigations of stuttering by Eggers and colleagues, e.g., Eggers et al., 2009, 2011, 2012), specific aspects of temperament may be experimentally tested as they relate to the *quantity* (e.g., the MLU of preschool-age children with Specific Language Impairment, SLI) and *quality* (e.g., perceived degree of hoarseness of children with vocal nodules) of speech-language production. Such study would not *prove* that specific temperamental characteristics “cause” a particular speech-language disorder, but would allow for consideration of such characteristics as potential mediational or moderational variables associated with the disorder. Of special interest, would be the possible predictive nature of specific temperamental characteristics to subsequent “consequences” of speech-language development, for example, recovery versus persistence, need for treatment, impact on school performance, and so forth.

Third, the directions for future research suggested above are cross-sectional in nature. However, there is a significant need for longitudinal study of temperament concurrent with (a)typical speech and language development. Very little is known about how temperamental characteristics, presumably through environmental and/or temperament-temperament interactions, change with recovery from or persistence of atypical forms of speech and language development.

Fourth, the majority of the empirical studies of temperament and (a)typical speech and language have employed either caregiver reports (e.g., Eggers et al., 2009) or behavioral observations (e.g., Walden et al., 2012), methodologies that assess more *overt* behavioral aspects of temperament. Thus, there is a need to include psychophysiological methods as well to assess the more *covert* aspects of temperament, for example, respiratory sinus arrhythmia (RSA, Jones, 2012). As use of these measurement tools and perspectives, separately, in conjunction, cross-sectionally and longitudinally advances, there will be need

for reexamination of their utility and meaningfulness. For example, further empirical study may indicate that various measures are more or less well-correlated with one another. Illustratively, this idea may be akin to an individual who smiles, and says, “Not at all,” when asked if he or she is frightened as the roller coaster slowly inches to the top before its fast plunge downward on the other side. Simultaneously, however, he or she may have sweaty palms (e.g., high skin conductance = high reactivity) and a rapidly beating heart (e.g., release of “vagal brake” in preparation for challenge).

Finally, various models that would seem applicable to consideration of temperament, may be adapted to develop theory-driven, hypothesis-testing empirical studies of the relation of temperament to (a)typical speech-language development. For example, models examining diatheses and stressors (for further review see, Monroe & Simons, 1991), biological sensitivity to context (for further review, see Boyce & Ellis, 2005), and differential susceptibility to environmental influences (for further review, see Belsky & Pluess, 2009) in relation to (a)typical human development may prove fruitful. Furthermore, many avenues of investigation regarding the relation between temperament and speech-language can be envisioned that might test extant accounts of this relation (e.g., the dual-diathesis stressor model of Conture et al., 2006; Conture & Walden, 2012) and/or replicate and extend findings resulting from published empirical studies of this relation (e.g., Anderson et al., Eggers et al., 2009, 2010; Embrechts et al., 1998).

Temperament and Speech-Language Disorders: A summary

In this review three disorders of speech and language were discussed in which temperament and/or related constructs have been speculated about, as well as empirically studied, namely: (1) Specific Language Impairment, (2) Developmental Stuttering, and (3) Voice Disorders. Roy and Bless (2000a) compare and contrast the *disability* (Figure 2 A) and *(pre)dispositional* (Figure 2 B) accounts of relations between emotion and speech-language disorders. These accounts should help us organize this rather disparate body of evidence. In both models, emotion and speech-language disorders are considered. What differs is the “directionality of effect,” with speech-language disorders either leading or following emotional processes.

The *(pre)dispositional* (or vulnerability or trait) model suggests that certain psychological processes directly cause the disorder or modify the course or expression of the disorder. In contrast, the *disability* model suggests that certain disorders have a negative impact on an individual's life (e.g., peer rejection) and this leads to changes in psychological processes, personality, etc. A third possibility (Figure 2 C) is that both “directionalities of effects” (i.e., speech-language disorder leads to temperamental characteristics and temperamental characteristics lead to speech language disorders) may occur. Thus, for some individuals, poorly regulated emotional or attentional processes may lead to difficulties adequately attending to ongoing speech-language planning and production. This could result in speech-language difficulties which, in turn, increase communicative/social withdrawal, a possible interaction that must await further empirical study.

It is also possible that the quantity and quality of an individual's experience with a speech or language problem confounds our ability to assess whether evidence supports one or the other model. For example, a child of 32 months of age who began stuttering 4 months ago has had considerably less experience with stuttering than an adult of 32 years of age who began stuttering 28 years ago. Experience with the problem is an issue for all speech-language disorders, an issue that awaits future clarification. Thus, one cannot categorically refute the *disability* model (i.e., speech-language disorder → psychosocial issues), that is, SLI, stuttering and/or voice disorders have a negative impact on a child's life leading to changes, subtle to not-so-subtle, in their psychosocial development.

On the other hand, the evidence from independent investigators suggests that psychological processes are associated with the onset, development and/or exacerbation of speech and language. Furthermore, there is some evidence, particularly with stuttering, that under-regulated emotional reactivity is associated with increased stuttering (e.g., Arnold et al., 2011; Walden et al., 2012). However, many studies to date are correlational in nature (Figure 2 D), identifying associations between aspects of temperament and specific speech-language problems that, in some cases, may be due to the relations these two variables have to a third-order variable such as gender, maternal education, experiences, and so forth. Despite this, some of the mechanisms speculated to underlie a temperament/speech-language association/correlation (e.g., CWS whose relatively high emotional arousal/reactivity is coupled with low emotional regulation) seem plausible, given our understanding of these mechanisms/processes outside the area of speech-language pathology. Certainly, there remain challenges to empirically ascertaining whether such processes contribute to disruptions and/or changes in fluency, language and voice.

