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INSTITUTIONAL REARING AND DEFICITS IN SOCIAL RELATEDNESS: POSSIBLE MECHANISMS AND PROCESSES

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ABSTRACT

This article summarizes the research on socio-emotional deficits in post-institutionalized children. Institutional rearing is associated with early social deprivation, including lack of individualized attention and consistent relatedness from a stable caregiver. Early socio-emotional development of joint attention, pretend play, and attachment are compromised in post-institutionalized children, which may contribute to persistent socio-emotional deficits in maintaining social boundaries, peer competence, and social cognition. Problems with attention and executive function may also contribute to difficulty in regulating social interactions. It is concluded that early social experience plays a role in the organization of neural circuits relevant to social interaction and regulation, thereby exerting a long-term influence on the underlying capacity to process social information.

KEY-WORDS: *early experience, institutionalization, social deprivation developmental outcomes, adopted children*

Worldwide, institutional rearing has been associated with delays in physical, behavioral, cognitive, and socio-emotional development (Ahmad & Mohamad, 1996; Ames, 1997; Benoit, Jocelyn, Moddeman, & Embree, 1996; Boostani & Tashakkori, 1982; Hostetter, Iverson, Thomas, McKenzie, Dole, & Johnson, 1991; Johnson, 2000; Kaler & Freeman, 1994; Rutter & the ERA Study Team, 1998; Sigal, Perry, Rossignol, & Oimet, 2003; Sloutsky, 1997). These delays may stem from social and physical privation, which may include malnutrition, poor medical care, inadequate cognitive and motor stimulation, and lack of a stable and responsive caregiver (Gunnar, Bruce, & Grotevant, 2000; Johnson, 2000). Of these various forms of privation, the lack of a stable and responsive caregiver is

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particularly difficult to ameliorate within the institutional setting. Children typically experience several shifts of caregivers each day and have significantly less face-to-face social contact with caregivers than do family-reared infants (Lee, 2000; Zeanah, Nelson, Fox, Smyke, Marshall, Parker, et al, 2003). It has been demonstrated that even when institutions provide adequate nutrition, healthcare, and stimulation, children still exhibit persistent socio-emotional difficulties (Hodges & Tizard, 1989; Tizard & Hodges, 1978). Thus, socio-emotional problems may reflect the absence of a stable, responsive primary caregiver (Gunnar et al., 2000).

Among children internationally adopted from institutions, physical and behavioral development demonstrates a remarkable recovery in the months and years following adoption (Ames, 1997; Johnson, 2000; Rutter, Andersen-Wood, Beckett, Bredenkamp, Castle, & Groothues, 1999). In contrast, socio-emotional difficulties persist and sometimes even increase over time in some children (Ames, 1997; Chisholm, 1998; O'Connor, Bredenkamp, Rutter, & the ERA Study Team, 1999). Difficulties relating to peers are apparent from early childhood and have been observed to continue into middle childhood and adolescence (Hodges & Tizard, 1989; Keaveney & O'Connor, 1997; Tizard & Hodges, 1978). In one study, institutionalized Romanian 2- to 4-year-old children, in spite of deficits in socio-emotional functioning, were observed to engage in frequent peer interactions (Kaler & Freeman, 1994). This finding indicates the need to focus on the quality of social interactions.

Lack of individualized attention and consistent relatedness may help explain why institutional care is associated with socio-emotional deficits years after adoption. Early socio-emotional developmental tasks such as the development of joint attention, pretend play, and attachment are compromised among post-institutionalized children (Chisholm, 1998; Chisholm, Carter, Ames, & Morison, 1995; Kreppner, O'Connor, Dunn, Andersen-Wood, & the ERA Study Team, 1999; Kroupina, Iverson, Gunnar, & Johnson, 2002; Lis, 2000; Minde, 2003; O'Connor et al, 1999; Tizard & Hodges, 1978; Tizard & Rees, 1975). Consequently, post-institutionalized children may lack the requisite groundwork for learning to negotiate social interactions and relationships and interpret social cues.

Joint attention refers to the capacity for social attention coordination that normally develops in infancy. In typically developing children, joint attention skills predict the development of social cognition abilities (Camaioni, Perucchini, Bellagamba, & Colonnesi, 2004; Charman, Baron-Cohen, Swettenham, Baird, Cox, & Drew, 2001; Wellman, Philips, Dunphy-Lelii, & LaLonde, in press). One possible explanation for this association is that the experience of coordinating attention with others increases awareness that the self and others do not always perceive and understand the world in the same way. Shared neural substrates may also play a role: left frontal cortical regions have been implicated in both joint attention (Mundy, Card, & Fox, 2000) and social cognition measures (Fletcher, Happe, Frith, Baker, Sloan, Frakowiak, & Frith, 1995; Liu, Sabbagh, Gehring, &

Wellman, 2004). Institutionalized infants who lack a stable, responsive caregiver and seldom receive undivided adult attention may not have access to the experiences they need to acquire joint attention skills. Eastern European children who had spent at least 12 months in institutions prior to adoption demonstrated delays in joint attention, especially in initiating joint attention bids, and these delays become more pronounced as their age at adoption increased (Kroupina et al., 2002). The finding of joint attention delays, if replicated, would suggest that post-institutionalized children may be at increased risk for subsequent delays in social cognition abilities.

