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Neuropsychological Functioning, Social Information Processing, and Parent-Reported Behavior and Social Competence in Internationally Adopted Girls with a History of Institutionalization

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Neuropsychological Functioning, Social Information Processing, and Parent-Reported Behavior and Social Competence in Internationally Adopted Girls with a History of Institutionalization

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by

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Abstract

**Background:** Internationally adopted (IA) children often experience poor pre-adoption conditions that may contribute to atypical neural development and deficits in neuropsychological, behavioral, and social functioning. In the current literature examining IA children, there is a relative lack of knowledge about executive functions (EF), attention, and social information processing (SIP) and the relationship of these domains of functioning with social and behavioral outcomes. Therefore, this study aims to test a model of social and behavioral functioning that proposes that neuropsychological factors (specifically working memory, inhibition, language, and attention) influence social and behavioral outcomes. We further aim to test the hypothesis that the relationship between neuropsychological functioning and social and behavioral outcomes is mediated by SIP. **Method:** Participants included girls between the ages of 6-12 years old with a history of institutionalization who were adopted from China (n = 32) or Eastern-Europe (n = 25) and control group of American-born, never-institutionalized girls that was well-matched for age and family income (n = 25). Participants completed measures assessing social information processing (Dodge Video Vignettes; DVV) and attention [Sky Search and Score! subtests from the Test of Everyday Attention for Children (TEA-Ch)]. Parents completed the Behavior Rating Scales of Executive Functions (BRIEF) and the Child Communication Checklist- 2nd edition (CCC-2) to provide information about their child’s executive functions and language. For the assessment of social competence and behavior in everyday occurring situations, parents also completed the Social Competence subscale from the Home and Community Social Behavior Scale (HCSBS) and the Child Behavior Checklist (CBCL). **Results:** Compared to the controls, the Eastern European group evidenced significantly more problems across domains of functioning, including social competence, behavior, inhibition,
working memory, auditory attention, and language. Language abilities were poorer in the Chinese group compared to the controls. Using generalized linear regression, language and inhibition significantly predicted parent-reported social competence. In a separate model, language, inhibition, and working memory predicted parent-reported behavior problems. SIP, as assessed by DVV Competent Responses, did not mediate the relationship between neuropsychological functioning and social and behavioral outcomes. **Conclusions:** IA children with a history of institutionalization may be vulnerable to negative neuropsychological, behavioral, and social outcomes. These findings support the use of measures assessing neuropsychological functioning to better understand behavioral and social adjustment following international adoption, offering clinicians greater insight into the specific needs of this population.
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Introduction

War, poverty, and a lack of social welfare in many nations have displaced thousands of children, resulting in an increase in international adoption in recent years (Lee et al., 2006). In 2000, approximately 19,000 children were internationally adopted (IA) to the United States, although changes in government policies decreased this number to approximately 7,000 in 2013 (U.S. Department of State, 2013). Given the need for stable homes for displaced children, there has been recent interest in understanding motivations to adopt children internationally. In a recent survey conducted by the United States Department of Health and Human Services (2013), 92% of parents surveyed endorsed the desire to grow their family as a primary motivator for internationally adopting. Other commonly endorsed motivations included the desire to provide a permanent home for a child (90%) and infertility (72%).

IA children often have had experiences that serve as risk factors for negative cognitive, behavioral, and social outcomes, including in-utero substance exposure, poor prenatal and perinatal healthcare services, pre-adoptive malnutrition, neglect, and abuse (McGuinness & Pallansch, 2000; O’Connor et al., 2000), lack of individualized care and attention (Gunnar et al., 2000), and few opportunities to engage in activities that facilitate cognitive development (e.g., playing with toys and interacting with others; Johnson, 2002). Existing studies have documented difficulties with behavior (MacLean, 2003; Rutter, Kreppner & O’Connor, 2001; Gunnar et al., 2001; Kreppner et al., 2001) and social functioning (Bruce, Tarullo, & Gunnar, 2009; Covel et al., 2008; Tarullo, Bruce, & Gunnar, 2007), which will be explored in greater depth below.
Despite cognitive risk factors that these children are exposed to, there is a relative lack of knowledge about executive functions (EF), attention, and cognitive aspects of social information processing (SIP). There is no research of which we are aware that has examined the relationship between neuropsychological functioning and SIP and the social and behavioral problems that these children are known to exhibit. Thus, the aim of the current study is to examine the impact of early institutionalization and environmental deprivation on neuropsychological functioning (attention, EF, and language), SIP, social competence, and behavior. Additionally, this study aims to test a hypothesized model that neuropsychological functioning (specifically working memory, inhibition, language, and attention) influences social and behavioral outcomes. We further aim to investigate the mediating role of SIP on this relationship. Finally, we aim to examine the influence of area of origin and age at adoption, factors that have been shown to be relevant when considering neuropsychological and behavioral outcomes in IA children.

*Biological and environmental factors, neuropsychological functioning, and social and behavioral outcomes in children: A theoretical model*

Within the social neuroscience literature, there has been recent interest in obtaining a better understanding of the process that underlies social and behavioral competence in children. Dodge and colleagues were among the first to propose a model that sought to explain the cognitive processes that occur while in social situations. Crick and Dodge (1994) defined SIP as the cognitive process of encoding and interpreting social information to generate a behavioral response. According to the Dodge et al. model (1994; 1987; 1995; 2003), the process of SIP occurs in six steps: encoding of internal and external situational cues, formulating mental representations and interpreting situational cues, selecting and clarifying goals for the situation, generating possible behavioral responses, selecting an optimal behavioral response, and initiating
and enacting the selected behavioral response. Although not central to the proposed model, the authors stated that SIP requires integration of a variety of specific neuropsychological abilities, including cognitive efficiency, working memory, retrieval and integration of prior experience for application to current social situations, pragmatic language, and meta-cognitive abilities to understand the mental states of others and predict potential behavioral responses (Crick & Dodge, 1994). Dodge (1986) also acknowledged the role of attention and stated that if attention is lacking while in social situations, inappropriate behavior can result.

Findings from two longitudinal studies have demonstrated that early weaknesses in SIP are associated with long-term problems with social competence and behavior. In typically developing children, those who exhibited hostile interpretations of the intentions of other children at a younger age were more likely to have reactive-aggressive behavioral tendencies, characterized by positive evaluations of aggression and its consequences in middle childhood (Crick & Dodge, 1996). In a separate study, Dodge and colleagues (2003) reported that early peer rejection in the 1st and 2nd grades predicted aggressive behavior in the 5th and 7th grades. Early peer rejection reportedly exacerbated later anti-social behaviors, including aggression, but only among children who evidenced aggressive tendencies as younger children. The tendency to attribute negativity to social interactions was associated with peer rejection at a younger age and increased aggression during middle childhood, indicating that SIP may mediate the relationship between early experience of social rejection and development of aggressive behavior. The authors posited that early childhood problems with SIP often resulted in impaired social competence and subsequent peer rejection. It was suggested that social rejection contributed to worsening social competence because children with hostile response tendencies may have not been provided with opportunities to increase social competence. Therefore, a preexisting
vulnerability for problems with SIP, coupled with peer rejection and a resulting lack of opportunities to engage in activities that facilitate development of social skills, may have resulted in worsening social competence over time (Dodge et al., 2003). The Dodge et al. model (1994; 1987; 1995; 2003), is limited in not having more comprehensively addressed environmental, biological, neuropsychological, and genetic factors that influence social and behavioral functioning (Beauchamp & Anderson, 2010; Yeates et al., 2007). Additionally, the Dodge model has been primarily applied to children with aggressive or hostile behaviors (Dodge et al., 1994; 1987; 1995; 2003) and there is limited evidence supporting its applicability to other problems with social competence, such as non-aggressive, disinhibited social behavior.

Neuroimaging findings have implicated the frontal lobes (i.e., the ventromedial, orbital, and dorsolateral prefrontal cortices) and other associated areas (i.e., the fusiform gyrus, the superior temporal sulcus, the amygdala) in the processing of social information (Eslinger, Flaherty-Craig, & Benton, 2004; Adolfs, 2001). Based on these findings, Yeates and colleagues (2007) proposed a model that sought to describe the role of EF on social and behavioral functioning. The authors specifically identified two domains of EF, inhibition and working memory, as especially relevant to social and behavioral functioning. Inhibitory control is relevant because it allows the individual to stop impulsive responses and appropriately engage in social reciprocity. Barkley (1997) similarly argued that poor inhibitory control may contribute to negative social outcomes that are commonly seen in children with attentional problems. Consistent with this idea, neuropsychological aspects of cognitive inhibition in typically developing children have been shown to significantly predict parent-reported social competence (Charman, Carroll, & Sturge, 2001).
With regard to working memory, both Dodge et al. (1987; 2003) and Yeates et al. (2007) posited that working memory supports the ability to process incoming social information and cues and use this information to generate a behavioral solution. This is supported by prior research that has reported that working memory is associated with social outcomes in various clinical populations, such as schizophrenia (Bora, Eryavus, Kayahan, Sungu, & Veznedaroglu, 2006) and attention deficit/ hyperactivity disorder (Kofler, Rapport, Bolden, Sarver, Raiker, & Alderson, 2011). Kifer and colleagues (2011) argued that negative behavioral and social outcomes that are commonly seen in children with attention problems are related to deficits in working memory that result in a lack of ability to efficiently process social cues from multiple, on-going sources of information. Together, this work provides a theoretical and empirical basis to support the relevance of inhibition (Yeates et al., 2007; Barkley, 1997; Charman, Carroll, & Sturje, 2001) and working memory (Bora, Eryavus, Kayahan, Sungu, & Veznedaroglu, 2006; Kofler, Rapport, Bolden, Sarver, Raiker, & Alderson, 2011; Yeates et al., 2007; Dodge et al., 1987; 2003) to social competence and behavior.

Language has been suggested to be the primary means by which individuals form social bonds (Gallagher, 1993). Although not central to their model, Crick and Dodge (1994) acknowledged that pragmatic language (e.g., ability to understand and appropriately use basic social elements of language, including non-verbal aspects of communication and social norms in social reciprocity) and the ability to understand non-literal language (e.g., irony, humor, and deception) may be relevant to SIP. Consistent with this, Yeates and colleagues (2007) discussed the role of pragmatic language on social functioning. Pragmatic language requires theory of mind (i.e., insight into the mental states, such as understanding that a person can say one thing while meaning another), which has implications for the ability to appropriately engage in social
interactions. Prior research supports the notion that pragmatic language is relevant to social functioning; for example, in children, it has been reported that the ability to participate in conversations with peers (e.g., make adjustments in communication in response to social cues) is positively associated with parental ratings of peer acceptance (Brinton & Fujiki, 1999).

In sum, Yeates and colleagues (2007) built upon the work of Dodge and colleagues (1994; 1987; 1995; 2003) by positing that neuropsychological functioning influences social and behavioral outcomes. The authors theorized that EF, specifically working memory and inhibition, and pragmatic language are highly relevant for social and behavioral functioning. When considering the model put forth by Yeates and colleagues (2007), it is has been noted that while this model more specifically explains neuropsychological influences on social and behavioral functioning, it is limited in its failure to address environmental and biological influences (Beauchamp & Anderson, 2010).

In view of the limitations of previous models, Beauchamp and Anderson (2010) formed an integrative model that sought to account for environmental, biological, and neuropsychological influences on social development and behavior. For Beauchamp and Anderson, internal (e.g., temperament, personality) and external/environmental factors (e.g., parental relationships, attachment, culture, socioeconomic status) together impact neural development and, thereby, neuropsychological functioning. Similar to the Yeates et al. model (2007), Beauchamp and Anderson (2010) cited previous work demonstrating that the frontal regions, together with many associated networks, are highly relevant to social competence and behavioral regulation (Eslinger, Flaherty-Craig, & Benton, 2004; Adolphs, 2001). Also similar to Yeates et al. (2007), the authors argued that inhibition, working memory, and pragmatic
language are domains of neuropsychological functioning that are highly relevant to social and behavioral functioning.

In contrast to the Yeates et al. (2007) model, Beauchamp and Anderson (2010) more broadly considered the role of language and argued that numerous aspects of language, including pragmatic, expressive, and receptive language, are important to social and behavioral outcomes. The authors posited that language is relevant when considering the ability to efficiently communicate emotional information to others and to express and comprehend verbally communicated information in social interactions. This is consistent with other authors that have argued that language abilities allow for the appropriate initiation and maintenance of conversation and the clear communication of intentions (Gallagher, 1993). As noted above, prior research has demonstrated that the ability to appropriately participate in conversations is positively associated with parental ratings of peer acceptance in children (Brinton & Fujiki, 1999). Speaking to the role of global language functioning, expressive and receptive language abilities and semantic processing have been associated with parent rating of behavior problems and on teacher ratings of social assertiveness (McCabe & Meller, 2004). A relative weakness for language may also be associated with greater vulnerability to behavior problems that may result from difficulties using language and effective communication skills to organize and structure the environment and implement effective behavioral solutions (Ayduk, Rodriguez, Mischel, Shoda, & Wright, 2007). Together, these findings suggest that pragmatic, expressive, and receptive language, are relevant to social and behavioral outcomes in children.

Also in contrast to the Yeates et al. (2007) model, Beauchamp and Anderson (2010) described the role of attention on social functioning and behavioral regulation. According to Beauchamp and Anderson (2010), attentional control, including the initiation and maintenance of
attention, allows for efficient processing of social information and self-monitoring of behavior. Inefficient attention can result in either omitting or incorrectly processing social information, potentially resulting in socially inappropriate behavior (Beauchamp & Anderson, 2010; Dodge, 1987). Numerous lines of research support the role of attention in social functioning. In young, typically developing children, better effortful attention was related to more favorable parent ratings of social skills and behavior regulation (Kochanaska, Murray, & Harlan, 2000). In a separate study of typically developing pre-school aged children, better attention, as assessed by the ability to accurately detect stimuli, was associated with more observed reciprocal play with peers (Murphy, Laurie- Rose, Brinkman, & McNamara, 2007).

When considering these models, it is important to clearly distinguish where SIP is considered relative to other areas of influence. Yeates et al. (2007) and Beauchamp and Anderson (2010) conceptualized SIP as an integration of neuropsychological abilities that impacts social competence and behavior. In contrast, Dodge and colleagues (1994; 1987; 1995; 2003) considered SIP as influenced by, yet distinct from, neuropsychological functioning. In view of research indicating impairments in social competence that are not explained by neuropsychological functioning (Green, Gilchrist, Burton, & Cox, 2000), Beauchamp and Anderson (2010) acknowledged that it may be reasonable to consider SIP as a process that influences social competence and behavior and is distinct from neuropsychological functioning. That is, SIP may be appropriately conceptualized as a complex process that is influenced by numerous environmental, biological, psychosocial, and neuropsychological factors (Dodge et al., 2003; Beauchamp & Anderson, 2010). With regard to specific areas of neuropsychological functioning, working memory (Dodge et al., 1987; 2003; Yeates et al., 2007), inhibition (Yeates
et al., 2007; Beauchamp & Anderson, 2010), attention, and language (Beauchamp & Anderson, 2010; Yeates et al., 2007; Dodge, 1986) may be especially important for efficient SIP.

