Journal of the International Neuropsychological Society (2013), **19**, 493–496.

doi:10.1017/S1355617713000398

SPECIAL SERIES – Guest Edited by E. Mark Mahone
INTRODUCTION

Social Outcomes in Pediatric Traumatic Brain Injury: Perspectives from Social Neuroscience and Developmental Psychology

Keith Owen Yeates
Department of Pediatrics, The Ohio State University, and The Research Institute at Nationwide Children's Hospital, Columbus, Ohio

(Received December 21, 2012; Final Revision January 11, 2013; Accepted January 11, 2013)

Traumatic brain injury (TBI) is a leading cause of death and disability in youth, and therefore represents a major public health problem (Centers for Disease Control and Prevention, 1999). In the United States alone, more than 700,000 children and adolescents sustain TBI annually, resulting in approximately 60,000 hospitalizations and 6,000 deaths (Faul, Xu, Wald, & Coronado, 2010). Among survivors, TBI frequently results in cognitive, emotional, and behavioral deficits, especially among children with more severe injuries (Yeates, 2010).

Although a substantial literature exists regarding the sequelae of childhood TBI, its effects on social competence remain largely uncharacterized and poorly understood. Although social competence predicts a host of other outcomes, including psychological adjustment, academic performance, and health status (Cacioppo et al., 2002; Rubin, Bukowski, & Parker, 2006), we know relatively little about the nature, basis, and consequences of social problems among children with TBI. Nevertheless, because of its critical developmental implications, poor social functioning almost certainly plays a major role in the declines in quality of life that occur following childhood TBI (DiBattitsta, Soo, Catroppa, & Anderson, 2012; Stancin et al., 2002).

Insights into the social outcomes of pediatric TBI are likely to require research that draws on methods and models from related fields. Developmental psychology has a long history of characterizing the individual characteristics and social skills, social interactions, and various aspects of social adjustment that constitute social competence during childhood (Rubin, Begle, & McDonald, 2012). More recently, the advent and growth of social neuroscience has promoted research on the neural substrates of social functioning. Social neuroscience uses a variety of methods, including neuroimaging, to conduct studies of the links between brain, emotion and cognition, and social behavior (Cacioppo, Berntson, Sheridan, & McClintock, 2000; Ochsner & Lieberman, 2001).

Previous research suggests that children with TBI are vulnerable to poor social outcomes (Rosema, Crowe, & Anderson, 2012). However, the existing research is limited in quantity and has largely not made use of state-of-the-art measures and models of social function, thereby precluding a comprehensive portrayal of social outcomes following childhood TBI. Fortunately, researchers have increasingly recognized that methods and models drawn from developmental psychology and social neuroscience provide a framework for the rigorous study of social outcomes in children with brain disorders (Beauchamp & Anderson, 2010; Yeates et al., 2007). This has led to significant growth in research focusing on social outcomes after childhood TBI.

This special series seeks to present state-of-the-art research on the social outcomes of childhood TBI; it is based on a symposium presented at the 2012 annual meeting of the International Neuropsychological Society in Montreal. This series includes studies from five different laboratories, all drawing on methods and models from social neuroscience and developmental psychology. Ewing-Cobbs et al. (this issue) present data on mutual gaze and joint attention (i.e., following the gaze of another person to share a common reference point) during mother–infant interactions, and their relationship to broader social outcomes, in young children with TBI. Cook et al. (this issue) describe the effects of TBI in adolescents on the anticipation of the consequences of social actions in a virtual environment, and the relationship of those judgments to cortical thickness measurements. Anderson et al. (this issue) discuss the early post-injury impact of childhood TBI on social cognition, communication, and attention/executive functions, as well as various aspects of social adjustment, and the relationship of those outcomes to both injury severity and family functioning. My colleagues

Correspondence and reprint requests to: Keith Owen Yeates, Ph.D., Department of Psychology, Nationwide Children's Hospital, 700 Children's Drive, Columbus, OH 432205. E-mail: keith.yeates@nationwidechildrens.org

and I (Yeates et al., this issue) describe the effects of pediatric TBI on peer relationships and friendships, based on data collected in the children's school classrooms, and the relationship of those outcomes to structural brain volumes. Finally, McDonald et al. (this issue) report on an innovative approach to assessing pragmatic language and social cognition in teens with TBI using videotaped vignettes of everyday conversational exchanges. Closer reading of the articles in this series reveals several themes worthy of mention: models of social competence; the environment as a moderator of social outcomes; neuroimaging as a technique for investigating the neural substrates of social outcomes; and the use of novel methods for assessing social outcomes.

MODELS OF SOCIAL COMPETENCE

One important advance reflected by these papers is the development of broad conceptual models of social competence (see Anderson et al., this issue). Integrated, multi-level models are critical to understanding social outcomes by promoting a comprehensive examination of the links between brain, cognition and emotion, and action (Cacioppo et al., 2000). Recent models characterize the relationships between social adjustment, peer interactions and relationships, social problem-solving and communication, social-affective and cognitive-executive processes, and their neural substrates (Beauchamp & Anderson, 2010; Yeates et al., 2007). These models help to move research beyond simple group comparisons to studies of the relationships between different levels of analysis, both within groups of children with TBI, and as compared to healthy children or those with orthopedic injuries.