Pretend play is another early-emerging social capacity that has been related to the development of social cognition abilities (Youngblade & Dunn, 1995) and to peer competence in typically developing preschool children (Connolly & Doyle, 1984). Kreppner and colleagues (1999) found that 4-year-old Romanian children who had been adopted into the UK demonstrated significantly lower frequencies of pretend play and role play than did a comparison group of within-country adoptees who had never been institutionalized, even after controlling for cognitive and verbal abilities. Of particular note, Romanian children adopted at younger than 6 months showed the same deficits in pretend play and role play as those adopted at 6-24 months. Thus, very early experience of social deprivation appears to have lasting consequences for socio-emotional development.

Attachment-related disturbances are among the most established and persistent socio-emotional sequelae of institutional rearing (Chisholm, 1998; Chisholm et al., 1995; Lis, 2000; Marcovitch, Goldberg, Gold, Washington, Wasson, Kerkewich, & Handley-Derry, 1997; Minde, 2003; O'Connor et al., 1999, Tizard & Rees, 1975; Tizard & Hodges, 1978). Post-institutionalized children certainly are less likely to be classified as securely attached, and some of these children seem unable to form selective attachments of any kind (Minde, 2003). Three years post-adoption, Romanian children adopted into British Columbia who had spent at least 8 months in institutions were more likely to be classified as insecurely attached based on a separation reunion procedure than were birth children or Romanian children adopted at younger than 4 months (Chisholm, 1998). These later-adopted children were also more likely to have abnormal attachment patterns. Similarly, among Romanian adoptees in the UK, about 20% exhibited attachment disturbances (O'Connor et al., 1999). Romanian adoptees in Ontario were less likely to be securely attached, and avoidant attachment was not observed in any of the 56 children in the study (Marcovitch et al., 1997). It has been argued that there is a linear relation between duration of institutionalization and incidence of attachment disorders (Minde, 2003), which is consistent with the findings of O'Connor and colleagues. Marcovitch and colleagues did not observe any relation between duration of institutionalization and attachment outcomes, but they speculate that the attachment assessment instrument they used may not accurately reflect the nature of attachment phenomena in post-institutionalized populations. O'Connor and colleagues noted significant heterogeneity in

attachment-related outcomes, even among children who had experienced severe privation for extended periods.

One enduring social abnormality among children who have been institutionalized is a difficulty in maintaining social boundaries (Chisholm, 1998; Chisholm et al., 1995; Hodges & Tizard, 1989; O'Connor et al., 1999; O'Connor, Rutter, & the ERA Team, 2000; Tizard & Rees, 1975; Zeanah, Smyke, & Dumitrescu, 2002). This behavior pattern has been described as indiscriminate friendliness (Chisholm, 1998). However, this terminology is misleading, because it is not true friendliness, but rather is a disinhibited, superficial attempt to socially engage strangers. Over half the young children observed in a large Bucharest institution commonly exhibited disinhibited social approach behaviors (Zeanah et al., 2002). These indiscriminate behavior patterns persist years after removal from institutionalization. Three years post-adoption, a group of Romanian children adopted into British Columbia who had spent at least 8 months in Romanian institutions exhibited more disinhibited social approach than either birth children or Romanian children adopted at younger than 4 months (Chisholm, 1998). Romanian post-institutionalized children adopted into the UK also exhibited disinhibited social approach when assessed at 4 and 6 years of age (O'Connor et al., 1999).

Disinhibited social approach has been conceptualized as a symptom of attachment disorder (Minde, 2003; O'Connor et al., 1999), and indeed that is how it is defined in the DSM-IV (American Psychiatric Association, 1994) and ICD-10 (World Health Organization, 1992). However, Zeanah and colleagues (2002) found that disinhibited social approach was common in a Bucharest institution and was unrelated to whether children exhibited attachment to a preferred caregiver. Based on this finding, Zeanah and colleagues concluded that disinhibited social approach was independent of attachment. Relatedly, in a follow-up of post-institutionalized Romanian children in the UK at age 6, a substantial number of children were securely attached to an adoptive parent but nevertheless continued to exhibit disinhibited social approach behaviors (Marvin & O'Connor, 1999). These findings suggest that developing an attachment does not necessarily eradicate disinhibited social approach behaviors. However, the absence of an attachment figure early in development may still play a role in the *etiology* of disinhibited social approach behaviors. The lack of individualized attention and consistent relatedness may influence the organization of developing neural circuits, predisposing a child to subsequent disinhibited social approach behaviors in ways that are not readily reversible. Indeed, Hodges and Tizard (1989) noted that over the long term, the only characteristic which differentiated between children adopted as toddlers from a high quality institution and a comparison group of birth children was the persistence of disinhibited social approach behaviors in a minority of the post-institutionalized children.

