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Applying the polyvagal theory to children's emotion regulation: Social context, socialization, and adjustment

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ABSTRACT

Effective emotion regulation is essential for children's positive development. Polyvagal theory provides a framework for understanding how parasympathetic regulation of cardiac activity contributes to children's adaptive versus maladaptive functioning. Maintenance of cardiac respiratory sinus arrhythmia (RSA) under social challenge should support emotion regulation and behavioral adjustment. Children's effective parasympathetic regulation and behavioral adjustment should be supported by appropriate parental socialization. These proposals were evaluated in a short-term longitudinal study of 94 preschool-aged children. Parenting and basal RSA were measured at home, then 6–10 months later behavioral adjustment and RSA in lab baseline and socially challenging contexts were measured. Children with relatively higher RSA in social challenge than at baseline (ΔRSA) had fewer internalizing problems (IP) and externalizing problems (EP), and better behavioral self-regulation (SR). Mothers who used more negative control had children with lower ΔRSA, more IP and EP, and less SR. Structural equation modeling showed that vagal regulation mediated associations between maternal negative control and children's adjustment; maternal negative control did not predict EP or SR after accounting for ΔRSA. Associations were consistent across boys and girls, with one exception: Higher ΔRSA was significantly associated with fewer EP in boys only. These findings suggest that the practical significance of physiological regulation might be best revealed in ecologically valid procedures, and that children's physiological mechanisms of emotion regulation are shaped by their experiences of parental socialization.

Effective emotion regulation is a critical component of children's adaptive functioning (Cole et al., 2004), but the etiologies and physiological underpinnings of emotion regulation (ER) remain uncertain. Polyvagal theory (Porges, 2001) provides one comprehensive framework for conceptualizing the physiological basis of ER, through dynamic parasympathetic control of cardiac activity to facilitate social engagement, focused attention, defensive responses, and self-soothing. However, the developmental literature in this area has not produced consistent relations between respiratory sinus arrhythmia (RSA) and indices of children's ER (e.g., Beauchaine et al., 2007; Calkins et al., 2007). Similarly, although parental socialization has been identified as an important contributor to individual differences in children's development of ER (Denham et al., 2007), attempts to link parental socialization to children's vagal regulation generally have not met with success (e.g., Kennedy et al., 2004). Porges' (2007) recent proposal regarding the meanings of context for interpreting dynamic changes in RSA might provide a framework for resolving past inconsistencies. In this investigation, we examined preschool-aged children's RSA in the context of a naturalistic social challenge, interacting with an unfamiliar peer group, in order to address three objectives. We examined how vagal regulation was related to ER, how parental socialization was related to vagal regulation, and whether vagal regulation mediated associations between parental socialization and preschoolers' ER.

1. Polyvagal theory and children's regulation and behavior problems

Basal RSA has been characterized as an index of individual differences in stable or typical levels of arousal associated with emotional reactivity, whereas dynamic changes in vagal

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enervation in response to task demands are thought to connote active regulation of arousal to support effective coping (Beauchaine, 2001; Calkins, 1997; Porges, 1995). However, there have been inconsistencies across studies in the relations reported between basal or dynamic RSA and behavioral measures of children's ER. For example, three recent studies of the relations between children's externalizing problems (EP) and both their basal and reactive RSA produced contradictory results. In samples ranging from preschool-age to elementary school-age, both basal RSA and RSA change to challenge tasks were reported to be negatively, positively, or non-significantly related to children's EP (Beauchaine et al., 2007; Calkins et al., 2007; Dietrich et al., 2007). Similarly, across studies of the relations between RSA and children's internalizing problems (IP), some researchers have reported that children with more IP have lower basal RSA or weaker vagal suppression (e.g., El-Sheikh, 2001; El-Sheikh et al., 2001; Fox and Field, 1989), but many have failed to replicate these associations (e.g., Gerlach et al., 2003; Marshall and Stevenson-Hinde, 1998; Schmidt et al., 1999). Within our own research, neither baseline RSA (Hastings and De, 2008) nor RSA suppression to a cognitive challenge (Hastings et al., 2008) was associated with a variety of indices of preschoolers' IP, EP and self-regulation (SR). These disparate findings call into question either the validity of polyvagal theory (Grossman and Taylor, 2007), or the efficacy of attempts to put polyvagal theory into practice.