Several of the studies in this series include analyses focusing on the relationships between different levels of analysis. For instance, Ewing-Cobbs et al. study how joint attention and mutual gaze as measured in parent–infant interactions are related to mental development and adaptive behavior. Anderson et al. examine the relationship between social cognition and communication, on one hand, and social adjustment, on the other. Cook et al. and Yeates et al. both examine how quantitative indices derived from structural neuroimaging are associated with social outcomes, with Cook et al. focusing on social cognition and Yeates et al. focusing on peer relationships and friendship.

ENVIRONMENT AS A MODERATOR OF OUTCOMES

A second theme is the recognition that social outcomes are likely to be a joint product of TBI and the child's broader social and family environment. Previous research has clearly demonstrated the important moderating role that the family environment can play in determining the behavioral and adaptive outcomes of childhood TBI (Yeates et al., 1997; Yeates, Taylor, Walz, Stancin, & Wade, 2010). The family environment also has been incorporated as an important influence in recent models of social competence (Beauchamp & Anderson, 2010; Yeates et al., 2007). In this series, both Anderson et al. and Ewing-Cobbs et al. examine the role of the family environment in predicting specific social outcomes. Notably, in Ewing-Cobbs et al., the children at greatest risk for poor outcomes were those whose TBI resulted from physical abuse (as opposed to other forms of non-inflicted trauma), who were less socially responsive, and had lower levels of family resources.

NEUROIMAGING

Not surprisingly, neuroimaging plays a critical role in research in social neuroscience. Both functional and structural approaches have been used in studies of the neural substrates of social cognition and behavior, and are now being applied to research on the social outcomes of childhood TBI (Hanten, Levin, Newsome, & Scheible, 2012). Three of the studies in this symposium include neuroimaging as a predictor of social outcomes. Cook et al. examine how children's judgments regarding the anticipated consequences of social behaviors are related to cortical thickness in brain regions involved in social cognition. Yeates et al. study the relationship of regional brain volumes to measures of rejection-victimization and friendship. Anderson et al. report on the relationship of clinical lesions to social adjustment. Of interest, cortical thickness and regional brain volumes were more predictive of social outcomes than measures of clinical lesions, suggesting that quantitative measurements may prove more sensitive to specific disruptions in brain function that result in social problems than relatively gross measures of lesion location or load. Quantitative measurements may be more sensitive in part because they can capture pathological effects that are not detectable as visible lesions (e.g., subtle atrophic changes).

NOVEL METHODS FOR ASSESSING OUTCOMES

Previous studies of social outcomes in childhood TBI have focused largely on social adjustment in a broad sense, as assessed primarily via parent ratings. Rating scales measuring social adjustment suffer from a variety of shortcomings (Crowe, Beauchamp, Catroppa, & Anderson, 2011), and provide limited insight into other aspects of social competence, including social cognition and interaction. One of the most outstanding aspects of the studies in this symposium is that they incorporate novel measurements of social competence that cut across multiple levels, ranging from social cognition to social interaction and behavior. Anderson et al. include a novel measure of affective theory of mind (Dennis et al., 2013), as well as a measure of social participation that taps children's engagement in typical social activities. McDonald et al. explore how pragmatic language and social cognition can be assessed using videotaped vignettes of everyday conversational exchanges. Cook et al. use virtual reality technology to elicit children's predictions about social

actions and anticipation of consequences for those actions. Yeates et al. use peer nominations and ratings obtained in children's classrooms to derive measures of social behavior, acceptance, and friendship. Ewing-Cobbs et al. use direct observations to obtain measures of children's mutual gaze and joint attention during interactions with their parents. These novel methods demonstrate the growing movement toward balancing ecological validity with experimental control in the assessment of social outcomes.

FUTURE DIRECTIONS

This series reflects a growing interest in the social outcomes of pediatric TBI. It provides a glimpse of future directions that such studies are likely to take, including the incorporation of additional methods from developmental psychology and social neuroscience that can provide a more nuanced knowledge base regarding the ways in which TBI can affect children's social functioning. Studies are likely to examine outcomes at multiple levels, ranging from neural substrates to social cognition to social interaction to social adjustment, and to investigate the relationships among those levels.

Eventually, findings from research in this area should provide the foundation for important clinical advances, including the development of more sensitive measures of social functioning that can be used by clinical neuropsychologists in their clinical practices, to help target children with poor social outcomes for further intervention. The literature on interventions to promote psychosocial outcomes after childhood TBI is minimal (Ross, Dorris, & McMillan, 2011), but future research should foster the development of interventions to promote better social outcomes following childhood TBI (Glang, Todis, Cooley, Wells, & Voss, 1997), perhaps through adaptations of existing treatment approaches (DeRosier & Gilliom, 2007; Frankel et al., 2010). Effective interventions, grounded in research on social outcomes, should facilitate the friendships and peer relationships of children with TBI and foster their overall social competence. In this way, research on social outcomes provides an opportunity to improve the long-term quality of life of children with TBI and their families.

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