Accident Analysis and Prevention 67 (2014) 1–6

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

The association between kinematic risky driving among parents and their teenage children: Moderation by shared personality characteristics

Johnathon P. Ehsani[a,*], Bruce Simons-Morton[a], Yunlong Xie[a], Sheila G. Klauer[b], Paul S. Albert[a]

[a] Eunice Kennedy Shriver National Institute of Child Health and Human Development, Bethesda, MD, USA
[b] Virginia Tech Transportation Institute, Blacksburg, VA, USA

ARTICLE INFO

Article history:
Received 25 March 2013
Received in revised form 6 January 2014
Accepted 6 January 2014

Keywords:
Parent
Teenager
Family
Driving behavior
Naturalistic driving

ABSTRACT

This study examined the driving behavior of 42 parent–teenager dyads for 18 months, under naturalistic driving conditions. At baseline participants' personality characteristics were assessed. Objective risky driving measures (kinematic risky driving) were captured by accelerometers for the duration of the study. To estimate teenage and parent correlations in kinematic risky driving, separate Poisson regression models were fit for teenagers and parents. Standardized residuals were computed for each trip for each individual. Correlations were obtained by estimating the Spearman rank correlations of the individual average residuals across teenagers and parents. The bootstrap technique was used to estimate the standard errors associated with the parent–teenager correlations. The overall correlation between teenage and parent kinematic risky driving for the 18-month study period was positive, but weak ($r = 0.18$). When the association between parent and teenagers' risky driving was adjusted for shared personality characteristics, the correlation reduced to 0.09. Although interesting, the 95% confidence intervals on the difference between these two estimates overlapped zero. We conclude that the weak similarity in parent–teen kinematic risky driving was partly explained by shared personality characteristics.

Published by Elsevier Ltd.

1. Introduction

It has previously been shown (Bianchi and Summala, 2004; Miller and Taubman-Ben-Ari, 2010; Prato et al., 2009) that teenagers drive in a similar manner to their parents. Several direct and indirect mechanisms have been proposed to explain possible familial associations in driving behavior. Throughout childhood and adolescence, children directly observe and are encouraged to emulate the habits of their parents, and this could apply to driving (Wilson et al., 2006). When teenagers are learning to drive, parents exert direct and immediate influence through driving instruction. However, indirect pathways such as common personality traits or attitudes may also account for similarities between parent and teenagers' driving behavior as well as driving in under similar geographic and traffic conditions.

The majority of studies examining the association between parents and their children's driving behavior have relied on archival driving records or self-reported driving behavior. An early study using driver history records established the initial evidence for parent–teenage associations in driving behaviors (Carlson and Klein, 1970). Recent studies extended the use of driver history records (Ferguson et al., 2001) by testing the prospective association between parent driver history and teenage driving violations and motor vehicle crashes (MVCs) (Wilson et al., 2006). Self-reported surveys, combined with self-reported traffic violations and crashes (Bianchi and Summala, 2004) have provided further evidence of similarity in the way parents and their children drive. However, few studies have evaluated factors that might moderate these similarities.

Studies using instrumented vehicles provide an opportunity to advance our understanding of the associations between parents' and teenagers' driving by providing an objective measure of risky driving (Simons-Morton et al., 2012). Using accelerometers, kinematic risky driving behavior can be quantified for each driver and the association between parent and teenage risky driving behavior objectively established. The first study of this kind was conducted in Israel in 2009 and tracked risky driving maneuvers for 75 families over a 9-month period using in-vehicle data recorders (IVDR).

* Corresponding author. Tel.: +1 301 435 6942; fax: +1 301 402 2084.
E-mail address: johnathon.ehsani@nih.gov (J.P. Ehsani).

0001-4575/$ – see front matter. Published by Elsevier Ltd.
http://dx.doi.org/10.1016/j.aap.2014.01.010

The results indicated parents' driving was moderately correlated with their children's and the associations varied by parents' and children's gender (Prato et al., 2009). These findings provided initial evidence of a correlation between parents and their teenage children's driving risky driving behavior using objective measures of risky driving.

However, data collection for the Prato et al. study coincided with the period that teenagers were required to drive under the direct supervision of a parent (for the first three months as part of Israel's Graduated Driver Licensing System). Unlike the high crash risk that is associated with first years of licensure (Williams, 2003), research has shown that teenage driving that occurs under parental supervision entails very low crash risk (Mayhew, 2003). Drivers participating in this study also received feedback (Toledo et al., 2008) that was shown to be effective over time in reducing their risky driving behavior and motor vehicle crashes. It is likely that teenage driving behavior was also more conservative when parents were present in the vehicle, and when monitoring devices were providing feedback on their driving behavior to their parents than would have been the case without parent passengers or IVDR feedback. Therefore, while the Prato et al. (2009) study provides a useful preliminary examination of the potential application of instrumented vehicles to measure the association between parents and their teenage children's driving behaviors, it is timely to evaluate this association under naturalistic conditions, where parents are not present as passengers and no feedback or intervention is provided.

