Early Violence Exposure and Executive Function: Implications for Psychopathology and Other Cautionary Points

Commentary on McCoy

Ayelet Lahat Louis A. Schmidt

McMaster University, Hamilton, Ont., Canada

Key Words

Executive function · Externalizing · Internalizing · Psychopathology · Violence exposure

Child and youth exposure to violence is a widespread problem in the United States [Finkelhor, Turner, Ormrod, & Hamby, 2009]. Exposure to violence is associated with numerous negative outcomes related to children's development, including their social and academic performance, as well as their mental health [Margolin & Gordis, 2000; Martinez-Torteya, Anne Bogat, Von Eye, & Levendosky, 2009; Schwartz & Gorman, 2003]. McCoy [this issue] offers a theoretical model linking exposure to family and community violence with self-regulation, an important aspect of children's development. As defined by McCoy, self-regulation involves an individual's ability to regulate his or her thoughts, behaviors, or emotions with the purpose of achieving a particular goal. McCoy focuses on three aspects of self-regulation, including executive function, effortful control, and emotion regulation. According to the model, children who experience violence that is chronic, proximal, and pervasive across multiple settings show the greatest risk for impairments in self-regulation. This model also suggests that resilience in the face of stress is common, particularly if social support networks are in place.

McCoy's model is theoretically important to unifying disparate findings in the field, and she should be applauded for providing a timely model on interactions among complex phenomena to understand how self-regulation may be compromised as a result of early exposure to violence. For example, her model will help inform and frame recent empirical findings linking exposure to violence, the brain, and psychopathology in childhood [e.g., Miskovic, Schmidt, Georgiades, Boyle, & MacMillan, 2010]. There are, however, still a number of caveats that are worthy of discussion that

McCoy's model raises in particular and that affect the field in general. First, we believe that additional discussion is needed on self-regulation as a putative mechanism underlying the relation between early violence exposure and psychopathology. Second, we would like to discuss issues related to definitional, conceptual, and measurement concerns. McCoy does an excellent job of acknowledging and addressing these issues, but we expand here on some of these points in more detail.

A crucial next step to McCoy's model is to consider the important implications this model may have. In particular, compromised self-regulation may be related to developmental trajectories that lead to psychopathology. One important aspect of self-regulation that has been linked to both externalizing and internalizing problems [Clark, Prior, & Kinsella, 2002; Hajcak, Franklin, Foa, & Simons, 2008; McDermott et al., 2009; Séguin & Zelazo, 2005; Wåhlstedt, Thorell, & Bohlin, 2008; Weinberg, Olvet, & Hajcak, 2010; White, McDermott, Degnan, Henderson, & Fox, 2011] is executive function: the control over thought and action in situations that require problem solving [Zelazo, Carlson, & Kesek, 2008].

Recent research [Lahat, Van Lieshout, Saigal, Boyle, & Schmidt, under review] has pointed to the importance of examining cognitive mechanisms such as executive function as potential moderators or mediators in the relations between early adversity and later psychopathology. Thus, McCoy's model could be extended to include self-regulation, and executive function in particular, as a possible underlying mechanism contributing to psychopathology. Examining executive function as a possible mediator or moderator may elucidate resilience and multifinality of early violence exposure [Cicchetti & Rogosch, 1996].

As noted by McCoy, violence exposure is linked to impairments in self-regulation. However, relatively few studies have specifically examined executive function directly in children exposed to violence. In one study [DePrince, Weinzierl, & Combs, 2009] that did examine executive function deficits directly in a sample of children exposed to familial violence, early familial violence exposure was associated with poorer performance on an executive function composite score (composed of working memory, inhibition, attention, and processing speed tasks). These findings were obtained after controlling for anxiety and dissociation symptoms, as well as socio-economic status and possible traumatic brain injury [DePrince et al., 2009]. Although this work links violence exposure directly with executive function, it does not inform us about whether executive function can serve as either a risk factor (when executive function is poor), or a protective factor (when executive function is high) in developmental trajectories leading to psychopathology.

A large body of research has shown links between exposure to violence and various forms of psychopathology, including both internalizing and externalizing problems [e.g., Evans, Davies, & DiLillo, 2008; Fowler, Tompsett, Braciszewski, Jacques-Tiura, & Baltes, 2009]. For example, externalizing problems such as deviant and aggressive behavior have been consistently shown to result from exposure to violence among children, adolescents, and young adults in cross-sectional and longitudinal studies [Gorman-Smith, Henry, & Tolan, 2004; Guerra, Rowell Huesmann, & Spindler, 2003; Lynch & Cicchetti, 1998; Miller, Wasserman, Neugebauer, Gorman-Smith, & Kamboukos, 1999]. With regard to internalizing problems, the most consistent findings in violence research are those related to post-traumatic stress disorder (PTSD) symptoms [Fitzpatrick & Boldizar, 1993; Horowitz, Weine, & Jekel, 1995; Lynch & Cicchetti, 1998]. Children and adolescents exposed to elevated rates of wit-

nessing violence and being victimized by it are at much greater risk for developing PTSD symptoms as well as being clinically diagnosed for the disorder [Fowler et al., 2009].