In summary, Dodge and colleagues were among the first to put forth a model of cognitive aspects of SIP. As part of the Dodge conceptualization, it was that suggested that SIP influences behavioral and social outcomes and is influenced by a variety of neuropsychological abilities, including working memory, pragmatic language, meta-cognitive skills, and attention (Dodge, 1986; Crick & Dodge, 1994). Yeates and colleagues (2007) proposed a model that sought to describe neuropsychological factors that are related to SIP, specifically inhibition, working memory, and pragmatic language. Beauchamp and Anderson (2010) further broadened this framework to consider internal factors, external/ environmental factors, neural development, and neuropsychological functioning, most prominently working memory, inhibition, attention, and global language processing, that together influence social and behavioral outcomes. In synthesizing these models, similar to that described by Beauchamp and Anderson (2010), it is posited that environmental (e.g., parenting factors, family functioning, previous experiences of learning and conditioning) and biological (e.g., genetics, pre- and peri-natal health care, medical or psychiatric conditions) factors influence the development of neural networks that regulate social and behavioral functioning. It is suggested that biological and environmental often influence each other. For example, previous research suggests that environment risk factors can exacerbate the effects of a medical condition. In the case of childhood traumatic brain injury, a medical condition that can influence neural development and has implications for behavioral and social functioning, it has been shown that post-injury recovery is influenced by environmental factors, such as parenting style and family functioning (Schwartz et al., 2003; Taylor et al., 2001). Disruptions to the development of neural networks impacts areas of neuropsychological
functioning that are important to SIP. Consistent with Dodge and colleagues (1994; 1987; 1995; 2003), Yeates and colleagues (2007), and Beauchamp and Anderson (2010), it is suggested that working memory is highly relevant to SIP because it supports the individual’s ability to process incoming social information and cues and use the information to generate a behavioral solution. Consistent with Yeates and colleagues (2007) and Beauchamp and Anderson (2010), it is also posited that inhibition is relevant because it allows for regulation of impulsive behavior while in social situations. In agreement with Beauchamp and Anderson (2010), it is argued that global language processing is relevant because it allows for efficient communication of information and the ability to comprehend verbally communicated information. Also consistent with Beauchamp and Anderson (2010), it is suggested that attention is important because it allows for efficient processing of information and self-monitoring of behavior. Together, these domains of neuropsychological functioning (working memory, inhibition, language, and attention) influence SIP, which in turn influences social and behavioral functioning in everyday occurring situations. However, it is acknowledged that there are numerous factors that influence SIP and subsequent behavior and social competence.

*Neuropsychological functioning in IA children*

Children who have been institutionalized prior to adoption often have lower general cognitive abilities relative to never-adopted, never-institutionalized peers (van IJendoorn & Juffer, 2006). However, children who have been adopted fare significantly better than children who remain institutionalized. A meta-analysis found that, relative to their siblings who remained in institutionalized care in their home country, IA children exhibit higher scores on measures of general cognitive functioning. When compared to never-institutionalized, American-born peers, IA children evidenced lower scores on measures of general cognitive functioning and higher
rates of learning disorders. These findings suggest that while IA children often evidence gains in functioning once adopted, the negative effects of early deprivation and institutionalization are often long-term (van Ijendoorn, Juffer, & Poelhius, 2005). A separate study investigated performance on measures of general cognitive functioning in three groups of pre-school aged children: a control group of never-adopted Romanian children who continued to live with their biological parents, Romanian children who were institutionalized and subsequently adopted by families living in Romania, and Romanian children who were institutionalized since birth and had yet to be adopted. The group of children that remained in long-term institutionalized care exhibited significantly poorer scores on measures of general cognitive functioning compared to both the control group and the adopted group. The adopted group had lower scores than the control group that remained with their biological parents. When the adopted children were re-assessed at 54 months post-adoption, younger age at adoption was associated with greater improvements in cognitive abilities (Nelson, Zeanah, Fox, Marshall, Smyke, & Guthrie, 2007). These results suggest earlier age at adoption, and consequently shorter duration of institutionalization, is associated with greater post-adoption recovery of cognitive abilities. This is consistent with other studies that have a documented a dose-response relationship between duration of early institutionalization and cognitive abilities in childhood, with longer institutionalization related to lower cognitive functioning (MacLean, 2003; Rutter, Kreppner & O’Connor, 2001; Rutter et al., 1998).

Prior research has documented the presence of disrupted neural development that is thought to be the result of poor pre-adoptive conditions during key developmental periods (Chugani et al., 2001; Gunnar et al., 2000). Because frontal brain regions develop more slowly than other neural areas, they may be particularly vulnerable to the adverse effects of early
environmental deprivation and institutionalization (Gunnar et al., 2007). Neuroimaging research has demonstrated that children who were institutionalized at an early age often evidence a variety of neurobiological consequences compared to never-institutionalized children. In a study examining patterns of connectivity in IA children with a history of environmental deprivation and typically developing controls, Behen and colleagues (2009) reported that IA children evidenced a more diffuse connectivity pattern that was attributed to incomplete neuronal pruning during development. Abnormal patterns of connectivity were reported as being most prominent in frontostriatal projections, suggesting that the frontal lobes and related networks may be particularly impacted by early environmental deprivation. In a separate study of Romanian adoptees with a history of environmental deprivation compared to typically developing controls, Chugani and colleagues (2001) reported decreased metabolisms in multiple areas, including the amygdala, hippocampus, and numerous frontal areas, including the orbital frontal gyrus and the infralimbic prefrontal cortex. Together, these studies indicate that IA children with a history of environmental deprivation often evidence abnormalities in a variety of neural areas, most prominently the frontal regions and associated networks (Chugani et al., 2001; Behen et al., 2009). Early disruption to frontal lobe development is associated with deficits in EF, a host of varied abilities that are thought to be necessary for purposeful, goal-directed behavior (Anderson, 1998), including organization of behavioral sequences (Fuster, 2002), initiation and monitoring of behavior (Chan, Shum, Touloupoulou, & Chen, 2008), and social awareness (Stuss & Alexander, 2000). Deficits in EF are related to impaired decision making, behavioral dyscontrol, and deficits in emotional regulation (Anderson et al., 2000). Attention is often conceptualized as a substrate of EF that involves cognitive arousal, vigilance, selective focusing of cognitive resources, sustaining mental effort over time (Barkley, 1997; Gioia, Isquith, Kenworthy, &
Barton, 2002; Bayliss & Roodernys, 2000; Sarkis, Sarkis, Marshall, & Archer, 2005; Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Geurts, Vetre, Oosterlaan, Roeyers, & Sergeant, 2004), and shifting and dividing cognitive resources between competing stimuli (Klenberg, Korkman, Nahti-Nuuttila, 2001). Neuroimaging findings have associated many frontal areas, specifically the dorsolateral and ventrolateral prefrontal cortices, with aspects of attention, including cognitive vigilance, sustained attention, selective and divided attention, cognitive set shifting, and inhibitory control (Duncan & Owen, 2002; Bellgrove, et al., 2004).

Previous research of IA children has documented significant parent-reported problems with behavior and social functioning in everyday situations that have been suggested to be behavioral manifestations of executive dysfunction and inattention (MacLean, 2003; Rutter, Kreppner & O’Connor, 2001; Gunnar et al., 2001; 2007; Stevens et al., 2008). Although neuroimaging findings indicate that EF and attention would be expected to be areas of relative weakness for international adoptees (Chugani et al., 2001; Behen et al., 2009), relatively few studies have examined this issue using neuropsychological measures. However, there are notable exceptions. Hostinar and colleagues (2012) reported that younger children between 2.5-4 years of age that were internationally adopted from multiple countries evidenced relative deficits in cognitive flexibility and inhibitory control compared to age-matched never-institutionalized, never-adopted controls. In a separate study that examined performance on a neuropsychological measure of inhibition, adoptees with a history of institutionalization evidenced poorer performance than both never-adopted controls and never-institutionalized international adoptees. Within the institutionalized group, poorer inhibition was correlated with longer duration of pre-adoptive institutionalization (Bruce et al., 2008). Specifically examining attention, compared to never-institutionalized, never-adopted controls, mild deficits on a
measure of visual sustained attention and cognitive vigilance were observed in a small cohort of children adopted from Romania (Chugani et al., 2001; Behen et al., 2009). Pollak and colleagues (2010) reported that IA children with a history of institutionalization evidenced a relative weakness on neuropsychological measures assessing visual, but not auditory, attention. In a recent study that included children adopted from multiple areas, including Eastern Europe and Asia, Loman and colleagues (2013) documented deficits in sustained attention and inhibitory control on visual measures of sustained attention. Patterns of performance suggested slower reaction time and vulnerability for omission errors, meaning that the stimulus was presented and the child failed to respond. While these studies contribute to our understanding of EF and attention in IA children, we are not aware of research that has examined the relationship of EF and attention with social competence and behavior.

The influence of EF and attention on behavior in IA children

As described above, IA children who were institutionalized from an early age often evidence abnormal neural development that is thought to be a primary contributor to long-term problems with behavior (Chugani et al., 2001; Gunnar et al., 2001). A meta-analysis reported that externalizing behavior problems are common in IA children and that poorer pre-adoption conditions are associated with more severe behavior problems (Juffer & van IJendoorn, 2005). In a separate study, 39% of IA with a history of institutionalization experienced clinically elevated parent-reported problems with attention in early childhood, which was significantly greater than never- institutionalized IA children and domestically adopted children. Children evidencing issues with attention in early childhood were at elevated risk for problems with attention and behavior at a follow-up assessment that was conducted at emerging adolescence (Stevens et al., 2008). In examining risk factors for negative behavioral outcomes, problems with parent-
reported behavior and attention were reported to be more common in children who were older at adoption, and thus experienced a longer duration of institutionalization, and who were adopted from Eastern Europe (Gunnar et al., 2001).

Taken together, prior research suggests that there is an inverse relationship between functional outcomes and duration of institutionalization when examining general cognitive functioning (Rutter et al., 1998), behavior, and attention (MacLean, 2003; Rutter, Kreppner & O’Connor, 2001; Kreppner et al., 2001). Problems in these areas have been shown to be more severe with greater time spent in institutionalized settings (MacLean, 2003; Rutter, Kreppner & O’Connor, 2001; Gunnar et al., 2001; Kreppner et al., 2001; Stevens et al., 2008). It has therefore been argued that disrupted neural development and impaired neuropsychological functioning that results from poor pre-adoption conditions may be a primary contributor to long-term problems with behavior and attention (Gunnar et al., 2001).

Environmental risk factors for executive dysfunction and inattention in IA children

Among IA children, risk for in-utero substance exposure may be particularly high for children adopted from Eastern European countries (Wismer Fries & Pollak, 2004). With respect to risk for in-utero alcohol exposure, per capita alcohol use in Eastern European countries, including Russia, is higher than other common counties of origin and twice as high as that of China (World Health Organization, 2004). Comparing Eastern European countries to other common countries of origin, including China, it has been noted that there may be differences in cultural norms regarding alcohol consumption while pregnant. As a cultural norm, Eastern European countries may be more tolerant of alcohol consumption during pregnancy, which may be related to less awareness of the negative effects of alcohol consumption on fetal development (Krieder & Cohen, 2005). Consistent with elevated risk for in-utero substance exposure, prior
research has documented greater post-adoption problems in Eastern European adoptees compared to IA children from other common areas of origin. In a population-based study examining rates of disability in IA children, as assessed by the 2000 United States Census, mental health disabilities were the most common form of disability. Rates of disability were highest for children adopted from Eastern European countries (Kreider & Cohen, 2005). Compared to that of other areas of origin, parent-reported internalizing and externalizing behavior problems have been reported to be highest in Eastern European adoptees (MacLean, 2003; Gunnar et al., 2007; Pomerleau et al., 2005).

In-utero substance exposure, including marijuana, cocaine, and alcohol, has been shown to globally impact neural development, resulting in persistent, widespread neuropsychological deficits (Fried & Smith, 2001; Hurt et al., 2001; Noland, Singer, Arendt, Minnes, Short, & Bearer, 2003). In-utero substance exposure has numerous mechanisms through which neural development is thought to be compromised. Teratogens, which are readily able to cross the placenta, decrease reuptake of neurotransmitters and disrupt the development of neuronal circuitry. Teratogens can also decrease blood flow to the fetus, resulting in hypoxia (Hurt et al., 2001). While in-utero marijuana exposure has been reported to have minimal effects on intelligence, significantly impaired EF and attention have been reported (Fried & Smith, 2001). In-utero cocaine exposure has been linked to deficits in multiples areas of EF and attention, such as cognitive efficiency, distractibility, and cognitive vigilance (Savage et al., 2005). Among commonly used substances, in-utero alcohol exposure (Fetal Alcohol Spectrum Disorder; FASD) may exert the most damaging effects on EF and attention. FASD has been associated with reduced overall brain size and abnormalities in shape, specifically in the cerebellum, basal ganglia, and corpus callosum. Global neuropsychological deficits are a common consequence of FASD.
with impaired EF and attention, specifically vigilance, cognitive flexibility, response inhibition, planning, and reasoning, observed to be prominent deficits (Riley & McGee, 2005). In a sample of pre-school aged children with a history of in-utero exposure to alcohol, cocaine, and/or marijuana, the additive effect of alcohol exposure was associated with greater deficits in motor inhibition, although all substance exposed groups evidenced clinically significant deficits in verbal fluency, motor inhibition, and planning even after controlling for severity of exposure (Noland, Singer, Arendt, Minnes, Short, & Bearer, 2003). In a separate study that compared children with FASD to children with attention deficit/ hyperactivity disorder (ADHD) without a history of in-utero substance exposure, those with FASD experienced similar levels of inattention without the level of impulsivity observed in children with ADHD, suggesting that prominent inattention may be a hallmark of FASD. Additionally, it was reported that inattention may be specific to modality, with global, significant impairments exhibited when performing visual attention tasks. For auditory attention tasks, impairments were only on tasks with long response intervals (Mattson, Lang, & Calarco, 2002). These findings suggest that for children with FASD, attention is an area of difficulty with more pronounced deficits when information was presented in a visual modality, which may be the result of impaired visuospatial processing, and when response times are longer, thereby increasing demands on cognitive vigilance. These difficulties with EF and attention are likely to have profound, negative implications for psychosocial functioning that may become especially prominent as children transition to adolescence. In support, it has reported that adolescents with a history of in-utero poly-substance exposure, including alcohol, have a greater likelihood of engaging in risk-taking behavior, such as substance use, even after controlling for socioeconomic status, delinquency, family history of substance use/abuse, and parental psychopathology (Day, Goldschmidt, & Thomas, 2006). These
findings indicate vulnerability to risk-taking behavior that may be the result of poor impulse control and behavioral regulation. Overall, the literature examining the effects of in-utero substance exposure suggest that in-utero substance exposure is detrimental to neural development, resulting in impaired neuropsychological functioning that may be especially pronounced with regard to EF and attention (Mattson, Lang, & Calarco, 2002; Noland, Singer, Arendt, Minnes, Short, & Bearer, 2003; Riley & McGee, 2005). Impaired EF and attention may in turn increase the risk for future negative psychosocial outcomes that result from behavioral dysregulation (Day, Goldschmidt, & Thomas, 2006).