The Naturalistic Teen Driving Study provides an opportunity to examine the association between parent and teenage risky driving behavior when parents were not present in the vehicle and no intervention or driver feedback was provided. To date, much has been learned about teenage driving relative to adult driving behavior from the data gathered for this study. Specifically, teenage driving that occurred while parents were in the vehicle involved very low risk and crash rates, suggesting it is not indicative of independent driving behavior (Simons-Morton et al., 2011a). Driving independently, teenage drivers' crash and near-crash (CNC) rates were significantly higher during the first six months of driving, relative to the subsequent 12 months, and were significantly higher than their parents during the 18-month study period (Lee et al., 2011). Unlike the finding by Prato et al. (2009), teenage drivers showed a large amount of variability in driving behavior over the study period. Specifically, the within-subject variation in risky driving was approximately of the same magnitude as the between-subject variation (Kim et al., 2013). A final notable finding is that the objective composite measure of risky driving behavior predicted crashes and near crashes for both teenagers and parents (Simons-Morton et al., 2012).

Beyond basic demographic characteristics, few studies have identified individual level characteristics associated with driving behavior. Individual perceptions of risk and driving ability have been examined extensively (Hatfield and Fernandes, 2009; Jonah and Dawson, 1987; Ulleberg and Rundmo, 2003), with mixed findings. Social norms represent a promising avenue of investigation (Simons-Morton et al., 2011b). Personality characteristics are the subject of enduring research interest, as they are stable traits associated with behaviors other than driving, including adolescent risk behavior (Cooper et al., 2003). However, the literature on personality characteristics and driving behavior is limited, findings are mixed, and the magnitude of the association between personality characteristics and driving behavior are modest (Dahlen and White, 2006; Jonah, 1997), and few studies have been based on objective measures of driving behavior (Nichols et al., 2011). Data from the Naturalistic Teen Driving Study present a unique opportunity to examine the association between personality and driving. Using objective data of parents and their teenage children's driving behavior, shared personality characteristics that account for similarities between parent and teenagers driving behavior can be explored.

The primary purpose of this study was to examine the association between parents and their teenage children's driving behavior for 18 months under naturalistic driving conditions, where newly-licensed teenagers drove independently and without supervision, and where no intervention or feedback was provided to the study participants. A secondary purpose was to determine the extent to which associations between parent and teenage driving behavior could be explained by shared personality characteristics.

2. Method

2.1. Participants and data collection

The primary vehicles of newly licensed teens were instrumented with data acquisition capabilities within three weeks of licensure, and participants were instructed to drive as they would normally. Multiple measures were assessed over the first 18 months of licensure.

2.1.1. Participants and selection criteria

The protocol for this study required the participation of newly licensed teenage drivers and at least one of their parents. Recruitment was conducted in local newspaper and driving schools in southwestern Virginia, USA. Participants were initially screened in a telephone interview for eligibility using the following inclusion criteria: (a) being less than 17 years old; (b) being newly licensed to drive independently, defined as holding a provisional driver's license allowing independent driving for no more than three weeks; (c) having at least one parent willing and able to participate; (d) access to a vehicle expected to survive mechanically for at least 18 months; (e) residing within a one hour drive of the research center; and (f) holding liability insurance on the vehicle to be used in the study (required by state law). Participants were excluded during the pre-screen telephone interview if they: (a) had a diagnosis of attention deficit disorder (ADD) or attention deficit hyperactivity disorder (ADHD); (b) had an identical twins (difficult to distinguish when coding); (c) needed to enter restricted areas (i.e., that do not allow cameras for security reasons); and (d) had only access to a pick-up truck (due to lack of a concealed space to install the instrumentation).

Participant recruitment was stratified to have a similar number of male and female teenage drivers and participants sharing and not sharing a vehicle with their parents. A total of 315 individuals responded to recruitment efforts, of which 42 fulfilled the eligibility criteria and were enrolled in the study. The final teenage sample comprised 22 females and 20 males with an average age of 16.4 years ($\pm$0.3). The parent sample for this study had 13 males and 29 females. Four participants withdrew from the study before the end of the 18-month data collection period, however, only one of those participants did not complete the final set of questionnaires. Over half of the parent participants (53.3%) reported a household income of over $100,000 and 84.4% reported a parent education level of a bachelor degree. During the study period, average household income in Virginia was $61,406 (U.S. Census Bureau, 2013a), and the percentage of individuals reporting educational attainment of a bachelor degree or higher was 34.4% (U.S. Census Bureau, 2013b). Vehicle and survey data were collected from June 2006 to September 2008.

2.1.2. Consent and incentives

Three consent forms were required for the study: parental consent and teenagers' assent for their participation, and an adult consent form for parent participation. Teenager assent was obtained separately from the parent to ensure their participation