Research has also shown that executive function is related to both externalizing and internalizing problems. For example, some researchers have proposed that atypical executive function development is related to physical aggression [Séguin & Zelazo, 2005]. Moreover, individual differences in children's effortful control abilities, assessed using behavioral and parent rating measures, were negatively associated with child externalizing problems reported by parents and preschool teachers [Olson, Sameroff, Kerr, Lopez, & Wellman, 2005]. Executive function, particularly reduced attention shifting, has also been found to moderate the link between exuberant temperament and propensity for risk-taking [Lahat et al., 2012]. As well, impairments in executive function have been associated with attention deficit/hyperactivity disorder [for a review, see Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005]. With respect to internalizing problems, specific executive functions such as increased response monitoring and inhibitory control have been found to be associated with increased anxiety [Hajcak et al., 2008; Hajcak & Simons, 2002; McDermott et al., 2009; Meyer, Weinberg, Klein, & Hajcak, 2012; Weinberg et al., 2010; White et al., 2011], whereas other executive functions such as increased attention shifting have been found to be associated with reduced anxiety problems [White et al., 2011].

Given these links among violence exposure, executive function, and psychopathology, future work should examine the role of executive function in the relations between early violence exposure and later psychopathology. Employing prospective longitudinal designs to this line of work would be particularly fruitful since they would be able to elucidate the role of underlying mechanisms as well as developmental trajectories that contribute to both externalizing and internalizing problems.

In addition to implications related to psychopathology, it is also important to consider definitional, conceptual, and measurement concerns. McCoy has successfully identified these issues, but we expand on some of these in more detail below. One of the main concerns limiting the field is one of definition. As McCoy correctly points out, it is difficult to define violence exposure, to delineate different types of exposure, to determine what exposure ultimately means in terms of intensity and duration, and to determine how people differ among their experiences related to violence. One thing is important to note here. It is not uncommon for researchers to cite studies of violence in which nearly 60–80% of children are exposed to some form of violence in childhood. In fact, McCoy cites one study in which nearly 60% of American children have been exposed [Finkelhor et al., 2009]. While any exposure to violence should be prevented and is cause for concern, we need to be careful not to conflate normative events with non-normative events. That is, rates this high raise the possibility that our definition of what constitutes exposure might be relatively broad.

A second issue is related to the conceptualization of the multiple levels of the model and whether the model is completely comprehensive. McCoy describes the transactional and bidirectional nature of different influences on self-regulation and the fact that the field has been limited by unidirectional suppositions and establishing causal relations. This point is well-taken. However, it is also difficult to establish causal relations among the various levels in McCoy's model, and there is little to no dis-

cussion of how the model would generate testable hypotheses. As well, McCoy's model may not be completely comprehensive. For example, McCoy uses a traditional conceptualization of the environment – one residing outside of the individual (e.g., peers, parents, communities). Recent empirical evidence suggests that researchers and the field of human development also need to consider endogenous environmental influences that affect gene expression [Schmidt, Fox, Perez-Edgar, & Hamer, 2009] and their interaction with other biological factors (e.g., physiology, electrochemical states, neural dynamics) [Schmidt & Miskovic, 2013]. Findings from other disciplines studying biological phenomena have long considered that these proximal internal influences may help develop more complete models of human development, including violence.

A third point that warrants discussion is related to general measurement and design issues. Much of the work in the violence exposure literature is based on self-report and subjective measures, limiting the reliability of the data given the inherent biases in these measures. As McCoy rightly points out, there needs to be more work conducted using more objective measures (e.g., interview, observational, and physiological) than self-report, and these objective indices need to be triangulated with subjective measures. It is important to point out, however, that regardless of the type of measure used, the fundamental psychometrics of the measure need to be established. If not, the reliability and generalizability of the findings can be questioned.

