Early Childhood Research Quarterly xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Early Childhood Research Quarterly

Earthquake effects: Estimating the relationship between exposure to the 2010 Chilean earthquake and preschool children's early cognitive and executive function skills

Celia J. Gomez [a,*], Hirokazu Yoshikawa [b]

[a] The RAND Corporation, United States
[b] New York University, New York, NY 10003, United States

ARTICLE INFO

Article history:
Received 16 July 2015
Received in revised form 7 July 2016
Accepted 9 August 2016

Keywords:
Earthquakes
Disasters
Propensity scores
Early childhood development

ABSTRACT

Little is known about how the experience of an earthquake affects young children's cognitive outcomes. On February 27, 2010, a severe earthquake shook southern Chile. The earthquake occurred during the course of a large-scale evaluation of an early childhood education intervention (child average age = 53 months) in Santiago, such that one cohort of children (n = 698) experienced baseline data collection 3–12 weeks after the earthquake occurred, while a different cohort of children (n = 720) did not. In this paper, we used these available evaluation data to conduct two sets of analyses that explore the relationship between preschool children's exposure to the 2010 Chilean earthquake and their early language, pre-literacy, mathematics and executive function outcomes. In the first set of analyses, we employed a propensity score analysis to estimate the short-term effect of the earthquake on preschool- aged children's early learning and executive function outcomes. Results suggest that children who experienced the earthquake had lower scores on some early language and pre-literacy assessments than those who did not, with effect sizes of approximately 20% of a standard deviation. Results from the second set of analyses suggest that among the families who experienced the earthquake, children whose parents reported more earthquake- related stressors performed significantly lower on some early language and pre-literacy outcomes. Implications of these findings for disaster relief efforts and future research are discussed.

1. Introduction

On February 27, 2010 at 3:34 a.m., one of the strongest earthquakes in history shook southern Chile. Santiago, the nation's capital, sits approximately 500 kilometers north of Concepción, the closest major city to the epicenter. While the city experienced much less devastation and damage than communities further south in the country, Santiago and its residents suffered collapsed buildings, blocked roads, and damaged homes (Barrionuevo & Robbins, 2010). This study explores how the earthquake impacted some of Santiago's youngest citizens—its preschool-aged children.

Few research studies explore the effects of natural disasters on young children (Anderson, 2005), and those that do tend to focus on children's mental health, socio-emotional development, or behavioral outcomes following a disaster (Vogel & Vernberg, 1993). Scholars have had fewer opportunities to document the effect of experiencing a natural disaster on young children's early learning skills. The present study contributes to the literature with two sets of analyses that explore the relationship between preschool-aged children's exposure to the 2010 Chilean earthquake and their early language and pre-literacy skills, emergent mathematics ability, and executive function.

The 2010 Chilean earthquake occurred in the middle of the implementation and evaluation of a large-scale teacher professional development program in publically-funded prekindergartens serving a high proportion of low-income families in Santiago (Yoshikawa et al., 2015). The schedule of data collection was such that one cohort of children in the sample began their preschool year and experienced baseline data collection just after the earthquake occurred, while a different cohort of children went through data collection a year earlier, not experiencing the natural disaster prior to taking the assessments. In the first set of analyses, we capitalize on this natural experiment and compare these two groups to estimate the relationship between children's experience of the earthquake and their performance on early childhood outcomes. However, the sampling procedures of UBC were such that pre-existing differences between the two groups may have

* Correspondence to: The RAND Corporation, 1776 Main St., Santa Monica, CA, 9040, United States.
E-mail address: cgomez@rand.org (C.J. Gomez).

http://dx.doi.org/10.1016/j.ecresq.2016.08.004
0885-2006/

Please cite this article in press as: Gomez, C. J., & Yoshikawa, H. Earthquake effects: Estimating the relationship between exposure to the 2010 Chilean earthquake and preschool children's early cognitive and executive function skills. *Early Childhood Research Quarterly* (2016), http://dx.doi.org/10.1016/j.ecresq.2016.08.004

contributed to the selection of children into the cohort that experienced the earthquake versus the cohort that did not. If unaccounted for, these differences could confound any estimated effect of the earthquake. To address these differences, we employ a propensity score analysis with the aim of making the two cohorts comparable on observed characteristics, save their earthquake exposure.

In a second set of more exploratory analyses, we test whether children's post-earthquake outcomes are related to their parents' report of stress following the disaster. Existing research suggests that children whose parents report more stress in the home after an earthquake often have more extreme behavioral or mental health symptoms themselves (Proctor et al., 2007); we test whether this pattern holds for children's early learning outcomes as well. Using only those children who were exposed to the earthquake—the only children for whom we have data on parent stress—we test whether parents' reports of earthquake-related stressors predict their children's early language and pre-literacy skills, emergent mathematics ability, and executive function following the event.