It has been argued that disinhibited social approach may stem from insensitivity to social cues (O'Connor et al., 1999). Deficits in aspects of social cognition, including emotion understanding and theory of mind, may impair the ability to read social and emotion cues, thereby making it difficult to appropriately

negotiate social transactions and interpersonal relationships. Indeed, social competence and peer relationship quality are associated with social cognitive abilities (Capage & Watson, 2001; Dunn & Cutting, 1999; Dunn & Hughes, 1998; Rogosch, Cicchetti, Shields, & Toth, 1995). Social cognitive abilities are longitudinally predicted by joint attention (Charman et al., 2001; Wellman et al., in press), pretend play (Youngblade & Dunn, 1995), and quality of attachment (Arranz, Artamendi, Olabarrieta, & Martin, 2002; Fonagy, Redfern, & Charman, 1997; Meins, Fernyhough, Russell, & Clark-Carter, 1998; Ontai & Thompson, 2002; Steele, Steele, Corft, & Fonagy, 1999). Given the demonstrated deficits of post-institutionalized children in all three of these domains, it seems reasonable to hypothesize that post-institutionalized children may be at increased risk for deficits in social cognition as well. Very little research has been done on social cognition in post-institutionalized children, but two recent studies provide preliminary support for this hypothesis. In one study, institutional rearing was associated with aspects of emotion understanding, including how children process and discriminate among facial expressions of emotion. Post-institutionalized children demonstrated difficulty with emotion recognition and with selecting appropriate facial expressions for happy, sad, and fearful vignettes (Wismer Fries & Pollak, 2004). However, the post-institutionalized children performed as well as a comparison group at recognizing and selecting angry facial expressions.

Our laboratory assessed two aspects of social cognition – emotion understanding and false belief understanding – in 6- and 7-year-old post-institutionalized children (Tarullo, Bruce, & Gunnar, manuscript under review). Two age- and sex-matched comparison groups were included: children internationally adopted from foster care and birth children. Post-institutionalized children scored lower than birth children on three computerized measures of emotion understanding, but this finding did not persist after controlling for group differences in verbal ability. These emotion understanding measures were designed for use with preschool children (Wismer Fries & Pollak, 2004), and therefore may not have been sensitive enough to detect subtle deficits in emotion understanding.

False belief understanding refers to the ability to attribute to others a belief which one knows to be false, an aspect of theory of mind which has been studied extensively in typically developing and clinical populations (Wellman, Cross, & Watson, 2001). We assessed false belief understanding using a standard unexpected transfer task, in which children must predict where a protagonist will search for an object based on the protagonist's false belief about the object's location. Typically developing children perform above chance levels at this task by age 4 or 5 (Wellman et al., 2001), so failing the task at age 6 or 7 would suggest a delay in false belief understanding. Nearly half the post-institutionalized children failed both trials of the false belief task, a pattern typical of much younger children (Tarullo et al., manuscript under review). The post-institutionalized children scored lower on the false belief task than a comparison group of birth children, even after controlling for verbal ability. Foster care children scored intermediate to the other two groups on the false belief task and did not differ significantly from either

group. Age at adoption, country of origin, and retrospective adoptive parent report of prenatal and early care risk factors did not account for the association of history of institutional rearing with prenatal early care risk factors.

Results from this study and from Wismer Fries and Pollak (2004) afford preliminary evidence that institutionalization may exert longitudinal influence on aspects of social cognitive development, years after removal from the institutional environment. Speculatively, the lack of individualized attention and consistent relatedness from a stable caregiver may affect the organization of neural circuits related to social cognition, either directly or by compromising developmental precursors of social development including joint attention, pretend play, and attachment. As Zeanah and colleagues (2002) note, the hypothesized relation between disinhibited social approach and social cognitive deficits raises questions about intervention strategies. Will interventions to lessen disinhibited social approach also improve social cognitive abilities, or will social cognitive difficulties need to be addressed directly before disinhibited social approach can be diminished?

Although we have hypothesized that insensitivity to social cues stems from social cognitive deficits that hinder perspective-taking, other explanations are possible. For example, post-institutionalized children could be insensitive to social cues because attentional deficits prevent them from noticing the social cues in the first place. Alternately, the children could notice the social cues but be unable to inhibit or modify their approach behaviors because of impulsivity and poor regulatory capacities. Moreover, executive function deficits could potentially explain not only disinhibited social approach but also observed social cognitive deficits. Performance on the false belief task requires multiple executive function abilities, including inhibitory control (Carlson & Moses, 2001), rule-based reasoning, and complex planning (Zelazo & Frye, 1998).