Alternatively, there could be contexts in which a reduction in parasympathetic enervation of cardiac activity would support adaptive responding, and contexts in which vagal suppression would fail to do so (Porges, 2007). The myelinated vagus has been nicknamed the "vagal brake" because of its tonic impeding of the sinoatrial node, which is normatively set higher than typical resting heart rate (Porges, 2001). The vagal brake inhibits sympathetic arousal, induces a calmer state, and facilitates social engagement "when the environment is perceived as safe" (Porges, 2007, p. 120). Conversely, under conditions of threat, releasing the vagal brake allows the sympathetic–adrenergic system to increase arousal and mobilize defensive reactions. Whether vagal suppression is adaptive, therefore, depends on whether the context that one encounters truly presents a threat which requires mobilization of resources, or whether an objectively safe environment is perceived to be dangerous. Prolonged decreases in RSA in response to non-threatening stimuli or safe contexts should be maladaptive and reflective of parasympathetic dysregulation (Friedman, 2007), by unnecessary mobilization of defensive reactions. To understand the contributions of parasympathetic regulation to children's maladaptive and adaptive functioning, it might be necessary to study children's physiological regulation within relevant and ecologically valid contexts that are ambiguous vis à vis the presence of threat.

The unfamiliar peer group procedure (e.g., Rubin et al., 2002), which elicits individual differences in children's confident or anxious reactions, may serve this purpose. This context could be perceived as affording positive opportunities for social engagement, which would be supported by high RSA, or as posing a social threat, which would require decreased RSA to mobilize defensive responses. Furthermore, recent technological advances in ambulatory cardiac monitors with incorporated recording of physical activity permit the recording and analysis of children's cardiac activity, while controlling for degree of motor activation (Grossman and Taylor, 2007). Relating children's RSA in a social challenge to indices of adjustment might help to clarify the utility of polyvagal theory for understanding children's ER.

2. Parental socialization of children's ER and parasympathetic regulation

Parental socialization of children's ER has emerged as a major focus of developmental research (Denham et al., 2007; Thompson and Meyer, 2007). Maternal and paternal socialization that is appropriately supportive, responsive and structuring, or that is not overly harsh, punitive and intrusive, is associated with children showing better behavioral SR and fewer IP or EP (Klimes-Dougan et al., 2007; Rubin et al., 2002, 2003). One mechanism by which parental socialization could contribute to children's adjustment is through influences on children's regulatory physiology. Animal studies of maternal care-giving behavior have shown that variations in socialization can affect autonomic regulation (Parent et al., 2005). Parallel mechanisms have been proposed in humans (Kofman, 2002), but the evidence for this is limited. Many researchers have failed to find significant associations between children's RSA and indices of socialization (e.g., Calkins and Johnson, 1998; Kennedy et al., 2004; Rubin et al., 1997), but a small set of studies provide evidence of such links. Mothers who coordinate interactions with their infants contingently and synchronously have infants with higher vagal tone (Haley and Stansbury, 2003; Moore and Calkins, 2004; Porter, 2003). Conversely, lower basal RSA or less vagal suppression has been found in children exposed to marital violence or negative maternal control practices (Calkins et al., 1998; Katz, 2007; Porter et al., 2003). Thus, young children living in adverse or hostile home environments may show less effective or appropriate vagal regulation.

There have been fewer prospective longitudinal studies predicting later children's RSA from earlier parental socialization. Burgess et al. (2003) found that infant attachment status at 14 months was not associated with basal RSA at 14 or 24 months, but unexpectedly, avoidant infants had significantly higher RSA at 48 months than secure or ambivalent infants. Following children from 2 to 4 years, Kennedy et al. (2004) found that children's basal vagal tone and mothers' self-reported responsive, negative and protective parenting were not concurrently associated at either time, and maternal parenting at 2 years did not predict children's vagal tone at 4 years. Overall, the existing literature has not yet provided consistent evidence that more appropriate parental socialization supports children's development of effective vagal regulation.

Several methodological issues might have limited past attempts to assess the relations between children's physiological regulation and parental socialization. Most researchers have only assessed children's basal or resting RSA, rather than dynamic vagal changes to stress or challenge, and it might be unreasonable to expect the normative range of parental socialization to override the genetic and epigenetic determinants of basal physiology. Those researchers who have examined vagal change typically have used the kinds of controlled laboratory tasks that, for the reasons considered previously, may not be effective for engaging the polyvagal system in ways that are appropriate for revealing children's adaptive ER. Socialization has most often been assessed using only parental self-report measures, but parent reports of their own parenting might be of questionable validity, and multi-method assessments of parenting usually are considered superior (Janssens et al., 2005). Finally, few investigators have considered whether paternal socialization might contribute to children's vagal regulation.

3. Objectives and hypotheses

Dynamic indices of physiology measured in ecologically meaningful contexts are likely to be more robust indicators of individual differences in children's SR, EP and IP, compared to basal physiology. Similarly, dynamic vagal regulation might serve as