1.1. Disasters and young children

Early studies in the field of disaster research suggested that young children (ages 0–5) are too young to understand the experience of an earthquake, and are unlikely to be affected by the event (Anderson, 2005). However, studies from the past 2–3 decades have made clear that young children do process and react to natural and human-caused disasters and, as a result, can experience emotional and psychological distress (Buchanan, Casbergue, & Baumgartner, 2009; Masten & Osofsky, 2010; Norris et al., 2002; Osofsky & Reuther, 2013). Research suggests that following a disaster, children can experience increased fear, more internalizing and externalizing behaviors, as well as behaviors symptomatic of post-traumatic stress disorder (PTSD), including separation anxiety, reliving the event, and emotional numbness or increased arousal (Norris et al., 2002; Osofsky & Reuther, 2013; Peek, 2008; Silverman & La Greca, 2002). These symptoms have been observed in young children following the experience of an earthquake (Endo, Shioiri, Toyabe, Akazawa, & Someya, 2007; Proctor et al., 2007), as well as other types of human-caused and natural disasters, including the 9/11 terrorist attacks (Chemtob, Nomura, & Abramovitz, 2008; DeVoe & Klein, 2011) and Hurricane Katrina (Osofsky, Kronenberg, Bocknek, & Hansel, 2015).

Research has indicated that the extent of a child's exposure to a disaster—sometimes measured by a child's physical proximity to the disaster (Goenjian et al., 1995) or the degree to which the disaster impacted the child's family, home, and/or immediate environment (DeVoe & Klein, 2011) is positively related to children's post-disaster symptoms. We might expect children living further from a disaster (like those in the sample of the present study) to have fewer symptoms or less extreme reactions than children closer to its epicenter. However, theory also suggests that children and families from disadvantaged populations—e.g. low-income communities, individuals with disabilities, and racial and ethnic minorities—may be more vulnerable to a disaster due to their social position (Peek & Stough, 2010). For example, families who live in poorly constructed homes or who have minimal access to food supplies are more likely to be affected by an earthquake than families with greater resources. As such, low-income families, including those who endure minimal physical destruction or live far from the event, like those in the sample of the present study, may nevertheless be prone to hardship following a disaster.

1.2. The effects of disasters and trauma on children's early learning outcomes

The majority of literature exploring the impact of an earthquake or other disasters on children focuses on symptoms related to PTSD or children's mental health (Anderson, 2005). Far less research has explored how experiencing a disaster might impact other domains of early child development, such as early language, pre-literacy, math skills, or executive function. The few extant studies on the topic suggest that experiencing a disaster might lead to decreased performance on these skills. In their review of literature covering a host of both natural and human-caused disasters, Vogel and Vernberg (1993) found that, on average, school-aged children experienced a decrease in academic performance after experiencing a disaster. This pattern may be caused by students' discontinuity in school experiences due to damaged buildings, displacement, or parents' fear of letting them travel to school or be out their care (Peek, 2008).

Stress or trauma caused by disaster exposure may also result in decreased academic performance. Trauma, defined as a deeply stressful, emotionally painful event that induces short and long-term feelings of fear and helplessness (Breslau et al., 1998; Sagi-Schwartz, 2008), can affect many domains of child development. Following a traumatic event, such as the experience of an earthquake, young children can exhibit difficulty concentrating on tasks at school (Cole et al., 2005; Osofsky & Reuther, 2013; Sagi-Schwartz, 2008). An inability to concentrate on an assessment could lead to short-term negative effects on measures of children's language and literacy, or mathematics skills following a disaster. In addition, children may temporarily regress in academic progress or skill development following trauma, another possible cause of short-term negative effects on early childhood measures of cognitive ability (Cole et al., 2005).

The literature also describes a link between experiencing trauma and children's executive function—including their ability to regulate their behavior and control impulses (DePrince, Weinzierl, & Combs, 2009). Masten and Obradovic (2008) suggest that the fear and anxiety associated with a natural disaster or other crises or traumatic events can negatively affect children's behavior regulation and executive function, while Leskin and White (2007) find a relationship between adults' heightened PTSD symptoms following a trauma and lower performance on executive function tasks.

Few studies explore the effects of natural disaster on cognitive outcomes and executive function; however, researchers have explored the effect of other types of traumas on these outcomes. For example, Sharkey (2010) and Sharkey, Tirado-Strayer, Papachristos, and Raver (2012) found that incidents of community violence decreased children's scores on math and reading achievement, attention, and impulse control a week after the event. While community violence is a qualitatively different type of trauma than that of an earthquake, both types of events have the potential to alter a child's immediate environment and make them fear for their safety, perhaps leading to short-term negative effects on children's cognitive performance.

1.3. The role of caregiver stress in children's response to disasters

Children's interactions with their parents and caregivers may mediate the effects of a traumatic event like an earthquake (DeVoe & Klein, 2011; Masten & Narayan, 2012; Masten & Obradovic, 2008). During and after an earthquake, caregivers can ease children's fears and help regulate behavior and emotions in the face of stress, in a protective fashion (Osofsky & Reuther, 2013). Child resilience in the face of the stress (Bonanno & Mancini, 2008; Masten & Wright, 2009) may, in part, depend on parents' and caregivers' ability to provide a sense of safety and security (Osofsky & Reuther, 2013; Proctor et al., 2007). However, some caregivers may face difficulties during the aftermath of a disaster that may hinder their relationships with their children (Deering, 2000; Kronenberg et al., 2010; Osofsky & Reuther, 2013). As parents cope with their own symptoms after a disaster, they may lack the material and emotional

Please cite this article in press as: Gomez, C. J., & Yoshikawa, H. Earthquake effects: Estimating the relationship between exposure to the 2010 Chilean earthquake and preschool children's early cognitive and executive function skills. *Early Childhood Research Quarterly* (2016), http://dx.doi.org/10.1016/j.ecresq.2016.08.004