These possibilities merit careful consideration given recent findings of attentional and regulatory problems among post-institutionalized children (Kadlec & Cermak, 2002; Kreppner, O'Connor, Rutter, Beckett, Castle, & Croft, 2001; Lin, 2003; Roy, Rutter, & Pickles, 2000; 2004). Attention regulation and inhibitory control are thought to contribute to the regulation of emotions (Posner & Rothbart, 1994). Thus, the externalizing behaviors frequently observed in post-institutionalized children (Ames, 1997; Fisher, Ames, Chisholm, & Savoie, 1997; Groze & Ileana, 1996; Hodges & Tizard, 1989; Hoksbergen, Ter Laak, Van Dijkum, Rijk, & Stoutjesdijk, 2003) may be partially attributable to executive function deficits affecting the ability to inhibit and regulate aggressive impulses. Attention regulation has also been linked to pervasive socio-emotional disturbance. Roy and colleagues (2004) found that among children reared in a high-quality institutional setting, overactivity and inattention were related to lack of selectivity in attachment relationships to caregivers, as well as to lack of selectivity in peer relationships.

Difficulty with sensory processing among post-institutionalized children is another factor that may impair the ability to negotiate social transactions and

relationships. Post-institutionalized children have been observed to have more difficulty than a control group with sensory processing of touch, movement, vision, and audition (Cermak & Daunhaer, 1997). Duration of institutionalization has been associated with lower performance on measures of sensory modulation and discrimination (Lin, 2003). It seems logical that processing and integrating basic sensory information would be a prerequisite for processing social information. Thus, sensory processing deficits could well contribute to social information processing deficits among post-institutionalized children.

Evidence of the persistent socio-emotional deficits following institutionalization suggests a role for early social experience in the organization of neural circuits relevant to processing social information. Rutter and O'Connor (2004) refer to this process as biological programming, and posit that it reflects either experience expectant or experience adaptive processes. In the case of an experience expectant process, the institutional environment would have failed to provide the minimum species-typical environment necessary to facilitate development of neural circuits related to the formation of selective attachments. In contrast, experience adaptive programming would imply that disinhibited social approach is an adaptive behavior within the institutional context to maximize interaction with caregivers, and that therefore neural circuits develop in such a way as to reinforce disinhibited social approach behaviors. Either model implies some sort of sensitive period for development of these neural circuits, such that there is limited plasticity to adapt the neural circuits in response to the post-adoption environment.

Animal models of early social deprivation can be helpful in identifying candidates for the developing neural circuits that may be influenced by early social experience. Rodent models indicate that early social deprivation is associated with greater difficulty with hippocampally mediated tasks (Meaney, Aitken, van Berkel, Bhatnagar, & Sapolsky, 1988). Rhesus monkeys reared in social isolation exhibited increased density in the dentate gyrus of the hippocampus compared to mother reared monkeys (Siegel, Ginsberg, Hof, Foote, Young, Kraemer, McKinney, & Morrison, 1993). This finding may be attributable to an increased concentration of neurofilament proteins in the dentate gyrus, which the authors contend may indicate neuronal vulnerability. Animal models also suggest that social deprivation can permanently alter neurotransmitter activity (e.g. dopamine) in the frontal lobes, which could impact the development of executive functions (Hall, Wilkinson, Humby, Inglis, Kendall, Marsden, & Robins, 1998). In addition, primate models link early deprivation with prolonged glucocorticoid elevations in response to stressors and increased reactivity to novelty (Higley, Suomi, & Linnoila, 1992). While animal models provide a starting point for understanding the impact of early social deprivation on the developing brain, many of the socio-emotional deficits observed in post-institutionalized children involve higher level representational capacities and executive functions difficult to model even in primates. Moreover, primate infants do not appear to share the exquisite sensitivity of human infants to early social deprivation. Primate infants reared in complete social isolation do not

exhibit psychosocial growth failure and show largely normative motor and cognitive functioning (Harlow, Harlow, & Suomi, 1971). Thus, it appears that whereas early social deprivation profoundly affects development across domains for human infants, effects in primate infants are predominantly confined to the social and behavioral spheres.

Several studies have investigated neurobiological processing in post-institutionalized children. Using positron emission tomography, Chugani and colleagues (Chugani, Behen, Muzik, Juhasz, Nagy, & Chugani, 2001) observed significantly reduced neural metabolism in the orbital frontal gyrus, infralimbic prefrontal cortex, medial temporal structures including the amygdala and hippocampus, lateral temporal cortex, and brain stem among post-institutionalized Romanian children compared to a control group of adults. The localization of these metabolic deficits in prefrontal and temporal structures is noteworthy, as these are the areas of the brain implicated in emotion regulation, executive function, and higher-level attentional processes.

Long term effects on the limbic-hypothalamic-pituitary axis have also been observed (Gunnar, Morison, Chisholm, & Schuder, 2001). Romanian children who had spent at least 8 months in institutions prior to adoption had elevated basal cortisol levels 6 ½ years post-adoption relative to comparison groups of birth children and Romanian children adopted at younger than 4 months. Moreover, duration of institutionalization beyond 8 months was linked to increasing elevations in cortisol levels, particularly in evening levels. Elevations in basal glucocorticoid levels, particularly evening levels, may reflect reduced density of Type I mineralocorticoid receptors in the hippocampus, a type of receptor involved in basal regulation of glucocorticoids (de Kloet, Vreugdenhil, Oitzl, & Joels, 1998). Thus, this finding provides a preliminary indication of a possible link between early social deprivation in humans and hippocampal organization.