Poor prenatal care, including a lack of medical care and adequate nutrition, is another environmental factor that has been shown to negatively impact neural development and neuropsychological functioning. This has also been suggested to be more common in Eastern European adoptees compared to adoptees from other common areas of origin, further underscoring Eastern European children’s elevated risk for negative post-adoption outcomes (MacLean, 2003; Gunnar et al., 2007; Kreider & Cohen, 2005; Pomerleau et al., 2005). Low birth weight, which can result from a variety of factors, including insufficient prenatal care and nutrition, has been associated with persistent executive dysfunction (Taylor, Minich, Bangert, Fliepek, & Hack, 2004; Nosarti et al., 2007). For example, children with a history of low birth weight evidence significantly lower scores across neuropsychological domains, including EF and attention measures of vigilance and cognitive set shifting (Taylor, Minich, Bangert, Fliepek, & Hack, 2004). In a study comparing young adults with a history of low birth weight to age-matched controls, low birth weight was associated with significant executive dysfunction that was most prominent on measures of response inhibition and cognitive flexibility (Nosarti et al., 2007). These studies provide a basis to suggest that low birth weight, a common consequence of
poor prenatal care and nutrition, is associated with wide spread neuropsychological deficits that often persist long-term.

Poor perinatal care, such as early malnutrition and neglect, has also been suggested to be more common in Eastern European adoptees (MacLean, 2003; Gunnar et al., 2007; Kreider & Cohen, 2005; Pomerleau et al., 2005) and contributes to problems with psychosocial and neuropsychological functioning. DeBellis and colleagues (2009) defined neglect as a history of failure of the parent to provide minimally adequate food, clothing, shelter, medical care, supervision, and emotional stability as defined by the United States Department of Social Services. Compared to a non-maltreated comparison group, neglected children evidenced suppressed functioning across multiple neuropsychological domains, including EF and attention (visual attention, planning, problem solving, and speeded naming). In a separate study, domestically adopted pre-school aged children with a history of neglect evidenced significant deficits across domains of neuropsychological functioning. Specific to EF and attention, age at adoption and task performance were found to be related such that earlier age at adoption, and thus shorter duration of neglect, was associated with better performance on measures of EF (Pears & Fisher, 2005). These findings indicate that the frontal regions may be particularly vulnerable to the negative effects of early insult with a dose-dependent relationship between length of neglect and deficits in EF and attention. In addition to neuropsychological deficits, children with a history of perinatal maltreatment and neglect experience poorer academic achievement, problems with social functioning (Glewwe & King, 2001; Alamio, Olson, & Frongillo, 2001), and more behavior problems (Alamio, Olson, & Frongillo, 2001).

Together, these studies support the association between environmental risk factors known to be common in the population of IA children, including in-utero substance exposure (Mattson,
Lang, & Calarco, 2002; Noland, Singer, Arendt, Minnes, Short, & Bearer, 2003; Riley & McGee, 2005) and poor prenatal (Nosarti et al., 2007) and perinatal care (Pears & Fisher, 2005; Patrick et al., 2005; DeBellis et al., 2009) and subsequent neural development and long-term neuropsychological functioning. These early environmental risk factors are thought to contribute to long-term risk for negative psychosocial and behavioral outcomes (Day, Goldschmidt, & Thomas, 2006; Glewwe & King, 2001; Alamio, Olson, & Frongillo, 2001) and have been shown to be more common in IA children from Eastern European counties (MacLean, 2003; Gunnar et al., 2007; Kreider & Cohen, 2005; Pomerleau et al., 2005; Wismer Fries & Pollak, 2004).

Social functioning in IA children

Prior research has shown that individuals with a history of maltreatment often evidence deficits in social perception and functioning. Individuals with a history of childhood abuse exhibited differential performance on a measure of affect recognition, specifically preferential attention for angry faces, a tendency to attribute hostility to neutral faces, and an impaired ability to accurately identify happiness and sadness (Gibb, Schofield, & Coles, 2008). In a separate study, maltreated teens were more sensitive to faces expressing anger, fear, and sadness while exhibiting an impaired ability to interpret neutrally-affective faces (Leist & Dadds, 2009).

It has been suggested that deficits in social functioning that are most commonly seen in IA children, such as disinhibited social behavior, atypical lack of social reserve, and indiscriminate friendliness, may be related to deficits in EF (Bruce, Tarullo, & Gunnar, 2009; Colvert et al., 2008; Chugani et al., 2001). On both parent-report and observational measures of social behavior, Bruce and colleagues (2009) reported more disinhibited social behavior in IA children compared to never-institutionalized controls. Duration of institutionalization predicted parent-reported social functioning; however, this relationship became non-significant after
controlling for performance on neuropsychological measures assessing inhibition, suggesting that deficits in specific aspects of EF and attention, which may be indicative of developmental lag, may be primary contributors to social difficulties. Prior research has demonstrated that IA children often evidence impairments on measures assessing social perception, an area suggested to be related to EF, although distinct from other domains of EF, including inhibition and working memory (Yeates et al., 2007). Tarullo and colleagues (2007) documented significantly poorer abilities on a false belief theory of mind task compared to children who were internationally adopted from foster care shortly after birth and a comparison of group of never-adopted, American-born peers. Colvert and colleagues (2008) similarly investigated performance on a theory of mind task and reported significantly poorer performance of IA children relative to a comparison group of domestically adopted children. In a separate study examining performance on an affect recognition task, IA children with a history of institutionalization were significantly poorer at accurately identify facial expressions and correctly matching facial expressions to happy, sad, and fearful situations compared to never-institutionalized, never-adopted controls (Wismer Fries & Pollak, 2004). Together, these studies document difficulties in specific areas of social perception. Overall, while the current literature examining outcomes in IA children furthers our understanding of the relationship between EF, attention, and social outcomes in IA children, additional research is needed to better understand neurocognitive factors that contribute to problems with social competence (Bruce, Tarullo, & Gunnar, 2009).

*Application of the integrative model of social and behavioral functioning to IA children*

As described above and depicted in Figure 1, the integrative model of social functioning in children suggests that external/environmental and biological factors influence neural development, which in turn impacts neuropsychological functioning, including working memory,
inhibition, attention, and language. Functioning in these areas influences social and behavioral outcomes. In applying this model to IA children with a history of institutionalization, country of origin may account for many environmental risk factors; as reviewed above, it has been suggested that children adopted from Eastern European countries may be at particularly high risk for in-utero teratogenic exposure and poorer care while in the institutionalized setting (MacLean, 2003; Gunnar et al., 2007; Kreider & Cohen, 2005; Pomerleau et al., 2005; Wismer Fries & Pollak, 2004). Age at adoption, which has often been used to estimate duration of institutionalization (Bruce, Tarullo, & Gunnar, 2009; Gunnar et al., 2007; 2000; Kreppner et al., 2001; Nelson, Zeanah, Fox, Marshall, Smyke, & Guthrie, 2007), has also been suggested to influence neural development (i.e., longer duration of institutionalization and environmental deprivation would be expected to result in greater impact on neural development). In IA children, biological factors may include genetic influences and biological effects of in-utero teratogenic exposure. Environmental and biological factors together impact neural development that influences areas of neuropsychological functioning that are particularly relevant to SIP. Consistent with previous authors, it is theorized that working memory (Dodge et al., 1994; 1987; 1995; 2003; Yeates et al., 2007; Beauchamp & Anderson, 2010), inhibition (Yeates et al., 2007; Beauchamp & Anderson, 2010), language, and attention (Beauchamp & Anderson, 2010) are domains of neuropsychological functioning that influence SIP, which, in turn, impacts social competence and behavior in everyday occurring situations. See Figure 2.

Specific aims

In view of the above reviewed literature, this study aimed to investigate:

1. The impact of early pre-adoption institutionalization on working memory, inhibition, language, attention, SIP, and social and behavioral outcomes. To do so, we examined group
differences between female adoptees from Eastern Europe and China compared to female
never-institutionalized, never-adopted, American-born controls.

2. The relationship of working memory, inhibition, attention, and language with parent-reported
social competence and behavior in everyday occurring situations.

3. The mediating influence of SIP on the relationship between neuropsychological functioning
and social competence and behavioral outcomes.

4. The influence of age at adoption and country of origin on the relationship between
neuropsychological functioning and social and behavioral outcomes.

Hypotheses

1. Relative to the never-institutionalized comparison group, it was hypothesized that the IA
groups from China and Eastern Europe would evidence significantly poorer working
memory, inhibition, attention, and language, fewer competent responses on a measure of SIP,
and more problems with social competence and behavior in everyday occurring situations.
Consistent with prior research (MacLean, 2003; Gunnar et al., 2007; Kreider & Cohen, 2005;
Pomerleau et al., 2005), it was also expected for problems to be significantly greater in the
Eastern European than the Chinese groups.

2. We expected for measures assessing working memory, inhibition, attention, and language to
significantly predict parent-reported social competence and behavior.

3. We further anticipated that SIP would mediate the relationship between neuropsychological
functioning and parent-reported social competence and behavior.

4. Finally, it was hypothesized that older age at adoption and Eastern Europe as the area of
origin (thus greater genetic, pre-and peri-natal, and early environmental risk factors) would
correspond with greater problems with neuropsychological functioning, behavior, and social competence.

Method

Participants

In collaboration with the International Adoption Center at Cincinnati Children’s Hospital Medical Center, the current study included a sample of girls that were adopted from Eastern Europe or China and a comparison group of age-matched, never-institutionalized, American-born controls. Female adoptees from Eastern Europe or China were selected because these groups represented the largest sources of IA children locally, nationally, and worldwide during our study period. In China, males are less often placed for adoption and a large proportion of males that are placed for adoption have significant neurocognitive impairments and developmental delays (Juffer & van Ijzendoorn, 2005). Therefore, we only included females in an effort to reduce heterogeneity within the sample. Eligibility criteria included being between the ages of 6 - 12 years old at the time of recruitment. For adoptees, additional criteria included being between 6 and 48 months of age at the time of adoption and having spent at least six months in pre-adoption institutionalized settings, such as orphanages, baby homes, or hospitals, to ensure that all children experienced early institutionalization and environmental deprivation. For all participants, exclusionary criteria included the presence of significant developmental delay or intellectual disability (e.g., diagnosis of Intellectual Disability or IQ < 70). These data were merged with an existing dataset that was collected as part of a previous study conducted by Shari Wade, Ph.D., and colleagues that used the same procedures. The previously collected sample consisted of 16 children adopted from China, 14 from Eastern Europe, and 14 never-
institutionalized controls. For the current study, we recruited additional participants for a total of 32 girls adopted from China, 25 from Eastern Europe, and 25 never-institutionalized controls.

Procedure

The study was approved by the Institutional Review Board at Cincinnati Children’s Hospital Medical Center. Potentially eligible children were identified from records maintained by the International Adoption Center at Cincinnati Children’s Hospital Medical Center. Control participants were recruited using a hospital-wide email and word of mouth. Parents of potentially eligible children were contacted via phone, mail, or email. If parents expressed interest, participants were screened to assure that all eligibility requirements were met. Once enrolled, informed consent was obtained from the parent or legal guardian. At a study visit that was conducted at the medical center, parents provided demographic information, participated in a brief background interview with a trained research assistant, and completed standardized parent-report measures (described below). The children were administrated a neuropsychological test battery that included measures assessing attention and SIP (described below). The tests administered are shown in Table 1. Total participation time was approximately 1.5 hours and families were compensated $25 for their time and travel.

Inhibition and working memory

Parents completed the Behavior Rating Inventory of Executive Functions (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000), a standardized parent rating of executive functions (EF). From the BRIEF, the current study used the Working Memory subscale, a measure of ability to hold information in mind to complete a task, encode information, and use this information to generate goals, plans, and sequence steps to achieve a goal. We also used the Inhibition subscale, a measure of inhibitory control and impulsivity (e.g., the ability to inhibit impulses and stop
behavior at the appropriate time). On the BRIEF, higher scores represent more problems. Scores on the BRIEF are reported as t-scores (mean of 50 and standard deviation of 10). The BRIEF has demonstrated high levels of internal consistency and stability and acceptable levels of inter-rater and test-retest reliability (Gioia, Isquith, Guy, & Kenworthy, 2000).

Attention

For the assessment of visual and auditory attention, we administered the Sky Search and Score! subtests from the Test of Everyday Attention for Children (Tea-Ch; Manly, Robertson, Anderson, & Nimmo-Smith, 1999). Sky Search assesses visual attention by requiring the child to find matching objects in a picture and circle them quickly. After doing so, the child completes a simplified motor speed version of the task. For Sky Search, we reported the attention score as the primary measure of performance. This score is calculated by subtracting the motor task from the attention task (i.e., attention minus motor speed). In doing so, the attention score allows for assessment of visual attention that is free from the impact of motor speed. The Score! subtest assesses auditory sustained attention by requiring the child to listen to a series of tones presented at irregular intervals and count the number of tones. For this subtest, we reported the total accuracy score as the primary measure of performance. For all TEA-Ch subtests, higher scores represent better task performance. Scores are reported as scaled scores (mean of 10 and standard deviation of 3). The TEA-Ch has been normed for children ages 6-15 and has demonstrated reliability and established validity for the assessment of various aspects of attention (Anderson, Fenwick, Manly, & Robertson, 1998; Heaton et al., 2001; Manly et al., 2001).

Language

Parents completed the Children’s Communication Checklist- 2nd edition, a parent-report measure of language abilities (CCC-2; Norbury, Nash, Baird, & Bishop, 2004). The current
study used the General Communication Composite as an assessment of language and across ten domains: speech, syntax, semantic, coherence of language, inappropriate initiation, stereotyped language, context, nonverbal communication, social relations, and interests. On the CCC-2, higher scores represent better developed abilities. Scores are reported as standard scores (mean of 100 and standard deviation of 15). Validation studies of the CCC-2 have demonstrated high levels of inter-rater reliability and consistency (Norbury, Nash, Baird, & Bishop, 2004).