This point is especially true in the use of relatively new biological measures. The last several decades have witnessed an exponential increase in the use of biological measures to understand complex human behavior and traits. Although their use has led to important new insights and discoveries, the basic psychometric parameters related to these measures (e.g., test-retest reliability, internal consistency) have not been, for the most part, systematically studied, particularly as it relates to violence exposure. Fortunately, recent studies have begun to examine repeated measurement of stress vulnerability measures over time such as salivary cortisol [MacMillan et al., 2009], frontal EEG asymmetry, and cardiac vagal tone [Miskovic, Schmidt, Georgiades, Boyle, & MacMillan, 2009] in populations exposed to violence in childhood, and they found modest to good stability. On a related note, few studies on violence exposure have used longitudinal designs as McCoy pointed out. Taken together, the use of cross-sectional designs and the use of biological measures with limited psychometric data in such designs will raise issues of how reliable and valid the findings are.

Overall, McCoy took an important first step by offering a comprehensive model that accounts for observed relations between early violence exposure and self-regulatory dysfunction. According to this model, children who experience violence that is chronic, proximal, and pervasive across multiple settings show the greatest risk for cognitive, behavioral, and emotional dysregulation. Furthermore, some children show resilience in the face of adverse experiences, and identifying the contribution of underlying mechanisms is of crucial importance. Here we suggest that executive function may be an important factor that plays a role in the relations between early violence exposure and later externalizing and internalizing problems. We also considered some of the definitional, conceptual, and measurement issues raised by McCoy's model and caveats for the field in general. Future research should examine the implications of McCoy's model and how these issues may be addressed when considering the relevance of this model and other models linking violence exposure to psychopathology.

Acknowledgment

This work was supported by a Lawson Post-Doctoral Fellowship to A.L.

References

- Cicchetti, D., & Rogosch, F.A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*, 8, 597–600.
- Clark, C., Prior, M., & Kinsella, G. (2002). The relationship between executive function abilities, adaptive behaviour, and academic achievement in children with externalising behaviour problems. *Journal of Child Psychology and Psychiatry*, 43, 785–796.
- DePrince, A.P., Weinzierl, K.M., & Combs, M.D. (2009). Executive function performance and trauma exposure in a community sample of children. *Child Abuse & Neglect*, 33, 353–361.
- Evans, S.E., Davies, C., & DiLillo, D. (2008). Exposure to domestic violence: A meta-analysis of child and adolescent outcomes. *Aggression and Violent Behavior*, 13, 131–140.
- Finkelhor, D., Turner, H., Ormrod, R., & Hamby, S.L. (2009). Violence, abuse, and crime exposure in a national sample of children and youth. *Pediatrics*, 124, 1411–1423.
- Fitzpatrick, K.M., & Boldizar, J.P. (1993). The prevalence and consequences of exposure to violence among African-American youth. *Journal of the American Academy of Child & Adolescent Psychiatry*, 32, 424–430.
- Fowler, P.J., Tompsett, C.J., Braciszewski, J.M., Jacques-Tiura, A.J., & Baltes, B.B. (2009). Community violence: A meta-analysis on the effect of exposure and mental health outcomes of children and adolescents. *Development and Psychopathology*, 21, 227–259.
- Gorman-Smith, D., Henry, D.B., & Tolan, P.H. (2004). Exposure to community violence and violence perpetration: The protective effects of family functioning. *Journal of Clinical Child & Adolescent Psychology*, 33, 439–449.
- Guerra N.G., Rowell Huesmann, L., & Spindler, A. (2003). Community violence exposure, social cognition, and aggression among urban elementary school children. *Child Development*, 74, 1561–1576.
- Hajcak, G., Franklin, M., Foa, E., & Simons, R. (2008). Increased error-related brain activity in pediatric obsessive-compulsive disorder before and after treatment. *American Journal of Psychiatry*, 165, 116–123.
- Hajcak, G., & Simons, R.F. (2002). Error-related brain activity in obsessive-compulsive undergraduates. *Psychiatry Research*, 110, 63–72.
- Horowitz, K., Weine, S., & Jekel, J. (1995). PTSD symptoms in urban adolescent girls: Compounded community trauma. *Journal of the American Academy of Child & Adolescent Psychiatry*, 34, 1353–1361.
- Lahat, A., Degnan, K.A., White, L.K., McDermott, J.M., Henderson, H.A., Lejuez, C., & Fox, N.A. (2012). Temperamental exuberance and executive function predict propensity for risk taking in childhood. *Development and Psychopathology*, 24, 847–856.
- Lahat, A., Van Lieshout, R.J., Saigal, S., Boyle, M.H., & Schmidt, L.A. (under review). Small for gestational age and poor fluid intelligence in childhood predict externalizing behaviors among young adults born at extremely low birth weight.
- Lynch, M., & Cicchetti, D. (1998). An ecological-transactional analysis of children and contexts: The longitudinal interplay among child maltreatment, community violence, and children's symptomatology. *Development and Psychopathology*, 10, 235–257.
- MacMillan, H.L., Georgiades, K., Duku, E.K., Shea, A., Steiner, M., Niec, A., Tanaka, M., Gensey, S., Spree, S., Vella, E., Walsh, C.A., DeBellis, M.D., Van der Meulen, J., Boyle, M.H., & Schmidt, L.A. (2009). Cortisol response to stress in female youths exposed to child maltreatment: Results of the Youth Mood Project. *Biological Psychiatry*, 66, 62–68.
- Margolin, G., & Gordis, E.B. (2000). The effects of family and community violence on children. *Annual Review of Psychology*, 51, 445–479.
- Martinez-Torteya, C., Anne Bogat, G., Von Eye, A., & Levendosky, A.A. (2009). Resilience among children exposed to domestic violence: The role of risk and protective factors. *Child Development*, 80, 562–577.
- McDermott, J.M., Perez-Edgar, K., Henderson, H.A., Chronis-Tuscano, A., Pine, D.S., & Fox, N.A. (2009). A history of childhood behavioral inhibition and enhanced response monitoring in adolescence are linked to clinical anxiety. *Biological Psychiatry*, 65, 445–448.
- Meyer, A., Weinberg, A., Klein, D.N., & Hajcak, G. (2012). The development of the error-related negativity (ERN) and its relationship with anxiety: Evidence from 8- to 13-year-olds. *Developmental Cognitive Neuroscience*, 2, 152–161.