Across socio-emotional, cognitive, and behavioral domains, duration of institutionalization has been consistently associated with severity and persistence of developmental delays (e.g. Fisher et al., 1997; Hodges & Tizard, 1989; Judge, 2003; Kreppner et al., 2001; Lin, 2003; Marcovitch et al., 1997; Rutter et al., 1999). However, significant heterogeneity in individual outcomes has been observed (MacLean, 2003; O'Connor et al., 1999; Rutter, Kreppner, & O'Connor, 2001). For example, Rutter and colleagues (2001) found that, while age at adoption did relate to the likelihood of atypical social functioning in Romanian adoptees, poor outcomes were not inevitable even among children who had spent 2 or more years in institutions. At age 6, one-fifth of these late-adopted children appeared to be functioning entirely normally across socio-emotional, cognitive, and behavioral domains. It is not known why some post-institutionalized children exhibit delays, while others perform at the developmentally expected level. Genetic factors may play a role in resilience or vulnerability to the effects of early deprivation.

In addition, other types of early adversity that may co-occur in institutionalized populations, such as malnutrition or prenatal alcohol exposure, partially account for the observed heterogeneous outcomes among children who

appear to have experienced similar quality and duration of institutional care. Several investigators have attempted to rule out these alternative explanations. Rutter and the ERA Study Team (1998) noted that malnutrition did not predict cognitive recovery among Romanian adoptees. Judge (2003) found that developmental recovery of Eastern European adoptees was not predicted by height or weight at the time of adoption, suggesting that post-adoption development was not a function of malnutrition or stunted growth. Kaler & Freeman (1994) reported that cognitive and social development among children in a Romanian orphanage was not related to birth weight or Apgar scores, and that developmental delays therefore appeared attributable to the experience of privation rather than to prenatal risk factors. However, in many research projects it is difficult to retrospectively assess prenatal risk factors with any assurance of accuracy. Prenatal experiences may well interact with the experience of institutional rearing in the organization of neural circuitry. Furthermore, until research is conducted which includes accurate, concurrent assessment of prenatal experience, the possibility cannot be ruled out that the sequelae attributed to institutional rearing may in fact be partially explained by prenatal experiences.

In sum, the evidence reviewed here supports a likely role for early social experience in the organization of neural circuits that deal with the underlying capacity to process social information. While much more research clearly is needed to clarify the mechanisms by which early social experience acts on the developing brain, current findings suggest that the neurobiological effects of early social privation are not easily reversible and have far-reaching consequences for socio-emotional functioning. These findings underscore the pressing need to develop, implement, and evaluate interventions for currently institutionalized children.

In recent years, important progress has been made in this area. Some interventions have focused on modifications within the institutional setting. Children in a pilot unit in a Bucharest institution were exposed to only four caregivers during their waking hours, and this increased consistency of caregivers was associated with fewer disinhibited social approach behaviors compared to children not housed on the pilot unit (Zeanah et al., 2002). Implementation of a daily structured 90-minute play session in an Indian institution led to significant gains in psychosocial, cognitive, and motor development over a 3 month period (Taneja, Sriram, Beri, Sreenivas, Aggarwal, & Kaur, 2002). Moreover, caregivers reported that, contrary to their expectations, their workload actually decreased as children became more active, playful, responsive, and independent. Another study found that children who received 5 minutes of extra social interaction each day for 6 weeks demonstrated greater cognitive and psychomotor improvement than a control group in the same institution who received no added interaction (Hakimi-Manesh, Mojdehi, & Tashakkori, 1984). An observational study comparing two Eritrean institutions reported fewer symptoms of emotional distress among children living in an institution that promoted the development of a close personal tie with at least one staff member, compared to children in an institution where interactions

with staff members were generally impersonal (Wolff & Fesseha, 1998). Another approach to intervention research is to compare institutionalization with alternative forms of care. The Bucharest Early Intervention Project, currently underway, is a randomized controlled trial of foster care placement as an alternative to institutionalization (Zeanah et al., 2003). This longitudinal research has the potential to elucidate the extent to which early intervention can mitigate the effects of early privation, and is an initial step towards identifying the underlying neural circuits affected by early social experience. It is imperative that such research and intervention efforts continue and increase, to inform the development of policies that will best support the optimal development of this vulnerable population of children.

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REFERENCES

Ahmad, A., & Mohamad, K. (1996). The socioemotional development of orphans in orphanages and traditional foster care in Iraqi Kurdistan. *Child Abuse and Neglect, 20,* 1161-1173.

American Psychiatric Association (1994). *Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV).* Washington, DC: American Psychiatric Association

Ames, E. W. (1997). *The development of Romanian orphanage children adopted into Canada. Final report to human resources development, Canada.* Burnaby, Canada: Simon Fraser University.

Arranz, E., Artamendi, J., Olabarrieta, F., & Martin, J. (2002). Family context and theory of mind development. *Early Child Development & Care, 172,* 9-22.

Benoit, T. C., Jocelyn, L. J., Moddemann, D. M., & Embree, J. E. (1996). Romanian adoption: The Manitoba experience. *Archives of Pediatric and Adolescent Medicine, 150,* 1278-1282.