*Social Information Processing (SIP)*

Limited studies to date have documented problems with social functioning in IA children (Bruce, Tarullo, & Gunnar, 2009; Tarullo et al., 2007; Colvert et al., 2008; Wismer Fries & Pollak, 2004). Given this gap in the literature, we administered the Dodge Video Vignettes (DVV) with the goal of assessing SIP in real-world situations that are often encountered by children (Crick & Dodge, 1994; Dodge, Bates, & Pettit, 1990; Dodge, Pettit, Bates, & Valente, 1995). The DVV consists of a series of video vignettes, each involving a provocation by a peer directed toward another child (e.g., knocking down the child's building blocks, not allowing the child to play ball). Verbal and facial cues by the provocateur are offered to indicate that the intention was either hostile (intentional act with a malicious goal), accidental (act was unintentional), pro-social (act was intended but for a positive goal, such as being helpful to the child), or ambiguous (both positive and negative social cues were present). Each vignette lasts approximately 30 seconds and vignettes are randomized so that intentions are presented in random order (Dodge & Coie, 1987). For administration, the child views each vignette and is asked to describe what occurred in the video, identify the perceived intention of the provocateur (e.g., “was the child being mean or not mean?”), and describe how he or she would respond behaviorally. The child then views a series of shorter videos that show ways that the child in the
video could have responded and the examinee is asked if the behavioral response was favorable or unfavorable. The DVV offers information about perception and interpretation of social cues and the ability to generate behavioral responses and evaluate possible outcomes (Crick & Dodge, 1994; Dodge, Bates, & Pettit, 1990; Dodge, Pettit, Bates, & Valente, 1995).

The current study administered an amended, shortened version that included six video vignettes that were included in the original version of the DVV. Consistent with the original DVV, after viewing each video, the child was asked to imagine being the child in the video who experienced a negative outcome as a result of the behavior of another child. The participant was then asked to describe what happened in the video, identify the intent of the peer behavior (mean or not), describe what she might do in that situation, and evaluate potential behaviors that could be done in response to the situation. In view of limited research suggesting that IA children often struggle with inappropriate disinhibited social behavior, such as atypical lack of social reserve, indiscriminate friendliness (Bruce, Tarullo, & Gunnar, 2009; Gunnar et al., 2007), the current study used the total number of competent responses as the primary measure of SIP. On this measure, raw scores ranged from 0-6. Prior research using the DVV in a similar administration format as this study (described below) reported satisfactory levels of reliability and validity. Performance on the DVV has been shown to be significantly correlated with performance-based measures assessing EF, specifically working memory and problem-solving, in children with traumatic brain injury (Warschausky, Argento, Hurvitz, & Berg, 2003).

Social Competence and behavior

Parents completed the Home and Community Social Behavior Scale (HCSBS; Merrell & Caldarella, 2002) to assess social competence, an area that the small amount of existing research has found to be impaired in IA children (Bruce, Tarullo, & Gunnar, 2009; Tarullo et al., 2007;
Colvert et al., 2008; Wismer Fries & Pollak, 2004). For this study, we used the Social Competence subscale as a measure of parent-reported social functioning in everyday occurring situations. The HCSBS has been normed for children ages 5 to 18 years old. On this measure, lower scores represent greater problems. Scores are reported as a T score (mean of 50 and standard deviation of 10). The HCSBS has demonstrated satisfactory reliability and validity (Lund & Merrell, 2001; Merrell & Boelter, 2001; Merrell, Streeter, & Boelter, 2001).

Parents also completed the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2000; 2001), a parent rating of child behavior problems that is widely used in both clinical and research settings. For the current study, we used the Total Behavior Problems subscale as a measure of overall behavioral functioning. The CBCL has been normed for children ages 6 to 18 years old. Scores are reported as a T score (mean of 50 and standard deviation of 10). Higher scores represent more behavior problems. The CBCL has high test-retest reliability and criterion validity and has been shown to be sensitive to childhood behavior problems (Achenbach & Rescorla, 2000; 2001).

Statistical approach

Univariate statistics were used to examine the distribution of the data and to test for normality. We reported means and standard deviations for demographic variables and measures of neuropsychological functioning, SIP, behavior, and social competence. Pearson’s correlations were used to test the bivariate relationships between predictors and outcome variables. Analysis of co-variance (ANCOVA), Bonferroni corrected, was used to compare the groups (contrast terms for never-institutionalized, Chinese adopted, or Eastern European adopted) on neuropsychological, SIP, and parent-report measures. In view of evidence suggesting that socioeconomic status influences access to mental health services and performance on
neuropsychological measures (Snells-Johns, Mendez, & Smith, 2004), family income of the adopted family was used as a covariate. Cohen’s d was used to examine the effect sizes for post hoc comparisons.

Given the demonstrated heterogeneity of IA samples with regard to behavioral outcomes (Tottenham et al., 2010; Colvert et al., 2008), examinations of group means may not be sensitive to between-subjects variation in behavioral neuropsychological functioning. Mean comparisons may also fail to provide information about whether group differences are clinically meaningful. Therefore, we reported the proportion of participants in each group that evidenced clinically significant elevations on parent-report measures of behavior and social competence. Consistent with prior pediatric research, a T score greater than or equal to 63 was used as a threshold for clinically significant problems for the CBCL Total Behavior Problems subscale and BRIEF Inhibition and Working Memory subscales. A T score of less than or equal to 35 on the HCSBS Social Competence subscale was used to determine clinical significance (Schwartz et al., 2003; Chapman et al., 2010; Karver et al., 2012). Consistent with prior research investigating neuropsychological outcomes in IA children (Behen et al., 2009), we also reported the proportion of participants that evidenced scores that were in the borderline impaired/ mildly impaired range or below on neuropsychological measures (i.e., ≤ 79 for standard scores or <6 for scaled scores; Strauss, Sherman, & Spreen, 2006). Chi square analyses were used to compare group differences in elevations on parent-report measures and rates of impairment.

Consistent with the approach for testing mediation described by Baron and Kenny (1986), generalized linear regression was used to examine the influence of neuropsychological factors (independent variables) on HCSBS Social Competence and CBCL Total Behavior Problems (dependent variable), controlling for group and family income. Using manual
backwards elimination, we eliminated non-significant predictors until only significant neuropsychological factors remained \((p < .05)\). Use of this method is consistent with previous pediatric research (Yeates et al., 2010; Karver et al., 2012; van der Heijden, Donders, Stijen, & Moons, 2006) and has been suggested to increase the numerical stability and generalizability of results (Hegewald, Pfahlberg, & Uter, 2003). In the second step, generalized linear regression was used to investigate the influence of neuropsychological factors that were found to be significant in the first step (independent variables) on DVV Competent Responses (mediator), again controlling for group and family income. In the final estimation, we examined the relationship between DVV Competent Responses (mediator) and HCSBS Social Competence and CBCL Total Behavior Problems (dependent variable), controlling for group, family income, and neuropsychological factors that were found to be significant in the first step (independent variables). In this way, we examined the mediating influence of SIP on the relationship between neuropsychological functioning and social and behavioral outcomes. For the final estimation, \(R^2\) was reported as a measure of effect size.

Prior research has shown that age at adoption and area of origin are relevant when examining behavioral and social outcomes in IA children (Bruce, Tarullo, & Gunnar, 2009; Gunnar et al., 2007; 2000; Kreppner et al., 2001; Nelson, Zeanah, Fox, Marshall, Smyke, & Guthrie, 2007). In view of these findings, we conducted an exploratory analysis that only included the IA groups. In this analysis, we examined the specific influence of area of origin (China or Eastern Europe) and age at adoption on the final estimations of the regression models.

Results

Sample characteristics
Demographic information is reported in Table 2. Groups were well matched for age, family income, and primary caregiver education ($p > .05$). The Eastern European group was older (in months) at the time of adoption compared to the Chinese group ($p = .005$).

In the IA groups, limited information was available about the child’s biological family and birth history and it should be emphasized that the following information was inconsistently available within the IA groups. In an open response question in which adopted parents were asked to provide any known information about their child’s birth parents or early history, five parents (20.0%) in the Eastern European group reported a known or suspected history of in-utero exposure to substances. No parents in the Chinese group referenced a history of in-utero substance exposure. With regard to birth weight, five (15.6%) parents in Chinese group were able to provide their child’s birth weight (range 64-107 ounces; mean 86.40 [17.34]). In the Eastern European group, 11 parents (44.0%) provided information about birth weight (range= 63-130 ounces; mean = 99.18 [21.10]. For children for whom such information was known, birth weight was significantly less for the Chinese ($p < .001$) and Eastern European ($p < .001$) groups compared to the controls (range = 84-156 ounces; mean = 122.66 [17.11]).

Parents in the control group reported that their child first walked at an average of 11.88 (3.33) months of age. This is compared to 14.50 (3.3) months in the Chinese and 15.25 (2.86) months in the Eastern European groups. Compared to the controls, this was significantly delayed for both the Chinese ($p = .007$) and the Eastern European ($p = .003$) groups. The mean age, in months, for speaking first word was 17.33 (5.85) in the Chinese group and 24.93 (11.12) in the Eastern European. Both the Chinese ($p = .02$) and the Eastern European groups ($p < .001$) were significantly delayed compared to control group (mean number of months = 12.59 [3.30]).
General cognitive functioning, as approximated by the two subtest estimate of intelligence from the Wechsler Abbreviated Scale of Intelligence, was in the average range across groups, although suppressed in the Eastern European and Chinese groups compared to the control group and the Chinese group compared to the Eastern European (see Table 2). Considering academic history, six (18.7%) children in the Chinese group and 12 (48.0%) in the Eastern European group had a history of school-based remedial services, compared to zero controls. Proportions were significantly higher in the Eastern European compared to the Chinese ($\chi^2 = 5.55, p = .01$) group and the controls ($\chi^2 = 15.78, p < .001$). Proportions were also higher in the Chinese higher compared to the controls ($\chi^2 = 5.23, p = .02$). Nine (28.1%) parents in the Chinese group and 16 (64.0%) in the Eastern European reported that their child’s teacher has expressed concerns about learning or behavior. This is compared to zero in the control group. Proportions differed between the Eastern European and the Chinese group ($\chi^2 = 7.33, p = .007$) and the controls ($\chi^2 = 23.52, p < .001$) and between the Chinese group and the controls ($\chi^2 = 8.35, p = .004$). No Chinese adoptees or controls were reported to have a history of grade retention, compared to three (12.0%) children in the Eastern European group. Proportions significantly differed between the Eastern European and the Chinese ($\chi^2 = 4.05, p = .04$) groups. One parent in the Chinese group (3.1%), four in the Eastern European group (16.0%), and one in the control group (4.0%) reported that their child had a diagnosis of attention deficit/hyperactivity disorder (ADHD). Of these participants, zero in the Chinese, three in the Eastern European, and one in the control group were prescribed medication for the treatment of ADHD. Neither rates of ADHD diagnosis nor prescription of ADHD medications differed between groups ($p > .05$).

*Distributions*
The following variables were normally distributed: TEA-Ch Sky Search Attention, TEA-Ch Score! Total Accuracy, BRIEF Working Memory and Inhibition, CCC-2 GCC, DVV Competent Responses, CBCL Total Behavior Problems, and HCSBS Social Competence. Family income was found to be negatively skewed ($skew = -1.04$).

**Bivariate relationships**

As reported in Table 3, Pearson’s correlations were used to investigate bivariate relationships. Correlations with family income were small to medium and ranged from -.07 with TEA-Ch Sky Search Attention to .22 with DVV Competent Responses (higher income related to higher scores). Considering parent-report measures of behavior with DVV Competent Responses, correlation coefficients were small to medium (.24 with HCSBS Social Competence and -.16 with CBCL Total Behavior Problems), suggesting that higher income was related to higher scores on the HCSBS and lower scores on the CBCL Relationships of DVV Competence Responses with the neuropsychological measures were small to medium and ranged from .02 with TEA-Ch Sky Search Attention to .37 with CCC-2 GCC (higher scores on neuropsychological measures related to more DVV Competent Responses). Among neuropsychological measures, correlation coefficients were small to large and ranged from .03 between CCC-2 GCC and TEA-Ch Sky Search Attention to .60 between BRIEF Inhibition and Working Memory. The positive relationship indicated that scores on these measures tended to increase together. The correlation between HCSBS Social Competence and CBCL Total Behavior Problems was -.57 (lower scores on the HCSBS related to higher scores on the CBCL). Correlations of neuropsychological measures with parent-report measures were small to large and ranged from -.02 (TEA-Ch Sky Search Attention) to .66 (CBCL Total Behavior Problems
and BRIEF Inhibition). The positive relationships suggest that lower scores on neuropsychological measures were associated with higher scores on the CBCL.

**Parent-reported behavior and social competence**

Means, standard deviation, ranges of scores, and impairment rates for parent-report measures are reported in Table 4. ANCOVA, controlling for family income, indicated that groups significantly differed on the HCSBS Social Competence subscale, $F(2, 78) = 6.80, p = .002$. The Eastern European group evidenced lower scores (lower social competence) than the never-institutionalized control group with a large corresponding effect size ($mean\ difference = 8.19, p = .001; d = 1.05$). Significant differences were also found on the CBCL Total Behavior Problems subscale, $F(2, 78) = 8.85, p = .001$. The Eastern European group evidenced more problems than the never-institutionalized control group with a large effect size ($mean\ difference = 11.08, p = .001; d = 1.31$). Compared to the controls, impairment rates were higher in the Chinese group ($\chi^2 = 4.28, p = .03$) and the Eastern European group ($\chi^2 = 5.14, p = .004$) on the CBCL Total Behavior Problems subscale. The difference between the IA groups was non-significant ($p > .05$).

**Neuropsychological functioning and SIP**

Means, standard deviation, ranges of scores, and impairment rates for measures of neuropsychological functioning and SIP are reported in Table 4. A series of ANCOVAs, controlling for family income, revealed that groups differed significantly on BRIEF Inhibition, $F(2, 82) = 7.67, p = .001$. The Eastern European group evidenced more problems compared to the Chinese with a medium effect size ($mean\ difference = 7.80, p = .02; d = .61$) and the controls with a large effect size ($mean\ difference = 11.97, p = .001; d = 1.80$). Rates of impairment were higher in the Eastern European group compared to the controls ($\chi^2 = 7.01, p = .008$). On BRIEF
Working Memory, $F(2, 82) = 18.88, p < .001$, the Eastern European group again evidenced more problems than the Chinese ($mean\ difference = 10.82, p < .001; d = .92$) and the controls ($mean\ difference = 16.96, p < .001; d = 1.77$) both with large corresponding effect sizes. Impairment rates were higher in the Chinese ($\chi^2 = 4.28, p = .03$) and the Eastern European ($\chi^2 = 15.78, p < .001$) groups compared to the controls and in the Eastern European compared to the Chinese groups ($\chi^2 = 7.02, p = .008$). On TEA-Ch Score! Accuracy, $F(2, 82) = 6.30, p = .003$, the Eastern European group underperformed the Chinese with a medium to large effect size ($mean\ difference = 2.7, p = .02; d = .69$) and the controls with a large effect size ($mean\ difference = 3.06, p = .003; d = .90$). Impairment rates were higher in the Eastern European group compared to the controls ($\chi^2 = 8.00, p = .005$) and the Chinese group ($\chi^2 = 5.98, p = .01$). Considering CCC-2 GCC, $F(2, 68) = 14.26, p < .001$), the controls evidenced better language abilities compared to the Chinese ($mean\ difference = 17.64, p = .002; d = 1.11$) and the Eastern European ($mean\ difference = 27.73, p < .001; d = 1.42$) groups, both comparisons yielding large effect sizes. Impairment rates were higher in the Eastern European group compared to the controls ($\chi^2 = 5.11, p = .02$). No group differences were found on DVV Competent Responses, $F(2, 75) = 1.87, p = .16$. With regard to other indices of the DVV, groups did not differ on Hostile, $F(2, 75) = 1.27, p = .28$, or Passive, $F(2, 75) = 1.13, p = .32$, Responses. As noted above, DVV Competent Responses was the primary measure of SIP in the test of mediation described below.

