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Reactivity and Regulation: The Impact of Mary Rothbart on the Study of Temperament

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Through her theoretical and empirical work, Mary Rothbart has had a profound impact on the scientific understanding of infant and child temperament. This special issue honors her contributions through the presentations of original, contemporary studies relevant to three primary themes in Rothbart's conceptual approach: the expansive scope and empirically-derived structure of temperament, the importance of considering developmental change, and the interplay of reactive and regulatory processes. In addition to summarizing these themes, this introductory article acknowledges the ways Mary has spurred progress in the field through methodological advances, institutional service, and pedagogy. Copyright © 2008 John Wiley & Sons, Ltd.

'...we will define temperament as constitutional differences in reactivity and regulation... influenced over time by heredity, maturation, and experience' (Rothbart & Derryberry, 1981, p. 37).

This definition is familiar to all developmental researchers interested in temperament. It is a succinct statement that elucidates multiple components of Mary Rothbart's framework for early-emerging individual differences. Furthermore, it is a suitable metaphor for the co-development of Mary's scholarship and her primary field of study.

In her own words: 'When I began work in psychology in the late 1950s, social learning approaches dominated the field of developmental psychology' (Rothbart, 2004, p. 492). Mary reacted to the state of the discipline in a manner different from many of her contemporaries. Her reaction was not immediate—her earliest publications concerned family interactions and the development of humour—but rather, were influenced through maturation and experience, particularly her experiences as a parent to two very different children. This reaction was complemented by Mary's regulatory capacity. Her ideas emerged from attention to, and integration of, information from a wide variety of sources, including research

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on behaviour genetics, comparative studies, and clinical observations. In the decades following the publication of her first papers on temperament, the interplay of her own reactivity and regulation was exemplified by the evolution of her theories in response to empirical findings she and others generated. Mirroring the 'balance involving contributions of both the infant and the caregiver' (Rothbart & Derryberry, 1981, p. 68), Mary's thinking shaped the field as the field shaped her thoughts.

The collection of papers contained in this special issue of *Infant and Child Development* pays homage to Mary Rothbart's empirical and theoretical contributions to developmental psychology by compiling empirical papers that use recent developments in methodology and theory to advance the intellectual agenda put forth in Mary's writing. In this introduction paper, we first recount the central themes of two seminal papers, both published in 1981. The first paper, *Development of Individual Differences in Temperament* (Rothbart & Derryberry, 1981) articulated the conceptual rationale for the dimensions Rothbart proposed as belonging under the temperament banner, the importance of considering temperament as a developmental process rather than a static attribute, the ways in which temperament influences and is influenced by the environment, the relevance of both reactive and regulatory factors in shaping individual differences, and considerations for appropriate measurement of traits across the lifespan. The second paper, *Measurement of Temperament in Infancy* (Rothbart, 1981) exemplified her approach to questionnaire measurement and introduced the Infant Behaviour Questionnaire (IBQ), which served as a rough template for a battery of instruments designed to assess temperament from the cradle to the grave and also helped set the stage for the development of standardized laboratory assessments. The influence of these two papers is clearly demonstrated by the frequency with which they appear in the literature, with each cited in more than 300 published papers (Social Sciences Citation Index, June 21, 2007) We close our introduction to this special issue with a brief section on the ways Mary has advanced the field through her organizational efforts, outreach programs, and teaching.

CONCEPTUAL THEMES

Scope and Structure of Temperament

In important ways, Mary Rothbart's conceptual approach to temperament was more inclusive than those of her contemporaries. In contrast to theorists who conceived of temperament primarily in terms of behaviour (e.g. Thomas & Chess, 1977), Rothbart and Derryberry (1981) argued that investigations of individual differences at the genetic, neural, endocrine, autonomic, and central nervous system levels would provide a more integrated understanding of temperament, a perspective that is apparent in the physiologically oriented and genetically informed studies by Talge, Donzella, and Gunnar, 2008 and Lemery-Chalfant, Doelger, and Goldsmith, 2008 described herein. Whereas others had previously suggested that temperament must be considered separately from motivation, cognition, and personality, and should be viewed as differences in the style with which an individual reacts to an external stimulus, Rothbart argued against the stylistic definition to suggest that the scope of temperament should be broadened to include differences in motivation to engage in certain activities and cognitions resulting from conflicting motivations, proposing that although personality was a more inclusive term than temperament, substantial overlap existed in the

domains subsumed under each (Goldsmith *et al.*, 1987). In comparison with those who confined the definition to emotional phenomenon (e.g. Goldsmith & Campos, 1986), Rothbart's perspective allowed features of motor activation and attention under the temperament umbrella. Finally, Rothbart took issue with broad constructs of 'mood' or 'emotionality' (e.g. Buss & Plomin, 1975; Thomas & Chess, 1977), arguing for distinctions between positive and negative emotions, and within negative affect.