Boostani, M., & Tashakkori, A. (1982). Social maturity of children reared in an Iranian orphanage. *Child Study Journal, 12,* 127-133.

Camaioni, L, Perucchini, P., Bellagamba, F., & Colonnesi, C. (2004). The role of declarative pointing in developing a theory of mind. *Infancy, 5(3),* 291-308.

Capage, L., & Watson, A. C. (2001). Individual differences in theory of mind, aggressive behavior, and social skills in young children. *Early Education & Development, 12*, 614-628.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*, 1032-1053.

Cermak, S. A., & Danhauer, L. A. (1997). Sensory processing in the post-institutionalized child. *American Journal of Occupational Therapy, 51,* 500-507.

Charman, T., Baron-Cohen, S., Swettenham, J., Baird, G., Cox, A., & Drew, A. (2001). Testing joint attention, imitation, and play as infancy precursors to language and theory of mind. *Cognitive Development, 15,* 481-498.

Chisholm, K. (1998). A three year follow-up of attachment and indiscriminate friendliness in children adopted from Romanian orphanages. *Child Development, 69,* 1090-1104.
Chisholm, K., Carter, M. C., Ames, E. W., & Morison, S. J. (1995). Attachment security and indiscriminately friendly behavior in children adopted from Romanian orphanages. *Development and Psychopathology, 7,* 283-294.
Chugani, H. T., Behen, M. E., Muzik, O., Juhasz, C., Nagy, F., & Chugani, D. C. (2001). Local brain functional activity following early deprivation: A study of postinstitutionalized Romanian orphans. *NeuroImage, 14,* 1290-1301.
Connolly, J. A. & Doyle, A. (1984). Relation of social fantasy play to social competence in preschoolers. *Developmental Psychology, 20,* 797-806.
de Kloet, R., Vreugdenhil, E., Oitzl, M., & Joels, A. (1998). Brain corticosteroid receptor balance in health and disease. *Endocrine Review, 19,* 269-301.
Dunn, J., & Cutting, A. L. (1999). Understanding others, and individual differences in friendship interactions in young children. *Social Development, 8(2),* 201-219.
Dunn, J., & Hughes, C. (1998). Young children's understanding of emotions within close relationships. *Cognition & Emotion, 12*, 171-190.
Fisher, L., Ames, E. W., Chisholm, K., & Savoie, L. (1997). Problems reported by parents of Romanian orphans adopted to British Columbia. *International Journal of Behavioral Development, 20,* 67-82.
Fletcher, P., Happe, F., Frith, U., Baker, S., Sloan, R., Frakowiak, R., & Frith, C. (1995). Other minds in the brain: A functional imaging study of "theory of mind" in story comprehension. *Cognition, 57,* 109-128.
Fonagy, P., Redfern, S., & Charman, T. (1997). The relationship between belief-desire reasoning and a projective measure of attachment security (SAT). *British Journal of Developmental Psychology, 15*, 51-61.
Groze, V., & Ileana, D. (1996). A follow-up study of adopted children from Romania. *Child and Adolescent Social Work Journal, 13,* 541-565.
Gunnar, M. R., Bruce, J., & Grotevant, H. (2000). International adoption of institutionally reared children: Research and Policy. *Development & Psychopathology, 12,* 677-693.
Gunnar, M. R., Morison, S. J., Chisholm, K., & Schuder, M. (2001). Salivary cortisol levels in children adopted from Romanian orphanages. *Development and Psychopathology, 13,* 611-628.
Hakimi-Manesh, Y., Mojdehi, H., & Tashakkori, A. (1984). Short communication: Effects of environmental enrichment on the mental and psychomotor development of orphanage children. *Journal of Child Psychiatry and Psychiatry and Allied Disciplines, 25,* 643-650.
Hall, F. S., Wilkinson, L. S., Humby, T., Inglis, W., Kendall, D. A., Marsden, C. A., & Robins, T. W. (1998). Isolation rearing in rats: Pre- and post-synaptic changes in striatal dopaminergic systems. *Pharmacology, Biochemistry, and Behavior, 59,* 859-872.
Harlow, H. F., Harlow, M. K., & Suomi, S. J. (1971). From thought to therapy: Lessons from a primate laboratory. *American Scientist, 59,* 538-549.
Higley, J. D., Suomi, S. J., & Linnoila, M. (1992). A longitudinal assessment of CSF monoamine metabolite and plasma cortisol concentrations in young rhesus monkeys. *Biological Psychiatry, 32,* 127-145.
Hoksbergen, R. A., Ter Laak, J., Van Dijkum, C., Rijk, K., & Stoutjesdijk, F. (2003). Attention deficity hyperactivity disorder in adopted Romanian children living in the Netherlands. *Adoption Quarterly, 6,* 59-73.

Hodges, J., & Tizard, B. (1989). Social and family relationships of ex-institutional adolescents. *Journal of Child Psychology, Psychiatry, and Allied Disciplines, 30,* 77-97.