**Test of mediation**

Using backward manual elimination of non-significant factors, controlling for group and family income, CCC-2 GCC and BRIEF Inhibition significantly predicted HCSBS Social Competence with a medium effect size ($R^2 = .49$). Lower income and poorer language and inhibition were associated with poorer social competence. See Table 5 for generalized linear
regression results prior to backward manual elimination of non-significant factors. In the second step, again controlling for group and family income, neither CCC-2 GCC \((p = .09)\) nor BRIEF Inhibition \((p = .10)\) significantly predicted DVV Competent Responses, suggesting lack of mediation. Neither country of origin \((p = .17)\) nor age at adoption \((p = .30)\) significantly contributed to the model. The final estimation of the model is reported in Table 6.

Again using backward manual elimination of non-significant factors controlling for group and family income, CCC-2 GCC, BRIEF Inhibition, and BRIEF Working Memory significantly predicted CBCL Total Behavior Problems with a large effect size \((R^2 = .61)\). Lower income and poorer language, inhibition, and working memory were associated with more behavior problems. See Table 5 for results prior to backward manual elimination. In the second step, controlling for group and income, CCC-2 GCC \((p = .07)\), BRIEF Inhibition \((p = .08)\), and BRIEF Working Memory \((p = .48)\) did not significantly predict DVV Competent Responses, again suggesting lack of mediation. Neither country of origin \((p = .37)\) nor age at adoption \((p = .96)\) significantly contributed to the model. The final estimation of the model is reported in Table 6.

To examine the possibility that these findings may be attributable to global developmental lag, we conducted an exploratory analysis in which general cognitive functioning, as estimated by the two-subtest version of the Wechsler Abbreviated Scale of Intelligence (WASI), was introduced as a control variable to the final estimations of the models. Considering HCSBS Social Competence, BRIEF Inhibition \((p < .001)\) and CCC-2 GCC \((p = .03)\) remained significant with the WASI estimate of intelligence a non-significant predictor \((p = .21)\). Considering CBCL Total Behavior Problems, BRIEF Inhibition \((p = .002)\), BRIEF Working Memory \((p = .02)\), and CCC-2 GCC \((p = .02)\) remained significant with the WASI estimate of intelligence non-significant \((p = .97)\).
In an effort to determine specific aspects of language that are most influential on social and behavioral functioning, we conducted an additional exploratory analysis in which we repeated the final estimations, this time using the individual subscales of CCC-2 instead of the CCC-2 GCC. Backwards manual elimination was again used until only significant CCC-2 subscales remained. With HCSBS Social Competence as the dependent measure, controlling for group, family income, and BRIEF Inhibition, the CCC-2 subscales of Initiation ($\beta = .32, t = 2.89, p = .005$) and Nonverbal Communication ($\beta = .27, t = 2.62, p = .01$) were significant. According to Bishop (1998), the Initiation subscale includes items assessing the ability to initiate and maintain conversations in a socially appropriate way (e.g., talking too much, talking to others without encouragement, starting conversations with strangers). The Nonverbal Communication subscale assesses the ability to effectively use nonverbal communication and to interpret nonverbal communications of others (e.g., smiling appropriately when talking to people, recognizing when other people are upset or angry, standing too close to others while talking with them). With the CBCL Total Behavior Problems as the dependent measure and controlling for group, family income, BRIEF Working Memory, and BRIEF Inhibition, the CCC-2 Interests subscale ($\beta = -.35, t = -4.16, p < .001$) was significant. According to Bishop (1998), this subscale assesses the ability to appropriately convey interests in conversation (e.g., making conversation about the interests of the other person, showing interest in what others say or do, talking repetitively about topics that are not of interest to others).

Discussion

Summary and support for hypotheses

This study examined behavior, social competence, neuropsychological functioning, and social information processing (SIP) in a sample of internationally adopted (IA) children with a
history of institutionalization compared to a never-institutionalized, American-born control group that was well matched for age and family income. Building on models of social and behavioral functioning that were proposed by Dodge and colleagues (1994; 1987; 1995; 2003), Yeates et al. (2007), and Beauchamp and Anderson (2010), this study aimed to investigate the relationship of neuropsychological factors (specifically working memory, inhibition, attention, and language) with social competence and behavior. We also tested the hypothesis that SIP would mediate this relationship. In view of findings from prior investigations of IA children (Kreppner et al., 2001; Gunnar et al., 2000; 2007; Bruce, Tarullo, & Gunnar, 2009), we examined the influence of area of origin and age at adoption on social and behavioral outcomes.

It was hypothesized that, relative to the control group, the IA groups would evidence significantly greater problems on parent-report measures of behavior and social competence and poorer functioning on measures assessing neuropsychological functioning and SIP. This was largely supported as across numerous domains of behavioral, social, and neuropsychological functioning, problems were greater in the IA groups compared to the controls. Compared to the controls, the Eastern European group evidenced more problems with parent-reported social competence and behavior. Rates of clinically significant behavior problems were elevated in the Eastern European and Chinese groups compared to the controls. On measures assessing neuropsychological functioning, the Eastern European group evidenced more problems with working memory, inhibition, and language than the controls. Impairment rates were higher in the Eastern European relative to the controls on measure of auditory attention, inhibition, working memory, and language. The Chinese group evidenced more problems with language compared to the controls and higher impairment rates on a measure of working memory. Overall, these
findings offer support for the hypothesis that behavioral, social, and neuropsychological functioning would be poorer in the IA groups compared to the controls.

It was also expected that problems with behavior and neuropsychological functioning would be significantly greater in the Eastern European compared to the Chinese groups. In support, the Eastern European group evidenced poorer auditory attention, inhibition, and working memory compared to the Chinese group. Impairment rates were significantly higher on measures of auditory attention and working memory. As discussed in greater detail below, these findings are consistent with prior research suggesting that adoptees from Eastern Europe may be at particularly high risk for negative post-adoption outcomes (Gunnar, 2007; Pomerleau et al., 2005; Kreider & Cohen, 2009).

Our second hypothesis stated that neuropsychological functioning would be associated with parent-reported social competence and behavior. Consistent with this, poorer language and inhibition were associated with poorer social competence. $R^2$ indicated a medium effect size with this model accounting for 49% of the variance in HCSBS Social Competence. In a separate model, poorer language, inhibition, and working memory were associated with more behavior problems. $R^2$ indicated a large effect size with this model accounting for 61% of the variance in CBCL Total Behavior Problems. The exploratory analysis that included estimated intelligence as a control variable revealed that problems with social competence and behavior were uniquely related to EF and language and not attributable to general cognitive abilities. The implications of these findings are discussed in greater detail below.

The results of this study failed to support other study hypotheses. Contrary to expectations, SIP did not mediate the relationship between neuropsychological functioning and behavioral and social outcomes. Also in contrast to hypotheses, age at adoption and area of
origin was not found to be associated with social and behavioral outcomes. This lack of support is discussed in greater detail below.

Executive functions

Prior research investigating normative neural development has demonstrated that the frontal lobes are particularly vulnerable to early disruption to neural development (Chugani et al., 2001; Behen et al., 2009). With this in mind, a relative weakness in EF would be expected following prolonged institutionalization and early environmental deprivation, although relatively few studies have specifically examined EF in IA children. Available research suggests that IA children with a history of institutionalization evidence poorer EF on performance-based measures, including poorer inhibitory control (Hostinar et al., 2012; Bruce et al., 2008). Consistent with these findings, the results of this study documented relative weaknesses in children adopted from Eastern Europe compared to never-institutionalized controls on measures assessing working memory and inhibition.

Yeates and colleagues (2007) posited that inhibitory control is relevant to social and behavioral functioning because it allows the individual to stop impulsive responses and appropriately engage in social reciprocity. Barkley (1997) similarly argued that impaired inhibitory control is a primary contributor to negative social outcomes that are commonly seen in children with attentional problems. Previous research has confirmed that inhibition is related to social competence in typically developing children (Charman, Carroll, & Sturge, 2001). Consistent with this, the findings of this study revealed that inhibition was predictive of both social competence and behavior. In explaining the relationship between inhibition and behavioral functioning, disinhibition has been associated with problems controlling behavior and appropriately stopping behavioral impulses. Children who experience problems with inhibition
often require higher levels of adult supervision, are often viewed as intrusive, and frequently require a higher degree of external structure to limit impulsivity. Specific to social functioning, disinhibition has been associated with being viewed by others as having poor behavioral control and as being overly intrusive in social situations, such as tending to interrupt conversations or disrupt activities (Gioia et al., 2000).

Prior authors posited that working memory supports the ability to process incoming social information and cues and use this information to generate a behavioral solution (Dodge et al., 1994; 1987; 1995; 2003; Yeates et al., 2007). Kolfer and colleagues (2011) suggested that negative behavioral outcomes that are commonly seen in children with attention problems are related to deficits in working memory that result in a lack of ability to efficiently process social cues from multiple, ongoing sources of information. Consistent with this, results of this study suggest that working memory influences behavioral functioning in IA children. Working memory would be expected to be important for numerous areas of behavior, including the ability to generate goals for behavior, to hold information and sequence information for the purpose of completing a task, to remember rules for specific tasks or situations, to execute multistep instructions, and to remain attentive to efficiently complete tasks (Gioia et al., 2000).

Attention

Consistent with previous work that has reported increased risk for problems with parent-reported attention (MacLean, 2003; Rutter, Kreppner & O’Connor, 2001; Gunnar, 2001; Kreppner et al., 2001), the control group and the Chinese group outperformed compared to the Eastern European group on a performance-based measure of auditory attention (TEA-Ch Score! Accuracy). Examination of rates of impairments and the range of scores indicated that the Eastern European group, compared to the Chinese group and the control, evidenced variable
performance and a significantly larger proportion of participants with performance in the borderline impaired range or below. As discussed subsequently, these findings are congruent with prior research that has described heterogeneous functioning in IA children (Tottenham et al., 2010; Colvert et al., 2008; Welsh, Viana, Petrill, & Mathias, 2007).

While these findings revealed differences in mean performance and in the proportions of participants evidencing borderline impaired auditory attention, we failed to find an association of attention with behavioral or social outcomes. This may be attributable to a difference the method for the assessment of neuropsychological functioning, specifically performance-based versus parent-report. Within the pediatric neuropsychological literature, there has been debate concerning the use of parent-report versus performance-based measures for the assessment of neuropsychological functioning. Prior research reported that performance-based measures often have little to no correspondence with parent-report measures. For example, in a sample of children with traumatic brain injury, correlations between performance-based measures and parent-report measures of EF were non-significant (Vriezen & Pigott, 2002). In a separate study that included children with various neurodevelopmental disorders, correlations between performance-based and parent-reported measures of EF were low to moderate. However, both were significantly correlated with findings on neuroimaging. According to the authors, this suggests that performance-based and parent-report measures assess different neuropsychological constructs. Perhaps more importantly, both are sensitive to neural pathology and offer clinically meaningful information (Anderson, Anderson, Northam, Jacobs, & Mikiewisc, 2002). In discussing limitations, it has been argued that performance-based measures may have limited ecological validity because administration occurs in a controlled setting that may fail to replicate situations that are experienced in everyday life (Vriezen & Pigott, 2002; Anderson, Anderson,
Northam, Jacobs, & Mikiewisc, 2002). In view of evidence suggesting that children are more likely to be identified as impaired based on parent-report compared to performance-based measures, it has been argued that parent-report measures may have limited validity because parents may often tend to over-report symptoms (Vriezen & Pigott, 2002). Overall, from a clinical and research perspective, these findings highlight the utility of both performance-based and parent-report measures for the assessment of neuropsychological functioning.

As an alternative explanation for the lack of support with regard to attention, the measures that were used in this study may lack sensitivity because they did not assess attention over an extended time interval. Sustained attention may be especially relevant given limited research documenting mild deficits on measures of sustained attention and cognitive vigilance in IA children (Chugani et al., 2001; Behen et al., 2009; Loman et al., 2013). Sustained attention over an extended time interval is an area of consistent deficit in children with developmental attention problems (Aase & Sagvolden, 2005; Bellgrove, Hester, & Garavan, 2004), including those with a history of in-utero exposure to alcohol (Mattson, Lang, & Calarco, 2002). Measures of sustained attention also have the advantage of allowing for examination of variability in performance, fluctuations in attention over time, and cognitive impulsivity (Aase & Sagvolden, 2005; Bellgrove, Hester, & Garavan, 2004). For future studies, inclusion of measures of sustained attention may further our understanding of neuropsychological weaknesses that underlie problems with parent-reported attention and behavior that have been documented in IA children (MacLean, 2003; Rutter, Kreppner & O’Connor, 2001; Gunnar et al., 2001; Kreppner et al., 2001; Juffer & IJzendoorn, 2005).

*Language*
These findings indicated that both the Chinese and Eastern European groups had poorer language abilities compared to the controls. Poorer parent-reported language skills were associated with greater problems with social competence and behavior problems in everyday situations. These findings are consistent with prior works that suggests that language may be particularly important for social and behavioral functioning, including the ability to efficiently communicate information to others, to comprehend verbally communicated information in (Beauchamp & Anderson, 2010), and to initiate and maintain conversations (Gallagher, 1993). A relative weakness for language may be associated with greater vulnerability to behavior problems that result from less ability to organize and structure the environment and implement effective behavioral solutions (Ayduk, Rodriguez, Mischel, Shoda, & Wright, 2007). Together, prior work and the findings of this study document the relevance of language to social and behavioral outcomes.

The results of the exploratory analysis indicated that of the domains of language that were assessed, initiation and nonverbal communication were significantly predictive of social competence. The ability to appropriately communicate interests was associated with parent-rated behavior problems. Consistent with the model of social functioning proposed by Yeates and colleagues (2007), these findings suggest that pragmatic, socially-laden aspects of language are highly relevant to social and behavioral functioning. Additionally, these CCC-2 subscales (Initiation, Nonverbal Communication, and Interests) have been reported to be highly associated with deficits in social communication and restricted repetitive interests that are characteristic of autism spectrum disorder (Bishop, 1998). Therefore, the findings of this study are consistent with research that has reported that quasi-autistic features, including problems with social
communication, are common IA children (Rutter et al., 1999; Johnson 2002; Colvert et al., 2008; MacLean, 2003).