Whereas Rothbart's proposals expanded the body of dimensions fitting within the temperament rubric, she alternatively trimmed and organized the list of traits with reference to both empirical and conceptual considerations. In developing the IBQ (Rothbart, 1981), Mary consolidated the nine dimensions identified by Thomas, Chess, and their colleagues (Thomas, Chess, Birch, Hertzog, & Korn, 1963; Thomas, Chess, & Birch, 1968), contending that some dimensions overlapped in content and noting the poor internal consistency of scales designed to assess some of the categories (Rothbart, 1981; Rothbart & Mauro, 1990). More recently, she has enhanced parsimony in the field through her factor analytic investigations of hierarchical structure among multiple (ranging from 14 to 20) highly differentiated scales. In research with infants, toddlers, children, adolescents, and adults, these explorations have consistently revealed factors of Surgency/Extraversion, Negative Affectivity, and Regulatory Capacity/Effortful Control, with additional factors emerging in the oldest populations (see Putnam, Ellis & Rothbart, 2001; Rothbart, Ahadi, & Evans, 2000). The current paper by Putnam, Rothbart, and Gartstein, 2008 makes use of both the wide range of discrete traits and the broader factors in examining continuity of temperament components from infancy through childhood.

Development of Temperament

Early theory regarding temperament (e.g. Buss & Plomin, 1975) emphasized longitudinal stability over the lifespan as a requisite for evidence of temperament. Rothbart (1989) and Rothbart & Derryberry (1981), in contrast, argued that such a criterion was excessively conservative, promoting a superficial understanding of temperament by discouraging integration of developmental change into models of individual differences. She convincingly argued that focusing on sources of instability of traits would, paradoxically, assist in identification of factors underlying stability.

Drawing from personality theorists such as Rutter (1987) and Hinde and Bateson (1984), Rothbart (1989) suggested that developmental change could affect reactive and regulatory processes in a number of ways. At the simplest level, the elicitors and expressions of temperament traits should be expected to change as children gain new understandings of their world. As such, the same underlying process can contribute to an individual's strong crying to unfamiliar persons as a toddler and their constrained affect at cocktail parties as an adult. Development also was seen as proceeding through the emergence of new behavioural tendencies and capacities. The appearance and consolidation of new mechanisms has two important implications. First, because some attributes, such as the ability to constrain impulses, are not apparent in early infancy, it may be difficult to identify differences between individuals on these attributes until a later age. Second, newly emergent qualities may alter the expression of other traits, contributing to apparent instability in these dimensions. For instance, an infant who is predisposed to negative affect may demonstrate low negativity as a pre-

schooler after developing the strong ability to exert effortful control in response to societal expectations, whereas a similarly negative infant who does not develop strong control may continue exhibiting high levels of distress throughout life.

The developmental nature of temperament was further emphasized through Rothbart's incorporation of socialization within temperament theory. Building upon ideas put forth by Escalona (1968) and Bell (1968, 1971), Rothbart proposed a balanced perspective, considering temperament as an open system that influenced, and was influenced by, interactions with the environment (Rothbart, 1989, 2004; Rothbart & Derryberry, 1981). A central element of this perspective was that 'objectively identical environments may have quite different effects on the experience of two children who differ in reactivity and self-regulation' (Rothbart & Derryberry, 1981, p. 65). Rothbart further suggested that the role of caregivers will be particularly important for the development of temperamentally vulnerable children (Rothbart & Derryberry, 1981). Rothbart's recent reviews of the literature on temperament and socialization (Rothbart & Bates, 1998, 2006; Rothbart & Putnam, 2002; Sanson & Rothbart, 1995) reveal the prescience of these comments, describing multiple studies indicating that parenting practices are most closely related to adjustment among children who are at risk for poor outcomes due to compromised effortful control or excessive levels of surgency or negative affect. Understanding of the interplay between parenting and temperament, and between regulatory and reactive dimensions, is extended in the current collection by Gaertner, Spinrad and Eisenberg, 2008.