We speculate that, over time, with advances in technology, theory and experimental design, certain psychological processes, for at least some speech and language disorders, will be shown to contribute to their actual expression (e.g., the behavioral characteristics associated with vocal nodules, functional dysphonia, or stuttering). This would support the predispositional or vulnerability account of the association between emotional/psychological processes and speech, language and voice. As part of these empirical investigations, it is likely that data from caregiver reports and coded behavioral observations will be increasingly augmented by evidence from psychophysiology (e.g., Ortega & Ambrose, 2011; Jones, 2012), electrophysiology (e.g., Arnold et al., 2011) and neural imaging (Blackford et al., 2012). Since temperament is manifest in infancy and can be measured during early childhood, discovering connections between communicative and attentional, emotional and motoric aspects of temperament during early childhood, prior to considerable experience with the disorder, would also support the idea that such processes may cause as well as result from communication disorders.

To gain further understanding, such associations must be carefully, empirically and programmatically studied in young children, with special emphasis on longitudinal studies. These studies will help predict stability and change in both temperamental and speech-language outcomes. They will also help determine the developmental time course of temperament and speech-language relative to one another. By employing these methods, we will better understand whether certain aspects of temperament develop *before* speech-language, some others *after* speech-language and still others develop *concurrently*. These studies necessitate increasing collaborations between psychologists and speech-language pathologists, providing a larger context for understanding (a)typical communication, especially in childhood, and helping to bring attentional, emotional and motoric aspects of temperament under the tent where causal variables reside.

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Appendix A. Continuing Education **Bold are correct answers**

1. Prior to temperamental accounts of children's social development, many accounts focused on
 - a. the environment
 - b. the id
 - c. the endogenous variables within children
 - d. the child speech-language communication
 - e. the child's genetic endowment
2. According to many theories of temperament, the following is true
 - a. behavioral characteristics are relatively stable over time
 - b. heritability is not salient to temperament
 - c. exogenous are more important than endogenous variables
 - d. there is little relation of temperament to a child's social development
 - e. speech-language disorders cause temperament
3. Which of the following best exemplifies the *disability* account of the association between emotion and speech-language disorder
 - a. a nine-month-old child (prior to production of the first true word) shy/withdrawn around strangers
 - b. shortly after beginning to stutter, a child becomes socially withdrawn
 - c. the child talks a lot even the mother is communicatively-socially withdrawn
 - d. a non-stop talking salesperson develops vocal nodules
 - e. receptive vocabulary is correlated with stuttering because both are related to a third-order variable (i.e., being a boy).
4. An infant who is highly reactive or behaviorally inhibited (i.e., highly reactive to novel, change, or differences) is 3 times more likely than low-reactive infants to exhibit____at seven years of age
 - a. SLI
 - b. function dysphonia
 - c. anxiety
 - d. emotion regulation
 - e. inhibitory control
5. Caregiver or parental rating scales/questionnaires used to measure temperament are thought, by some, to reflect
 - a. an averaging effect because they are based on observations across various situations and context
 - b. a more sensitive index of how temperament may be expressed differentially across context

- c. the gold standard for the measurement of temperament
- d. identical information to that based on non-parental observers
- e. totally unbiased information about children's social development

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Highlights

- Definitions and means of measuring temperament are provided
- Five salient perspectives on temperament are described
- Major theories of temperament discussed
- Temperament re language disorders, stuttering and voice is discussed
- Four possible relations between temperament and speech-language described

Figure 1.

Five possible perspectives regarding environmental and temperamental influences on children's social-communicative development: (A) *Environmental* perspective, (B) General *temperamental* perspective, (C) Experiences *moderate* temperament influence, (D) Experiences *mediate* temperament influence and (E) *Goodness of fit* between child's experiences and child's temperament

Figure 2.

Four possible accounts of the relation between temperament and speech-language disorder: (A) *Causal* (Temperament causes Speech-Language Disorders), (B) *Consequential* (Temperament consequence of Speech-Language), (C) *Bi-directional* (Temperament causes Speech-Language causes Temperament) and (D) *Correlational* (Temperament related to Speech-Language because both are related to a third-order variable, e.g., gender, maternal education, etc.)

Table 1

Temperament's specific and global dimensions, heritability, biological bases, importance of stability and developmental outcome frameworks relative to selective-listing of theorists (see prose).

Theorist	Specific Dimensions of Temperament	Global Dimensions	Heritability	Biological Bases	Importance of Stability	What develops?
Buss and Plomin	Emotionality, Activity, Sociability	None	High	High	High	Increased differentiation
Thomas and Chess	Rhythmicity, Activity, Approach to novelty, Adaptability, Sensory threshold, Quality of mood, Intensity of mood, Distractibility, Attention span	Easy, Difficult, Slow to warm up	Not a critical issue	Moderate	High	Expression of temperament is a function of environmental factors
Rothbart	Specific dimensions change with age	Reactivity, Regulation/extraversion, negative affect and effortful control	High	High	High	Dimensions and expression of temperament change with age and social experience
Goldsmith	Arousal + basic emotions	None	High but not a critical issue	High	High	Social factors shape temperament and its expression
Kagan	Behavioral Inhibition	None	Moderate	High	Moderate	Expression of inhibition