Hostetter, M., Iverson, S., Thomas, W., McKenzie, D., Dole, K., & Johnson, D. (1991). Medical evaluation of internationally adopted children. *New England Journal of Medicine, 325,* 479-485.

Johnson, D. E. (2000). Medical and developmental sequelae of early childhood institutionalization in Eastern European adoptees. In C. A. Nelson (Ed.), *The Effects of Early Adversity on Neurobehavioral Development: Minnesota Symposia on Child Psychology* (Vol. 31, pp. 113-162). Mahwah, NJ: Lawrence Erlbaum.

Judge, S. (2003). Developmental recovery and deficit in children adopted from Eastern European orphanages. *Child Psychiatry and Human Development, 34,* 49-62.

Kadlec, M. B., & Cermak, S. A. (2002). Activity level, organization, and social-emotional behaviors in post-institutionalized children. *Adoption Quarterly, 6,* 43-57.

Kaler, S. R., & Freeman, B. J. (1994). Analysis of environmental deprivation: Cognitive and social development in Romanian orphans. *Journal of Child Psychiatry and Psychology and Allied Disciplines, 35,* 769-781.

Keaveney, L., & O'Connor, T. (April, 1997). *The network of social relations of adoptees exposed to severe early deprivation*. Presented at the Biennial Meeting of the Society for Research in Child Development, Washington, D.C.

Kreppner, J. M., O'Connor, T. G., Dunn, J., Andersen-Wood, L., & the ERA Study Team (1999). The pretend and social role play of children exposed to early severe deprivation. *British Journal of Developmental Psychology, 17,* 319-332.

Kreppner, J. M., O'Connor, T. G., Rutter, M., Beckett, C., Castle, J., & Croft, C. (2001). Can inattention/overactivity be an institutional deprivation syndrome? *Journal of Abnormal Child Psychology, 29,* 513-528.

Kroupina, M., Iverson, S., Gunnar, M. R., & Johnson, D. E. (2002). Social and communication skills of post-institutionalized children. *Pediatric Research, 51,* 20A.

Lee, K. (2000). Crying patterns of Korean infants in institutions. *Child: Care, Health, and Development, 26,* 217-228.

Lin, S. H. (2003). Sensory integration, growth, and emotional and behavioral regulation in adopted post-institutionalized children. *Dissertation Abstracts International: Section B: The Sciences & Engineering, 64(3-B),* 1478.

Lis, S. (2000). Characteristics of attachment behavior in institution-reared children. In P. M. Crittenden and A. H. Claussen (Eds.), *The organization of attachment relationships: Maturation, culture, and context* (pp. 141-170). New York, NY: Cambridge University Press.

Liu, D., Sabbagh, M. A., Gehring, W. J., & Wellman, H. M. (2004). Decoupling beliefs from reality in the brain: An ERP study of theory of mind. *Neuroreport, 15(6),* 991-995.

MacLean, K. (2003). The impact of institutionalization on child development. *Development and Psychopathology, 15,* 853-884.

Marcovitch, S., Goldberg, S., Gold, A., Washington, J., Wasson, C., Kerkewich, K., & Handley-Derry, M. (1997). Determinants of behavioural problems in Romanian children adopted in Ontario. *International Journal of Behavioral Development, 20,* 17-31.

Marvin, R., & O'Connor, T. G. (April, 1999). The formation of parent–child attachment following privation. Presented at the Biennial Meeting of the Society for Research in Child Development, Albuquerque, NM.

Meaney, M. J., Aitken, D. H., van Berkel, C., Bhatnagar, S., & Sapolsky, R. M. (1988). Effect of neonatal handling on age-related impairments associated with the hippocampus. *Science, 239,* 766-768.

Meins, E., Fernyhough, C., Russell, J., & Clark-Carter, D. (1998). Security of attachment as a predictor of symbolic and mentalising abilities: A longitudinal study. *Social Development, 7,* 1-24.

Minde, K. (2003). Assessment and treatment of attachment disorders. *Current Opinion in Psychiatry, 16,* 377-381.

Mundy, P., Card, J., & Fox, N. (2000). EEG correlates of the development of infant joint attention skills. *Developmental Psychobiology, 36(4),* 325-338.

O'Connor, T. G., Bredenkamp, D., Rutter, M., & the ERA Study Team (1999). Attachment disturbances and disorders in children exposed to early severe deprivation. *Infant Mental Health Journal, 20,* 10-29.

O'Connor, T. G., Rutter, M., & the ERA Study Team (2000). Attachment disorder behavior following early severe deprivation: Extension and longitudinal follow-up. *Journal of the American Academy of Child and Adolescent Psychiatry, 39,* 703-712.

Ontai, L. L., & Thompson, R. A. (2002). Patterns of attachment and maternal discourse effects on children's emotion understanding from 3 to 5 years of age. *Social Development, 11,* 433-450.

Posner, M. I., & Rothbart, M. K. (1994). Attentional regulation: From mechanism to culture. In P. Bertelson, P. Eulen, et al. (Eds.), *International Perspectives on Psychological Science, Vol. 1: Leading Themes* (pp. 41-55). Hillsdale, NJ: Lawrence Erlbaum.