When considering the findings with regard to language, it should be noted that in IA children, it is often difficult to distinguish language difficulties that are associated with English as a second language from more fundamental and persistent weaknesses or deficits in neurocognitive aspects of language processing (Welsh, Viana, Petrill, & Mathias, 2007). In the exploratory analysis, it was revealed that pragmatic socially-laden aspects of language were most relevant to social and behavioral outcomes. Areas that may be expected to be impacted in individuals with English a second language, such as syntax and speech, were not significantly predictive of social and behavioral outcomes. Nonetheless, this study is limited by having not assessed English language fluency as distinct from neurocognitive and social aspects of language. However, there is available information that may speak to functioning in these areas. With respect to English language experience, as part of the interview for this study, parents were asked if their child continues to be exposed to her native language. Six parents (five Chinese and one Eastern European) reported that their child continued to be exposed to their native language with all parents reporting that English is the primary language spoken at home and at school. Recruitment criteria required that children were 6 - 12 years old at the time of testing. For adoptees, additional criteria included being between 6 and 48 months of age at adoption. Given this criteria, the minimum possible time in the United States since adoption would be two years (e.g., the child was adopted at 48 months of age and was 6 years old at testing). For the current sample, the average number of months in the U.S. was 84.76 for the Chinese adoptees and 78.40 for the Eastern European ($t = 1.24, p = .22$). Considering scores on measures that assess language-based skills, although means were in the average range across groups, the Eastern
European group evidenced significantly lower scores on the CCC-2 GCC compared to the controls and the Chinese group. On the Vocabulary subtest of the Wechsler Abbreviated Scale of Intelligence, a measure of ability to provide definitions of words of increasing difficulty, performance of both the Chinese \( \text{mean} = 54.34 \ (10.37) \), and Eastern European \( \text{mean} = 44.92 \ (10.25) \) groups was within the average range. However, both the Chinese \( (p = .03) \) and Eastern European \( (p < .001) \) underperformed the controls and the Eastern European underperformed the Chinese \( (p = .002) \).

In summary, results of this study indicated that pragmatic, not constructional, aspects of language were predictive of social and behavioral functioning. The IA children in the sample have been in the United States for an average of approximately seven years and the majority use English as their primary language with few continuing to be exposed to their native language. These results may suggest adequate English experience. Language processing abilities were the average range, although weaker than the controls. This is in line with prior research that has reported that although in the broadly average range, IA children with a history of institutionalization often evidence relative weaknesses in language processing (Loman, Wiik, Freen, Pollak, & Gunnar, 2009). However, it is also acknowledged that we are unable to conclude that relative weaknesses on measures assessing language were not influenced by English language fluency and/or cultural factors.

*Social functioning and SIP*

In the IA literature, it has been suggested that social functioning is highly relevant when considering long-term adjustment following international adoption, including the ability to form attached relationships with caregivers and build relationships with peers (Colvert et al., 2008; Tarullo, Bruce, & Gunnar, 2007). Prior research examining social functioning in IA children has
documented significant problems characterized by indiscriminant friendliness and disinhibited social behavior (Bruce, Tarullo, & Gunnar, 2009; Gunnar et al., 2007; Colvert et al., 2008; Tarullo, Bruce, & Gunnar, 2007). Consistent with this, findings from this study demonstrated that IA children from Eastern Europe experience more problems with social competence compared to their never-institutionalized, American-born peers.

Previous work using the DVV has demonstrated that performance on measures of SIP is related to social functioning throughout childhood (Crick & Dodge, 1996). In this study, DVV Competent Responses significantly predicted HCSBS Social Competence ($\beta = 1.80, t = 2.57, p = .01; \text{group and family income controlled}$). However, the relationship between DVV Competent Responses and HCSBS Social Competence was non-significant when controlling for language and inhibition. The lack of support for SIP as a mediator may be attributable to a lack of statistical power; for future studies, the use of a larger sample size may reveal findings not documented in this study. Alternatively, it may be that Dodge’s conceptualization of SIP, which was developed to explain social difficulties characterized by aggressive or hostile behaviors, is not applicable to IA children. In describing the social difficulties that are often evidenced by IA children, disinhibited social behavior, including indiscriminant friendliness, has most commonly been reported (Bruce, Tarullo, & Gunnar, 2009; Colvert et al., 2008; Chugani et al., 2001) and we are aware of no studies that have reported significant problems with aggressive or hostile behaviors in IA children. Therefore, it may be that the Dodge conceptualization of SIP is not applicable beyond its original context of describing aggressive or hostile behaviors.

*Age at adoption*

Previous authors have described a dose-dependent relationship between duration of institutionalization and negative post-adoption outcomes (Gunnar et al., 2001; Nelson, Zeanah,
Fox, Marshall, Smyke, & Guthrie, 2007; Rutter et al., 1998). In contrast to these findings and study hypotheses, the correlation of age at adoption with both HCSBS Social Competence ($r = .03$) and CBCL Total Behavior Problems ($r = -.01$) was low, suggesting a weak relationship between age adoption and social and behavioral outcomes. Additionally, the exploratory analysis that included only the IA groups failed to demonstrate a relationship between age at adoption with behavioral and social outcomes. Overall, contrary to expectations, these findings failed to document a relationship between age at adoption and post-adoption social and behavioral outcomes.

Age at adoption is often conceptualized as a proxy for duration of institutionalization with prior work reporting a strong relationship ($r = .97$) between age at adoption and duration of institutionalization (Morison & Ellwood, 2001). However, other researchers have noted that age at adoption also represents length of time in the adopted family. Because families who internationally adopt tend to be of higher socioeconomic status, the post-adoption environment is likely more enriched than the institutionalized setting and may be therapeutic in supporting improved psychosocial functioning. Children who are adopted at an older age have likely spent less time in this enriched environment and would thus be expected to evidence poorer psychosocial outcomes compared to adoptees that have spent a greater amount of time in the enriched environment (van IJzendoorn, & Juffer, 2006; Tottenham et al., 2010). More time in the adopted family also allows the child to adjust to changes that are part of the adoption experience, including living with a new family and in a new culture, entering a new school system, and learning a new language (Bruce, Tarullo, & Gunnar, 2009). To investigate the influence of time in the adopted environment on social and behavioral outcomes, we introduced time since adoption to the final estimation of the regression models. For both HCSBS Social Competence
and CBCL Total Behavior Problems, time since adoption was a non-significant predictor \((p > .05)\). As an alternative explanation for the lack of findings with regard to age at adoption, the sample that participated in this study was selected to represent higher functioning IA children (e.g., children without a history of intellectual disability or significant developmental delay). Given these exclusionary criteria, children experiencing more severe persisting effects resulting from prolonged institutionalization may have been excluded. Additionally, there was a restricted age range (mean = 8.63, SD = 1.35 for sample as a whole), which may have limited variance to be able to detect findings with regard to age.

**Country of origin**

It was hypothesized that the Eastern European group would exhibit significantly more problems with behavioral, social, and neuropsychological functioning compared to the Chinese group. Consistent with this, the Eastern European underperformed the Chinese group on numerous measures assessing behavior and neuropsychological functioning. It was also expected that Eastern Europe as the area of origin would be associated with poorer social competence and behavior in the regression analyses, a hypothesis that was not supported. Although the reason for these non-significant findings is unclear, it may be that problems attributable to area of origin were well characterized by the other factors that were including in the models, specifically working memory, inhibition, and language.

Despite the non-significant relationship with social and behavioral outcomes, examination of mean comparisons, impairment rates, and range of scores indicates heterogeneity of functioning and the presence of a subset of Eastern European children that evidenced significant difficulties across measures of neuropsychological functioning and behavior compared to both the Chinese group and the controls. Heterogeneity of functioning has been
documented by previous research in IA populations and has been attributed to numerous factors that vary between children, including genetic risk factors, maternal health, in-utero exposure to teratogens, quality of pre-adoptive medical care, pre-adoptive abuse, neglect, and/or malnourishment, and duration of institutionalization (Tottenham et al., 2010; Colvert et al., 2008; Welsh, Viana, Petrill, & Mathias, 2007). With increasing awareness of heightened risk for negative post-adoption outcomes for Eastern European adoptees, there are efforts designed to mitigate risk for negative outcomes. The St. Petersburg- U.S.A. Orphanage Project is a program that was designed to offer child development training to orphanage staff (e.g., knowledge of normative child development, sensitive responsiveness to children). It has been reported that this program was efficacious in increasing consistency and stability of staff members. Compared to children in orphanages not participating in the intervention, those that received the intervention demonstrated greater gains in staff-reported physical growth, cognitive ability, language, motor functioning, and social skills (Groark, Muhamedrahimov, Palmov, Nikiforova, & McCall, 2005). Considered together with the findings of the current study, the findings of Groark and colleagues (2005) provide evidence to suggest that Eastern European adoptees may be at elevated risk for negative neuropsychological, behavioral, and social outcomes and would be expected to benefit from intervention to ameliorate these problems.

**Cultural considerations**

Previous authors have noted the difficulty associated with selection of an appropriate control group for comparison with international adoptees, an issue that is largely attributable to the heterogeneity of this population and the multitude of factors that are thought to contribute to long-term issues with psychosocial and neurocognitive functioning (Tottenham et al., 2010; Colvert et al., 2008; Welsh, Viana, Petrill, & Mathias, 2007). The current study included a
control group of never-institutionalized children without a history of institutionalization or early environmental deprivation. While some research has similarly used a never-institutionalized, never-adopted control group (Tarullo, Gavin, & Gunnar, 2011; Wismer Fries & Pollak, 2004; Behen et al., 2009; Pollak et al., 2010; Bruce, Tarullo, & Gunnar, 2009; Tottenham et al., 2010), other lines of research have used groups of domestically adopted children (Stevens et al., 2008; Colvert et al., 2008; Groza & Ryan, 2002; Croft et al., 2001; Kreppner et al., 2001), never-adopted children living with their biological parents in their country of origin (Nelson, Zeanah, Fox, Marshall, Smyke, & Guthrie, 2007), and internationally adopted children without a history of institutionalization (Loman et al., 2013; Stevens et al., 2008; Bos, Fox, Zeanah, & Nelson, 2009; Tarullo, Gavin, & Gunnar, 2011; Pollak et al., 2010; Bruce, Tarullo, & Gunnar, 2009). The advantage of the never-adopted, never-institutionalized group is that it offers an ecologically valid comparison of the IA groups relative to their current environment peers (i.e., peers that are raised in similar enriched family environments) that are without a history of institutionalization. Its use is limited because it is not possible to ascertain what proportion of observable differences is attributable to cultural factors and/or difficulties that may arise as a result of adjustment to living in a new family and in a new culture. As discussed below, cultural issues may pertinent when considering parent-reported behavior, social functioning and neuropsychological test data.

Prior research has provided evidence to suggest that parent-report on standardized measures of child behavior may vary as a function of culture. In a sample of typically developing children raised by biological parents from birth, Crijen and colleagues (1999) reported significant cultural differences in patterns of responding on a standardized parent-report measure of child behavior problems. Parent reports of Chinese children were found to be significantly above the overall sample mean on subscales assessing somatic complaints, social problems,
attention problems, and delinquent behavior. In explaining the potential underlying cause of cultural differences in parent-reported behavior, previous authors have primarily focused on characteristics of parents, including cultural differences in the threshold for assessing problematic behavior and linguistic differences that may cause parents to focus on different problem areas (Crijnen, Achenbach, & Verhulst, 1999). However, in seeking to clarify the potential role of culture on group differences in parent-reported behavior in the current study, such explanations may be less applicable because parents themselves did not differ by group in their own cultural background. As an alternative explanation, recent work has demonstrated that genetic factors may influence risk for developing problems with inattention following prolonged institutionalization. Stevens and colleagues (2009) provided evidence to suggest the presence of a specific genetic polymorphism that may increase risk for problems with attention following prolonged pre-adoption institutionalization. While these preliminary findings contribute to our understanding of risk factors for negative outcomes following international adoption, further research is needed that more comprehensively examines biological factors that influence post-adoption outcomes.

Cultural bias in neuropsychological test instruments may have contributed to differences between the controls and IA groups. Significant differences in neuropsychological test performance between white and minority examinees have been widely demonstrated (Razani, Burciaga, Madore, & Wong 2007; Boone, Victor, Wen, Razani, & Pontón, 2007; Manly, Jacobs, Touradji, Small, & Stern, 2002). Many neuropsychological tests were developed and normed utilizing predominately Caucasian/white samples, thereby limiting the ability of neuropsychological tests to validly evaluate the abilities of examinees of diverse populations (Harris, Tulsky, & Schultheis, 2003). For example, commonly used neuropsychological may be
culturally biased for numerous reasons, including item bias such that questions contain information and language that may be specific to western cultures (Pedraza & Mungas, 2008; Brickman, Cabo, & Manly, 2006). Research examining healthy adults has demonstrated that factors thought to represent acculturation, such as the amount of time educated outside of the United States (Razani, Burciaga, Madore, & Wong 2007) and time living in the United States (Boone, Victor, Wen, Razani, and Pontón, 2007), influence neuropsychological test performance. Other potentially relevant factors may include health status, genetic influences, environmental factors (Morgan, Marsiske, & Whitfield, 2008), differing connotations of words between cultures (Pedraza & Mungas, 2008; Brickman, Cabo, & Manly, 2006), and cultural norms and experiences that may better prepare individuals for the experience of neuropsychological test (Brickman, Cabo, & Manly, 2006). Given this theoretical basis, bias on neuropsychological measures should be considered when interpreting the findings of this study.

The limited geographic sampling of country of origin (China and Eastern Europe) and destination (United States) may also be relevant when considering these findings. For example, as noted above, cultural variation in social norms about substance use may result in differential risk for in-utero substance exposure depending on country of origin. Compared to international adoptees from other areas of origin, those from Eastern Europe may be at particularly high risk for behavior problems arising from in-utero substance exposure. Aside from a history of institutionalization, greater risk for in-utero exposure to substances would be expected to profoundly influence neural development and subsequent problems with behavior and social competence (Gunnar et al., 2007). Potentially consistent with increased risk factors for children adopted from Eastern Europe, the limited available data from the current study suggest that
children in the Eastern European group were more likely to have suspected or confirmed teratogenic exposure and may have been of lower birth weight compared to the controls.

Few studies to date have examined differences in psychosocial functioning between countries of destination. Empirical investigation in this area is often difficult to conduct because many non-western countries do not currently keep systematic records of international adoption (Juffer & IJzendoorn, 2005). In one of the few existing studies that has examined the relationship between country of destination and post-adoption outcomes, Juffer and IJzendoorn (2005) offered evidence to suggest that parents of children adopted to North American countries tend to report significantly more total behavior problems on standardized measures of child behavior compared to parents of children adopted to non-North American countries, including European countries. Given these findings, additional research is needed to more fully understand the influence of country of destination on post-adoption psychosocial functioning.