Reactive and Regulatory Processes

A developmental approach to temperament is particularly important in distinguishing between reactive and regulatory underpinnings of individual differences. Although Rothbart suggested that 'new and more complex forms of reactivity emerge with development' (Rothbart & Derryberry, 1981, p. 63), the majority of research in this area has followed her proposal that 'development may be seen as involving changes over time in the balance between reactive and regulatory processes' (Rothbart & Derryberry, 1981, p. 41). The relationship between reactivity and regulation is dynamic and reciprocal in nature, creating difficulties for separating the often oppositional forces. By applying knowledge regarding normative developmental trends, however, it is possible to disentangle the two to a degree. Two maturational trends are particularly salient in their controlling influence over reactive response systems available in early infancy: the development of inhibited approach during the second half of the first year and the growth of effortful control over the toddler and preschool periods.

Research by Rothbart and others concerning the inhibition of approach demonstrates the benefits of considering normative change in regulatory processes within models of individual differences. This work built upon observations that, whereas approach responses appear during early infancy, common fears such as separation and stranger anxiety do not mature substantially until late infancy, accompanied by increased inhibition in response to stimulus novelty and intensity (Schaffer, Greenwood, & Parry, 1972). Rothbart (1988, 1989) reasoned that, because latencies to reach for and grasp low-intensity stimuli are governed primarily by approach tendencies, they should not be altered by maturation,

but instead remain stable over late infancy. In contrast, individual differences in the emerging regulatory influence of inhibition will disrupt interindividual stability of children's latencies to reach for high-intensity objects. Her results supported this reasoning (Rothbart, 1988). Subsequent replications of this study suggest that this developmental change in reactions to stimulus intensity can be detected in cardiac responses and parent ratings of temperament, as well as behavioural approach (Putnam & Stifter, 2002), supporting Mary's contention that constructs of reactivity and self-regulation are flexible and general, and are able to be applied at the autonomic, behavioural, and affective levels (Rothbart & Derryberry, 1981).

Perhaps the most influential aspect of Rothbart's perspective on temperament is her theory of, and research on, effortful control during early childhood, carried out largely through collaboration with Michael Posner (e.g. Posner & Rothbart, 1981, 1998, 2000, 2002, 2007; Rothbart, Ellis, & Posner, 2004; Rothbart, Ellis, Rueda, & Posner, 2003; Rothbart & Posner, 1985; Rothbart, Posner & Hershey, 1995; Rothbart & Rueda, 2005). As Posner and Rothbart (2007) recently wrote, 'Until recently, almost all of the major theories of temperament have emphasized temperament's more reactive aspects' (p. 122). Behavioural approach and inhibition, although regulatory in the sense that they modulate other reactive processes, can be interpreted with respect to differences in arousal, affective, and motivational reactivity (Rothbart *et al.*, 2004). In contrast, the construct of effortful control, defined as the ability to inhibit dominant responses to perform sub-dominant ones, to detect errors, and to engage in planning (Rothbart *et al.*, 2004), concerns aspects of regulation that are conscious and voluntary, thus more purely regulative.

Although self-regulation had long been a fundamental concept in developmental psychology (e.g. Kopp, 1982), Rothbart was one of the first to explicitly link these abilities to temperament. Central to her theory is the proposal that self-control, in terms of both normative development and individual differences, is intimately tied to executive attention. Her earliest writings in the field (Posner & Rothbart, 1981; Rothbart & Derryberry, 1981) proposed this notion, which was later supported through factor analyses of fine-grained scales that revealed a factor defined at multiple ages by dimensions of inhibitory control, attention shifting, and attention focusing (Putnam *et al.*, 2001; Rothbart, Ahadi, Hershey, & Fisher, 2001). The link between executive attention and effortful control has been validated further in studies showing interconnections between laboratory tasks assessing multiple components of attentional and behavioural control (e.g. Kochanska, Murray, & Harlan, 2000) and convergence of laboratory and parent-rated measures of dimensions of attentional and inhibitory control (Gerardi-Caulton, 2000; Rothbart *et al.*, 2003).

The influence of incorporating effortful control within the sphere of temperament is apparent and increasing. A recent search of PsycInfo (2007, June 28) using the subject terms 'temperament' and 'effortful control' identified only 10 publications between 1989 and 2000, 15 between 2001 and 2003, but 45 between 2004 and 2006. These recent publications have also aided in the integration of other domains of developmental studies with temperament, exploring topics as diverse as academic achievement, psychopathology, emotion socialization, peer interactions, self-esteem, and memory. Four of the six papers in the current collection (Auerbach *et al.*, 2008; Gaertner *et al.*, 2008; Lemery *et al.*, 2008; Putnam *et al.*, 2008) add to this burgeoning body of knowledge.