Rogosch, F. A., Cicchetti, D., Shields, A., & Toth, S. L. (1995). Parenting dysfunction in child maltreatment. In M. Bornstein (Ed.), *Handbook of parenting* (Vol. 4, pp. 127-159). Hillsdale, NJ: Erlbaum.

Roy, P., Rutter, M., & Pickles, A. (2000). Institutional care: Risk from family background or pattern of rearing? *Journal of Child Psychology and Psychiatry and Allied Disciplines, 41(2)*, 139-149.

Roy, P., Rutter, M., & Pickles, A. (2004). Institutional care: Associations between overactivity and lack of selectivity in social relationships. *Journal of Child Psychology & Psychiatry, 45,* 866-873.

Rutter, M., Andersen-Wood, L., Beckett, C., Bredenkamp, D., Castle, J., & Groothues, C. (1999). Quasi-autistic patterns following severe early global privation. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 40,* 537-549.

Rutter, M., & the ERA Study Team (1998). Developmental catch-up, and deficit, following adoption after severe global early privation. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 39,* 465-476.

Rutter, M., Kreppner, J. M. & O'Connor, T. G. (2001). Specificity and heterogeneity in children's responses to profound institutional privation. *British Journal of Psychiatry, 179,* 97-103.

Rutter, M., & O'Connor, T. G. (2004). Are there biological programming effects for psychological development? Findings from a study of Romanian adoptees. *Developmental Psychology, 40,* 81-94.

Siegel, S. J., Ginsberg, S. D., Hof, P. R., Foote, S. L., Young, W. G., Kraemer, G. W., McKinney, W. T., & Morrison, J. H. (1993). Effects of social deprivation in

prepubescent rhesus monkeys: Immunohistochemical analysis of the neurofilament protein triplet in the hippocampal formation. *Brain Research, 619,* 299-305.

Sigal, J. J., Perry, J. C., Rossignol, M., & Oimet, M. C. (2003). Unwanted infants: Psychological and physical consequences of inadequate orphanage 50 years later. *American Journal of Orthopsychiatry, 73,* 3-12.

Sloutsky, V. M. (1997). Institutional care and developmental outcomes of 6- and 7-year-old children: A contextualist perspective. *International Journal of Behavioral Development, 20,* 131-151.

Steele, H., Steele, M., Corft, C., & Fonagy, P. (1999). Infant-mother attachment at one year predicts children's understanding of mixed emotions at six years. *Social Development, 8*, 161-178.

Taneja, V., Sriram, S., Beri, R. S., Sreenivas, V. Aggarwal, R., & Kaur, R. (2002). 'Not by bread alone': Impact of a structured 90-minute play session on development of children in an orphanage. *Child: Care, Health, & Development, 28,* 95-100.

Tarullo, A. R., Bruce, J., & Gunnar, M. R. (2004). False belief and emotion understanding in post-institutionalized children. (Manuscript under review).

Tizard, B., & Hodges, J. (1978). The effect of early institutional rearing on the development of eight-year-old children. *Child Development, 43,* 337-358.

Tizard, B., & Rees, J. (1975). The effect of early institutional rearing on the behavioral problems and affectional relationships of four-year-old children. *Journal of Child Psycholgoy and Psychiatry, 16,* 61-73.

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development, 72,* 655-684.

Wellman, H. M., Philips, A. T., Dunphy-Lelii, S. & LaLonde, N. (in press). Infant social attention predicts preschool social cognition. *Developmental Science.*

Wismer Fries, A. B., & Pollak, S. D. (2004). Emotion understanding in post-institutionalized Eastern European children. *Development and Psychopathology, 16,* 355-369.

Wolff, P. H., & Fesseha, G. (1998). The orphans of Eritrea: Are orphanages part of the problem or part of the solution? *American Journal of Psychiatry, 155,* 1319-1324.

World Health Organization (1992). *The ICD-10 Classification of Mental and Behavioral Disorders: Clinical Descriptions and Diagnostic Guidelines.* Geneva: World Health Organization.

Youngblade, L. & Dunn, J. (1995). Individual differences in young children's pretend play with mother and sibling: Links to relationships and understanding of other people's feelings and beliefs. *Child Development, 66,* 1472-1492.

Zeanah, C. H., Nelson, C. A., Fox, N. A., Smyke, A. T., Marshall, P., Parker, S. W., & Koga, S. (2003). Designing research to study the effects of institutionalization on brain and behavioral development: The Bucharest Early Intervention Project. *Development and Psychopathology, 15,* 885-907/

Zeanah, C. H., Smyke, A. T., & Dumitrescu, A. (2002). Attachment disturbances in young children. II: Indiscriminate behavior and institutional care. *Journal of the American Academy of Child and Adolescent Psychiatry, 41,* 983-989.

Zelazo, P. D., & Frye, D. (1998). Cognitive complexity and control: II. The development of executive function in childhood. *Current Directions in Psychological Science, 7(4),* 121-126.