- Miller, L.S., Wasserman, G.A., Neugebauer, R., Gorman-Smith, D., & Kamboukos, D. (1999). Witnessed community violence and antisocial behavior in high-risk, urban boys. *Journal of Clinical Child Psychology*, 28, 2–11.
- Miskovic, V., Schmidt, L.A., Georgiades, K., Boyle, M., & MacMillan, H.L. (2009). Stability of resting frontal electroencephalogram (EEG) asymmetry and cardiac vagal tone in adolescent females exposed to child maltreatment. *Developmental Psychobiology*, 51, 474–487.
- Miskovic, V., Schmidt, L.A., Georgiades, K., Boyle, M., & MacMillan, H.L. (2010). Adolescent females exposed to child maltreatment exhibit atypical EEG coherence and psychiatric impairment: Linking early adversity, the brain, and psychopathology. *Development and Psychopathology*, 22, 419–432.
- Olson, S.L., Sameroff, A.J., Kerr, D.C., López, N.L., & Wellman, H.M. (2005). Developmental foundations of externalizing problems in young children: The role of effortful control. *Development and Psychopathology*, 17, 25–45.
- Schmidt, L.A., Fox, N.A., Perez-Edgar, K., & Hamer, D.H. (2009). Linking gene, brain, and behavior: DRD4, frontal asymmetry, and temperament. *Psychological Science*, 20, 831–837.
- Schmidt, L.A., & Miskovic, V. (2013). A new perspective on temperamental shyness: Differential susceptibility to endogenous environmental influences. *Social and Personality Psychology Compass*, 7, 141–157.
- Schwartz, D., & Gorman, A.H. (2003). Community violence exposure and children's academic functioning. *Journal of Educational Psychology*, 95, 163–173.
- Séguin, J.R., & Zelazo, P.D. (2005). Executive function in early physical aggression. In R.E. Tremblay, W.W. Hartup, & J. Archer (Eds.), *Developmental origins of aggression* (pp. 307–329). New York: Guilford Press.
- Wählstedt, C., Thorell, L.B., & Bohlin, G. (2008). ADHD symptoms and executive function impairment: Early predictors of later behavioral problems. *Developmental Neuropsychology*, 33, 160–178.
- Weinberg, A., Olvet, D.M., & Hajcak, G. (2010). Increased error-related brain activity in generalized anxiety disorder. *Biological Psychology*, 85, 472–480.
- White, L.K., McDermott, J.M., Degnan, K.A., Henderson, H.A., & Fox, N.A. (2011). Behavioral inhibition and anxiety: The moderating roles of inhibitory control and attention shifting. *Journal of Abnormal Child Psychology*, 39, 735–747.
- Willcutt, E.G., Doyle, A.E., Nigg, J.T., Faraone, S.V., & Pennington, B.F. (2005). Validity of the executive function theory of attention-deficit/hyperactivity disorder: A meta-analytic review. *Biological Psychiatry*, 57, 1336–1346.
- Zelazo P.D., Carlson, S.M., & Kesek, A. (2008). Development of executive function in childhood. In C.A. Nelson & M. Luciana (Eds.), *Handbook of developmental cognitive neuroscience* (2nd ed., pp. 553–574). Cambridge: MIT Press.