METHODOLOGICAL ADVANCES

Consideration of the dynamic and reciprocal relationships between children and their caretakers also influenced Mary Rothbart's approach to measurement. Rothbart explicitly recognized that measures of temperament in the home, through experimenter observation or parent report, 'cannot represent an *independent* contribution of the child to family interaction' (Rothbart & Derryberry, 1981, p. 69). In opposition to strong critiques of parent report (e.g. Kagan, 1994), however, Rothbart has continually advocated a components-of-variance approach, in which laboratory, home, and questionnaire methods are seen as imperfectly overlapping sources of information (Rothbart & Bates, 1998, 2006). The current paper by Stifter, Willoughby, Towe-Goodman and The Family Life Project Key Investigators (2008) follows this theme, using new statistical techniques to disentangle method and trait sources of variance in judgments made by parents and observers.

In addition to elucidating the conceptual meaning of parent reports, Rothbart strived to minimize bias and inaccuracy in parental ratings of child temperament. In developing the IBQ, she avoided asking parents to make global judgments, compare their child with others, or recall events from the distant past, instead asking parents to judge the frequency of concrete child behaviours in response to commonly occurring stimuli (Rothbart, 1981). This strategy has characterized the creation of a battery of questionnaires assessing temperament in infants, toddlers, children, adolescents, and adults (Capaldi & Rothbart, 1992; Ellis & Rothbart, 2005; Gartstein & Rothbart, 2003; Goldsmith, 1996; Putnam, Gartstein, & Rothbart, 2006; Putnam & Rothbart, 2006; Rothbart *et al.*, 2000, 2001; Simonds & Rothbart, 2004). A testament to the utility of these questionnaires can be found in a recent review of literature on temperament and child development from 2001 to 2006. The authors found Rothbart's questionnaires to be the most frequently used instruments for assessing temperament in infancy and childhood (Klein & Linhares, 2007), and all studies reported in this special issue employ scales from these measures.

In collaboration with Hill Goldsmith, Rothbart also addressed the need for standardized laboratory procedures. Since the original locomotor and prelocomotor versions of the Laboratory Temperament Assessment Battery (LAB-TAB) were introduced (Goldsmith & Rothbart, 1991), versions for multiple age groups have been created (Buss & Goldsmith, 2000; Goldsmith, Reilly, Lemery, Longley, & Prescott, 1999; Goldsmith & Rothbart, 1996, 1999). The behaviours coded in these systems are based in Rothbart's suggestion that temperament should be assessed through quantification of responses in terms of threshold, intensity, and time course (Rothbart & Derryberry, 1981). The LAB-TAB procedures are currently being used in a number of laboratories. The publications expected to emerge from this ongoing research will represent a major advance in the field, since they will allow comparison of results across studies in a manner that has not been possible.

CITIZENSHIP

Mary Rothbart's influence on the temperament field extends far beyond her list of publications. Mary has been tireless in her efforts to build connections among those who share her scholarly passion. In addition to organizing formal meetings of the Occasional Temperament Conference and preconference gatherings of the

Personality and Temperament group, Mary has often hosted informal weekend retreats at her cottage on the Oregon coast, combining intellectual rigour with gracious friendship. She has also enhanced the quality and prominence of temperament research in the broader discipline of child development through her service on multiple governing councils, editorial boards, and review panels. In recent years, Mary has taken the temperament message beyond academia, developing practical applications of this knowledge, such as interventions to enhance children's effortful control and to educate parents, efforts for which she received the 'Champion for Children' award from Birth to Three in 2006.

Despite the accolades Mary has earned, when discussing her career, she focuses most concertedly on the relationships her efforts have allowed her to cultivate. She has been a source of not only knowledge, but also of inspiration and comfort, to colleagues, students, and countless others. Her extensive vita is more impressive when one considers the input she has offered on papers written by authors with whom she never officially collaborated. This quality of selflessness has been particularly apparent to her undergraduate, graduate, and post-doctoral students who have received manuscript drafts swimming in red ink that noted both problems and potential in the writing. At conferences, Mary peruses poster sessions to convey sincere support and give guidance to junior researchers whose work had been inspired by hers. Even those she has never met benefit from her generosity, as she has pledged to never charge for access to her instruments.

In short, Mary's scholarly brilliance is matched by her personal character. It has been an honour to have been mentored and influenced by her theory, research, and dedication to the temperament field. Over the past three decades, Mary's spirit and intellect have continually invited positive reactions from those around her. The lessons she has imparted in person and in text will continue to regulate the development of the field for generations to come.

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