Home and family environment

The current study is limited by lacking in ability to better describe the influence of factors related to the child’s home and family environment, including parenting practices and family functioning, on long-term outcomes. Prior research has demonstrated that these factors are relevant when considering the development and maintenance of long-term problems with behavior and social functioning in neurocognitively at-risk pediatric populations (van Londen, Juffer, & van IJzendoorn, 2007; Groza & Ryan, 2002; Croft, O’Connor, Keaveney, Groothues, Rutter, 2001). In international adoptees, neurocognitive vulnerability for behavioral dysregulation and executive dysfunction may be exacerbated by adoption-related stress, including the pressure to learn a new language and cultural norms, adopt new routines, and form a relationship with adoptive families at a later age than children who are raised by biological
parents from birth (Bruce, Tarullo, & Gunnar, 2009). Neurocognitive vulnerability for behavioral dysregulation may be further exacerbated by factors related to family functioning.

This study is further limited by having failed to assess parental attachment, an area that has been shown to be highly relevant when considering post-adoption behavioral, social, and neuropsychological outcomes (Groza & Ryan, 2002; Kreppner et al., 2001; Croft, O’Connor, Keaveney, Groothues, & Rutter, 2001; MacLean, 2003). Parents who reported less positive relationships with their adopted children tended to report more child behavior problems (Groza & Ryan, 2002). In a study that examined observations of parent-child interaction in families of children adopted from Romania, longitudinal improvements in parenting behavior, including greater sensitivity and responsiveness, were associated with decreased parent-reported behavior problems. Positive parenting behaviors increased with greater time since adoption. In explaining these findings, it was suggested that cognitive and developmental delays in the adopted child may increase negative parenting behavior, which is in turn associated with poorer child behavior (Croft, O’Connor, Keaveney, Groothues, & Rutter, 2001; MacLean, 2003). Previous authors have suggested that attachment may be relevant when considering disinhibited behavior that may be especially prominent in social situations (Kreppner et al., 2008; Bruce, Tarullo, & Gunnar, 2009). Aside from the contribution of disruption during key periods of neural development, a lack of early parental attachment during institutionalization may result in insufficient early social experience that may contribute to disinhibited social behavior, difficulty forming emotional bonds with peers and adopted family members, and greater difficulty interpreting social cues (Bruce, Tarullo, & Gunnar, 2009; Gunnar, Bruce, & Grotevant, 2000). With regard to the neuropsychological outcomes, IA children with lower performance on measures of intelligence have been reported to exhibit greater difficulty forming attached relationships with their adopted...
parents (MacLean, 2003). In a separate study, insecure/disorganized maternal attachment was associated with poorer general cognitive functioning and psychomotor skills (van Loonden et al., 2007). Overall, these findings indicate that attachment is relevant when considering a range of outcomes in IA children.

This study is further limited by having not assessed family attitudes about race socialization and enculturation. Because international adoption often results in multiracial and multiethnic families, parental attitudes about race socialization (i.e., acknowledgement of the prevalence and potentially negative effects of racial discrimination) and enculturation (i.e., belief in the value of promoting ethnic-specific experiences and development of a positive attitude about the child’s country of origin) may be relevant when considering adjustment following international adoption. Lee and colleagues (2006) described attitudes about cultural socialization and race in parents of IA children, including those from Eastern European, Asian, and Latin American countries. Parents of children adopted from Eastern Europe reported lower enculturation beliefs compared with parents of children of other countries of origin. Across countries of origin, higher value on cultural socialization to the child’s country of origin was associated with greater help seeking behavior, such as speaking with a teacher about issues their adopted child is experiencing (Lee et al., 2006).

Overall, existing research findings indicate that home and environmental factors, including attachment, parenting behavior, and parental beliefs about acculturation and race socialization, are relevant when considering long-term behavioral and neuropsychological outcomes in IA children. The current study is therefore limited by a lack of ability to describe the influence of these factors on behavioral and social competence. Studies that more
comprehensively examine the family environment are needed to better understand factors that have the potential to support behavioral and social adjustment of IA children.

*History and background information*

Because families and adoption agencies often have little to no contact with biological parents of international adoptees, relevant family history and background (e.g., pre and perinatal exposure to teratogens, utilization of prenatal health care services, maternal health during pregnancy, presence of perinatal complications), is often unknown. Additionally, direct information about pre-adoptive conditions, including the quality of healthcare received prior to adoption, individualized care and attention (Gunnar et al., 2000; Groza & Ryan, 2002), and availability of opportunities to engage in activities that would facilitate cognitive development (Johnson, 2002), is often difficult to obtain. Knowledge about in-utero substance exposure would be expected to increase our understanding of individual risk for long-term negative outcomes in IA children given its relevance to EF and attention (Riley & McGee, 2005; Noland, Singer, Arendt, Minnes, Short, & Bearer, 2003; Mattson, Lang, & Calarco, 2002), although information in this regard is difficult to reliably collect. While some studies have used dysmorphology to assess for fetal alcohol exposure, this method is limited because children with lower levels of alcohol exposure may experience negative neuropsychological and behavioral outcomes in the absence of dysmorphic features (Wilibarger, Gunnar, Schneider, & Pollak, 2010). Although the current study reported what is known about early background and development, these data were inconsistently available. This study is therefore limited by a lack of consistent knowledge about these key developmental influences, a limitation that is inherent to research in this population.

*Stated age of international adoptees*
For international adoptees, exact biological age is often unknown and it has been suggested that many of these children are likely biologically older than their stated birth date indicates. There are numerous reasons why this may occur. Firstly, it has been reported that some orphanages and baby homes often change the birth dates of children to make the children seem younger because it is believed that younger children are more desirable to prospective adoptive families. Secondly, for children abandoned by birthparents, birth date is typically estimated and the method used to do so can vary. In some countries, such as Vietnam, the birth date is typically listed as the date that the child came into the care of the orphanage or baby home. In other countries, including China, the birth date is often estimated based on the size of the child and/or other relevant physical features, such as the remnant of an umbilical cord. Children who were malnourished, experienced in-utero exposure to teratogens, and/or received poor pre and perinatal care would be expected to be smaller in size compared to typically developing infants, resulting in a tendency to underestimate age (Aronson, 2007).

For the children who participated in this study, it is difficult, if not impossible, to determine if the stated birth dates accurately represent biological age. This potential inaccuracy of biological age has potentially vast implications for the interpretation of neurobehavioral test data. If some of the children in this sample were biologically older than their stated birth date indicates, the norms used to score the neurobehavioral test data would overestimate functioning and underestimate impairment. For example, if a child who was biologically eight-years old was stated to be six-years old, the use of six-year old norms would result in seemingly better test performance, based on normative data for six-year old children, than would be observed based on norms for eight-year old children. Because this incorrect birth date would have resulted in better test scores, based on normative data, test scores potentially overestimated functioning and
underestimated impairments. For the purpose of the current study, the possibility of incorrect birth dates may have resulted in overestimation of neuropsychological, social, and behavioral abilities in the IA groups. However, while the possibility of incorrect ages may be more problematic in countries of origin not included in this study, such as Vietnam or Ethiopia, this issue may be less prevalent for children adopted from the countries of origin that were included in this study (M. Staat, personal communication, October 10, 2014).

Additional limitations

This study is limited by having assessed behavior and social competence using only parent-report. A more comprehensive assessment of current behavioral and social functioning would be obtained by using structured interviews, observational measures, and standardized measures from multiple raters across different contexts, including teacher- and self-report. Additionally, there are potentially relevant domains of functioning that were not assessed. Inclusion of neuropsychological measures assessing sustained attention, academic achievement, memory, and language, including expressive, receptive, and pragmatic language, may be important for future investigations of IA children (van IJzendoorn, Juffer, & Poelhuis, 2005). There is also a need for research that more comprehensively assesses quasi-Autistic symptoms in IA children (Rutter et al., 1999; Johnson 2002; Colvert et al., 2008; MacLean, 2003) and the relationship of these symptoms with social and behavioral outcomes. While the current study used parent-report measures of working memory and inhibition, future studies may benefit from the use of performance-based measures that may further contribute to our understanding of neuropsychological functioning in IA children.

The DVV is the only measure of which we are aware the specifically examines cognitive aspects of SIP (Crick & Dodge, 1994; Dodge, Bates, & Pettit, 1990; Dodge, Pettit, Bates, &
Valente, 1995). However, there are notable limitations associated with the use of this measure, including the lack of empirical evidence to support the validity of the DVV coding system used in this study. Additionally, at the current time, there is no available normative data for the DVV. While the inclusion of the control group in this study offers a mean comparison of performance of the IA groups relative to never-institutionalized, American-born peers, the lack of normative data nonetheless limits our ability to compare performance on the DVV to a large normative sample of same-age peers. Further limiting the DVV, this measure was created in 1987, approximately 25 years prior to data collection for the current study. The situations depicted in the DVV may be less relevant or not easily relatable to the current generation of children. An updated version of the DVV is necessary to modernize to the appearance and content of the videos and to assure that the social situations depicted are relatable to present-day children. As an additional consideration, there are other outcome measures of the DVV, in addition to competent responses, that may contribute to our understanding of SIP, such as hostile and inept responses tendencies. Comparing responses in different situations (e.g., peer provocation versus peer entry), may also further our understanding of SIP (Dodge et al., 2002). Finally, as noted above, Dodge’s conceptualization of SIP, which was developed to explain social difficulties characterized by aggressive or hostile behaviors, may not be applicable to IA children who more commonly evidence problems with disinhibited social behavior (Bruce, Tarullo, & Gunnar, 2009; Colvert et al., 2008; Chugani et al., 2001).

There are concerns regarding the normative data for the TEA-Ch, specifically that the norms are based on a sample of typically developing children in New Zealand (Manly, Robertson, Anderson, & Nimmo-Smith, 1999). Given this normative sample, it cannot be
determined that the cultural difference between the TEA-Ch normative sample and the participants in this study did not influence findings that relied on this measure.

This study design is further limited by use of a cross-sectional rather than longitudinal design. Therefore, we can only document functioning at a single time point and cannot make specific claims about development and long-term maintenance of problems. Longitudinal studies may be especially important in view of limited evidence suggesting that problems with behavioral and emotional functioning emerge with time and may become especially problematic as IA children transition to adolescence (Colvert et al., 2008). Sample size is a further limitation. With a larger sample, this study may have had greater statistical power to detect group differences and patterns not documented in this sample. As an additional consideration, families that participated in this study, both within the IA and control group, are predominantly higher income with higher levels of parental education. The restricted income range likely reduced correlations of income with other measures. However, given the high expense associated with international adoption, families are often of higher socioeconomic status (Lee et al., 2006). This sample is therefore thought to be representative of the population of families of IA children. Finally, this study only included girls because girls represent the largest population of IA children. Additionally, because boys less frequently placed for adoption, a large proportion of boys that are available for adoption, especially those adopted from China, often have significant neurocognitive impairments and developmental delays. Therefore, we did not include boys in an effort to reduce heterogeneity within the sample (Juffer & van Ijzendoorn, 2005). In support, prior research has suggested that IA boys may evidence more severe behavior problems, particularly with attention (Stevens et al., 2008; Loman et al., 2013), hyperactivity (Stevens et al., 2008), and aggression (Groza, Ryan, & Cash, 2003). Given the potential relevance of these
domains of functioning with SIP, the DVV may be expected to be particularly sensitive to problems with behavior and social competence that may be more severe in IA boys.

*Future research*

Future studies that examine neuropsychological functioning in IA children should utilize a more comprehensive test battery that examines functioning across multiple domains, including sustained attention, memory, and academic achievement. Additional research is needed that uses structured diagnostic interviews, observational measures, and teacher- and self-report measures to obtain more in-depth information about behavior and social competence across settings and contexts. There is also a need for research that more comprehensively assesses autistic symptoms that have been documented by previous authors (Rutter et al., 1999; Johnson 2002; Colvert et al., 2008; MacLean, 2003). Given limited prior research suggesting that parenting style may influence the development and maintenance of behavior problems in international adoptees (Croft, O’Connor, Keaveney, Groothues, Rutter, 2001; Groza & Ryan, 2002), studies that more fully examine factors related to the family functioning, including parenting practices and attachment, are needed. To our knowledge, there are few longitudinal studies of outcomes following international adoption (Croft, O’Connor, Keaveney, Groothues, & Rutter, 2001; Colvert et al., 2008; MacLean, 2003). The use of studies using longitudinal designs is needed to achieve a better understanding of long-term functioning and adaptation throughout childhood and adolescence. Finally, there is a need for studies that examine a broader range of children from various countries of origin and destination to more fully understand the spectrum of functioning within the IA population.

*Strengths and implications*
This study contributes to the limited research examining behavioral, social, and neuropsychological outcomes in IA children. It is the first of which we are aware that has used a standardized measure to understand the effect of early institutionalization and environmental deprivation on cognitive aspects of SIP. By including measures that assess multiple different aspects of attention and EF, this study increases our understanding of the neuropsychological functioning of IA children and the relationship between neuropsychological functioning and social and behavior outcomes. Finally, this study has the advantage of having groups that were well-matched on key demographic variables, including age, parental education, and family income.

These results contribute to our knowledge of the influence of early institutionalization and deprivation on neuropsychological and social development, offering professionals greater insight into the specific needs of IA children. For professionals working in mental health care settings, these results demonstrate that IA children are at risk for neuropsychological deficits and problems with behavior and social competence that may persist long-term. Therefore, IA children may benefit from interventions to help ameliorate negative psychosocial outcomes. For educators and professionals working in school-based settings, these findings indicate that many IA children may be expected to benefit from educational accommodations to help reduce the impact of relative weaknesses in neuropsychological functioning, including problems with attention, EF, and language, on academic performance. Given the presence of problems with social competence, IA children may also benefit from school-based interventions to facilitate social adjustment, such as participation in structured social activities. Finally, medical professionals working with IA children in a primary care setting should attend to issues with
neuropsychological, behavioral, and social functioning and refer for mental health and educational intervention, as appropriate.
Figure 1. Integrative model of social functioning.

Biological risk factors:
- Genetic risk factors
- Perinatal health
- Biological effects of teratogenic exposure
- Medical or psychiatric conditions

Neuropsychological functioning:
- Attention
- EF: working memory and inhibition
- Language

SIP:
1. Encoding
2. Representation
3. Response search
4. Decision making
5. Enactment

Behavioral outcomes:
- Social competence
- Behavior

Environmental factors:
- Family functioning
- Parenting and parental attachment
- Previous experiences of learning or conditioning
- Educational quality
- Early experiences that facilitate neural development (e.g., toys, social interactions)
- Culture
- SES

Neural development
Figure 2. Application of integrative model of social functioning to Internationally Adopted children.
<table>
<thead>
<tr>
<th>Test name</th>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test of Everyday Attention for Children Sky Search subtest</td>
<td>TEA-Ch Sky Search</td>
<td>Performance-based measure of visual attention that is free from the impact of motor speed</td>
</tr>
<tr>
<td>Test of Everyday Attention for Children Score! Subtest</td>
<td>TEA-CH Score!</td>
<td>Performance-based measure of auditory sustained attention</td>
</tr>
<tr>
<td>Behavior Rating Scale of Executive Functions Inhibition subscale</td>
<td>BRIEF Inhibition</td>
<td>Parent-report measure of inhibitory control and impulsivity</td>
</tr>
<tr>
<td>Behavior Rating Scale of Executive Functions Working Memory subscale</td>
<td>BRIEF Working Memory</td>
<td>Parent-report measure of ability to hold information in mind to complete a task, encode information, and use this information to generate goals, plans, and sequence steps to achieve a goal</td>
</tr>
<tr>
<td>Children’s Communication Checklist - 2nd edition, General Communication Composite</td>
<td>CCC-2 GCC</td>
<td>Parent-report measure of language and across ten domains: speech, syntax, semantic, coherence of language, inappropriate initiation, stereotyped language, use of context, nonverbal communication, social relations, and interests</td>
</tr>
<tr>
<td>Dodge Video Vignettes Competent responses</td>
<td>DVV Competent</td>
<td>Performance-based assessment of perception and interpretation of social cues and the ability to generate competent behavioral responses</td>
</tr>
<tr>
<td>Home and Community Social Behavior Scale Social Competence subscale</td>
<td>HCSBS Social Competence</td>
<td>Parent-report measure of social functioning in everyday occurring situations</td>
</tr>
<tr>
<td>Child Behavior Checklist Total Behavior Problems</td>
<td>CBCL Total Behavior Problems</td>
<td>Parent-report measure of overall behavioral functioning</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>Eastern European</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------</td>
<td>------------------</td>
</tr>
<tr>
<td>N</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Age at testing in years</td>
<td>8.89 (1.64)</td>
<td>8.60 (1.17)</td>
</tr>
<tr>
<td>[6.6 - 12.5]</td>
<td>[7.0 - 12.0]</td>
<td>[6.1 - 12.0]</td>
</tr>
<tr>
<td>Age at adoption in months</td>
<td>---</td>
<td>23.70(10.38)</td>
</tr>
<tr>
<td>c</td>
<td></td>
<td>[8 - 42]</td>
</tr>
<tr>
<td>Time since adoption in</td>
<td>---</td>
<td>84.76 (15.71)</td>
</tr>
<tr>
<td>months</td>
<td></td>
<td>[43 - 136]</td>
</tr>
<tr>
<td>Primary caregiver</td>
<td>High school or GED = 4.0%</td>
<td>High school or GED = 8.0%</td>
</tr>
<tr>
<td>education</td>
<td>Some college = 16.0%</td>
<td>Some college = 16.0%</td>
</tr>
<tr>
<td></td>
<td>4-year degree = 16.0%</td>
<td>4-year degree = 36.0%</td>
</tr>
<tr>
<td></td>
<td>Graduate/ professional degree = 64.0%</td>
<td>Graduate/ professional degree = 40.0%</td>
</tr>
<tr>
<td>Family income</td>
<td>$30 - $59,000 = 4.0%</td>
<td>$30 - $59,000 = 4.0%</td>
</tr>
<tr>
<td></td>
<td>$60 - $79,000= 4.0%</td>
<td>$60- $79,000= 8.0%</td>
</tr>
<tr>
<td></td>
<td>$80 - $99,000= 24.0%</td>
<td>$80 - $99,000= 20.0%</td>
</tr>
<tr>
<td></td>
<td>&gt;$100,000 = 68.0%</td>
<td>&gt;$100,000 = 68.0%</td>
</tr>
<tr>
<td>Age first walked in</td>
<td>11.88 (3.33)</td>
<td>15.25 (2.86)</td>
</tr>
<tr>
<td>months</td>
<td></td>
<td>[a,b]</td>
</tr>
<tr>
<td>Age spoke first word in</td>
<td>12.59 (3.30)</td>
<td>24.93 (11.12)</td>
</tr>
<tr>
<td>months</td>
<td></td>
<td>[a,b]</td>
</tr>
<tr>
<td>WASI IQ</td>
<td>119.20 (13.44)</td>
<td>94.08 (13.34)</td>
</tr>
<tr>
<td>[a,b,c]</td>
<td>[97 - 142]</td>
<td>[73 - 128]</td>
</tr>
<tr>
<td>History of remedial</td>
<td>0 (0%)</td>
<td>12 (48.0%)</td>
</tr>
<tr>
<td>school services N (%)</td>
<td></td>
<td>[a,b,c]</td>
</tr>
<tr>
<td>Teachers expressed</td>
<td>0 (0%)</td>
<td>16 (64.0%)</td>
</tr>
<tr>
<td>concerns N (%)</td>
<td></td>
<td>[a,b,c]</td>
</tr>
<tr>
<td>History of grade</td>
<td>0 (0%)</td>
<td>3 (12.0%)</td>
</tr>
<tr>
<td>retention N (%)</td>
<td></td>
<td>[a]</td>
</tr>
<tr>
<td>Diagnosed ADHD</td>
<td>1 (4.0%)</td>
<td>4 (16.0%)</td>
</tr>
</tbody>
</table>

a = significant difference between Control and Eastern European; b = significant difference between control and Chinese; c = significant difference between Eastern European and Chinese.

Noted: GED= General Equivalency Diploma (GED)
Table 3. Correlations among factors and outcome variables.

<table>
<thead>
<tr>
<th></th>
<th>Income</th>
<th>TEA-Ch Sky Search</th>
<th>TEA-Ch Score!</th>
<th>BRIEF Inhibition</th>
<th>BRIEF Working Memory</th>
<th>CCC-2 GCC</th>
<th>DVV Competent responses</th>
<th>HCSBS Social Comp</th>
<th>CBCL Tot Behav Probs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family Income</td>
<td>--</td>
<td>-.07</td>
<td>-.13</td>
<td>-.15</td>
<td>-.14</td>
<td>.20</td>
<td>.22</td>
<td>-.12</td>
<td>-.21</td>
</tr>
<tr>
<td>TEA-Ch Sky Search</td>
<td>--</td>
<td>--</td>
<td>.36</td>
<td>.05</td>
<td>-.22</td>
<td>.03</td>
<td>.02</td>
<td>-.09</td>
<td>-.02</td>
</tr>
<tr>
<td>TEA-Ch Score!</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-.22</td>
<td>-.17</td>
<td>.34</td>
<td>.08</td>
<td>.16</td>
<td>-.22</td>
</tr>
<tr>
<td>BRIEF Inhibition</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.60</td>
<td>-.54</td>
<td>-.29</td>
<td>-.55</td>
<td>.66</td>
</tr>
<tr>
<td>BRIEF Working Memory</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-.54</td>
<td>-.18</td>
<td>-.50</td>
<td>.65</td>
</tr>
<tr>
<td>CCC-2 GCC</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.37</td>
<td>.53</td>
<td>-.63</td>
</tr>
<tr>
<td>DVV Competent responses</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>.24</td>
<td>-.16</td>
</tr>
<tr>
<td>HCSBS Social Comp</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>-.57</td>
</tr>
<tr>
<td>CBCL Tot Behav Probs</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

70
Table 4. Neurobehavioral data and impairment rates.

<table>
<thead>
<tr>
<th>Test</th>
<th>Control</th>
<th>Eastern European</th>
<th>Chinese</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCSBS Social Competence</td>
<td>Mean (SD) a</td>
<td>58.52 (6.26)</td>
<td>51.57 (1.57)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>46 - 67</td>
<td>31 - 64</td>
</tr>
<tr>
<td></td>
<td>N (% impaired)</td>
<td>0 (0.0%)</td>
<td>2 (8.0%)</td>
</tr>
<tr>
<td>CBCL Tot Behav Prob</td>
<td>Mean (SD) a</td>
<td>43.76 (7.17)</td>
<td>55.12 (9.87)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>32-56</td>
<td>34-79</td>
</tr>
<tr>
<td></td>
<td>N (% impaired)</td>
<td>0 (0.0%)</td>
<td>7 (28.0%)</td>
</tr>
<tr>
<td>TEA-Ch Sky Search</td>
<td>Mean (SD)</td>
<td>9.16 (2.44)</td>
<td>7.08 (3.77)</td>
</tr>
<tr>
<td>Attention score</td>
<td>Range</td>
<td>4 – 13</td>
<td>1 – 15</td>
</tr>
<tr>
<td></td>
<td>N (% impaired)</td>
<td>2 (8.0%)</td>
<td>7 (28.0%)</td>
</tr>
<tr>
<td>TEA-Ch Score!</td>
<td>Mean (SD) a,c</td>
<td>10.16 (2.93)</td>
<td>7.16 (3.67)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>5 – 15</td>
<td>2 – 14</td>
</tr>
<tr>
<td></td>
<td>N (% impaired)</td>
<td>1 (4.0%)</td>
<td>9 (36.0%)</td>
</tr>
<tr>
<td>BRIEF Inhibition</td>
<td>Mean (SD) a,c</td>
<td>48.00 (7.68)</td>
<td>60.20 (12.44)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>38-67</td>
<td>40-82</td>
</tr>
<tr>
<td></td>
<td>N (% impaired)</td>
<td>2 (8.0%)</td>
<td>10 (40.0%)</td>
</tr>
<tr>
<td>BRIEF Working Mem</td>
<td>Mean (SD) a,c</td>
<td>44.72 (5.74)</td>
<td>61.88 (12.36)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>36-57</td>
<td>39-83</td>
</tr>
<tr>
<td></td>
<td>N (% impaired)</td>
<td>0 (0.0%)</td>
<td>12 (48.0%)</td>
</tr>
<tr>
<td>CCC-2 GCC</td>
<td>Mean (SD) a,b</td>
<td>100.68 (18.04)</td>
<td>72.47 (21.37)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>69-124</td>
<td>20-103</td>
</tr>
<tr>
<td></td>
<td>N (% impaired)</td>
<td>5 (20.0%)</td>
<td>10 (40.0%)</td>
</tr>
<tr>
<td>DVV Competent Resp</td>
<td>Mean (SD)</td>
<td>4.25 (1.59)</td>
<td>3.48 (1.73)</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>1-6</td>
<td>1-6</td>
</tr>
</tbody>
</table>

a = significant difference between Control and Eastern European; b = significant difference between control and Chinese; c = significant difference between Eastern European and Chinese.

Note: Mean group comparisons were Bonferroni corrected and controlled for family income; clinical elevation for parent-report behavioral measures defined by T-score \( \geq 63 \); for neuropsychological data, borderline impaired or below defined by Standard Score \( \leq 79 \) or scaled score <6.
Table 5. Regression models examining the influence of neuropsychological measures on behavioral outcomes before manual backward elimination of non-significant factors.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>SE</th>
<th>Std $\beta$</th>
<th>t</th>
<th>p</th>
<th>Variable</th>
<th>$\beta$</th>
<th>SE</th>
<th>Std $\beta$</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCSBS Social Competence</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CBCL Total Behavior Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>-.51</td>
<td>.94</td>
<td>-.05</td>
<td>-.54</td>
<td>.58</td>
<td>Group</td>
<td>-.29</td>
<td>1.08</td>
<td>-.02</td>
<td>-.27</td>
<td>.78</td>
</tr>
<tr>
<td>Family income</td>
<td>-.77</td>
<td>.33</td>
<td>-.22</td>
<td>-2.32</td>
<td>.02</td>
<td>Family income</td>
<td>-.47</td>
<td>.38</td>
<td>-.10</td>
<td>-1.23</td>
<td>.22</td>
</tr>
<tr>
<td>CCC-2 GCC</td>
<td>.09</td>
<td>.05</td>
<td>.23</td>
<td>1.85</td>
<td>.06</td>
<td>CCC-2 GCC</td>
<td>-.13</td>
<td>.05</td>
<td>-.26</td>
<td>-2.40</td>
<td>.01</td>
</tr>
<tr>
<td>BRIEF Inhibition</td>
<td>-.25</td>
<td>.08</td>
<td>-.36</td>
<td>-3.07</td>
<td>.003</td>
<td>BRIEF Inhibition</td>
<td>.32</td>
<td>.09</td>
<td>.36</td>
<td>3.48</td>
<td>.001</td>
</tr>
<tr>
<td>BRIEF Working Memory</td>
<td>-.19</td>
<td>.08</td>
<td>-.28</td>
<td>-2.25</td>
<td>.02</td>
<td>BRIEF Working Memory</td>
<td>.25</td>
<td>.10</td>
<td>.27</td>
<td>2.50</td>
<td>.01</td>
</tr>
<tr>
<td>TEA-Ch Score!</td>
<td>.10</td>
<td>.26</td>
<td>.04</td>
<td>.38</td>
<td>.70</td>
<td>TEA-Ch Score!</td>
<td>-.20</td>
<td>.30</td>
<td>-.60</td>
<td>-.66</td>
<td>.50</td>
</tr>
<tr>
<td>TEA-Ch Sky Search</td>
<td>-.38</td>
<td>.28</td>
<td>-.14</td>
<td>-1.36</td>
<td>.17</td>
<td>TEA-Ch Sky Search</td>
<td>.07</td>
<td>.32</td>
<td>.02</td>
<td>.23</td>
<td>.81</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$R^2$</td>
<td>.64</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Group = Chinese, Eastern European, or control
Table 6. Results of generalized linear regression analysis examining the influence of neuropsychological measures on behavioral outcomes.

<table>
<thead>
<tr>
<th>Variable</th>
<th>β</th>
<th>SE</th>
<th>Std β</th>
<th>t</th>
<th>p</th>
<th>Variable</th>
<th>β</th>
<th>SE</th>
<th>Std β</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group</td>
<td>-.58</td>
<td>.93</td>
<td>.06</td>
<td>-.62</td>
<td>.53</td>
<td>Group</td>
<td>-.48</td>
<td>1.07</td>
<td>-.03</td>
<td>-.44</td>
<td>.65</td>
</tr>
<tr>
<td>Family income</td>
<td>-.73</td>
<td>.32</td>
<td>-.20</td>
<td>-2.27</td>
<td>.02*</td>
<td>Family income</td>
<td>-.48</td>
<td>.37</td>
<td>-.10</td>
<td>-1.30</td>
<td>.19</td>
</tr>
<tr>
<td>CCC-2 GCC</td>
<td>.12</td>
<td>.04</td>
<td>.32</td>
<td>2.81</td>
<td>.006*</td>
<td>CCC-2 GCC</td>
<td>-.13</td>
<td>.05</td>
<td>-.26</td>
<td>-2.51</td>
<td>.01*</td>
</tr>
<tr>
<td>BRIEF Inhibition</td>
<td>-.33</td>
<td>.07</td>
<td>.49</td>
<td>-4.63</td>
<td>&lt;.001</td>
<td>BRIEF Inhibition</td>
<td>.30</td>
<td>.09</td>
<td>.34</td>
<td>3.32</td>
<td>.001**</td>
</tr>
<tr>
<td>$R^2$</td>
<td></td>
<td>.49</td>
<td></td>
<td></td>
<td></td>
<td>$R^2$</td>
<td></td>
<td>.61</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Group = Chinese, Eastern European, or control


competence in boys with ADHD. *Emotional and Behavioral Difficulties, 6*, 31-49.


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