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Can providing feedback on driving behavior and training on parental vigilant care affect male teen drivers and their parents?

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ABSTRACT

This study focuses on investigating the driving behavior of young novice male drivers during the first year of driving (three months of accompanied driving and the following nine months of solo driving). The study's objective is to examine the potential of various feedback forms on driving to affect young drivers' behavior and to mitigate the transition from accompanied to solo driving. The study examines also the utility of providing parents with guidance on how to exercise vigilant care regarding their teens' driving. Driving behavior was evaluated using data collected by In-Vehicle Data Recorders (IVDR), which document events of extreme g-forces measured in the vehicles.

IVDR systems were installed in 242 cars of the families of young male drivers, however, only 217 families of young drivers aged 17–22 ($M = 17.5$; SD = 0.8) completed the one year period. The families were randomly allocated into 4 groups: (1) *Family feedback:* In which all the members of the family were exposed to feedback on their own driving and on that of the other family members;

(2) *Parental training:* in which in addition to the family feedback, parents received personal guidance on ways to enhance vigilant care regarding their sons' driving; (3) *Individual feedback:* In which family members received feedback only on their own driving behavior (and were not exposed to the data on other family members); (4) *Control:* Group that received no feedback at all.

The feedback was provided to the different groups starting from the solo period, thus, the feedback was not provided during the supervised period.

The data collected by the IVDRs was first analyzed using analysis of variance in order to compare the groups with respect to their monthly event rates. Events' rates are defined as the number of events in a trip divided by its duration. This was followed by the development and estimation of random effect negative binomial models that explain the monthly event rates of young drivers and their parents. The study showed that: (1) the *Parental training* group recorded significantly lower events rates (−29%) compared to the *Control* group during the solo period; (2) although directed mainly at the novice drivers, the intervention positively affected also the behavior of parents, with both fathers and mothers in the *Parental training* group improving their driving (by −23% for both fathers and mothers) and mothers improving it also in the *Family feedback* group (by −30%). Thus, the intervention has broader impact effect beside the targeted population.

It can be concluded that providing feedback on driving behavior and parental training in vigilant care significantly improves the driving behavior of young novice male drivers.

Future research directions could include applying the intervention to a broader population, with larger diversity with respect to their driving records, culture, and behaviors. The challenge is to reach wide dissemination of IVDR for young drivers accompanied by parents' involvement, and to find the suitable incentives for its sustainability.

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1. Introduction

Young drivers in Israel, as in many other countries all over the world, experience higher road crash rates than any other age group. The over-representation in crashes is especially substantial in severe and fatal crashes (ICBS, 2011). This problem received considerable public and media attention which led, among other efforts, to modifications in the Israeli driver licensing process. Starting in July 2013, newly licensed young drivers are required to drive only when accompanied by an experienced driver for the first three month after receiving their driving license, and are not allowed to drive at night unaccompanied for the first six months. The accompanying driver must be over the age of 24 and have at least five years of driving experience, or be over the age of 30 with at least three years of driving experience. During the first two years after licensure, the new driver is restricted to drive with no more than two passengers, unless when accompanied by an experienced driver (zero blood alcohol content (BAC) for all drivers under 24 years old, compared to 0.05% for other drivers). The graduation from the accompanied to the solo period is automatic, based only on the passage of time. This study was completed before July, 2013, when there was no restriction on night driving nor minimal amount of driving within the accompanied driving period.

A previous study (Lotan and Toledo, 2007) showed that throughout the accompanied driving period the involvement of novice drivers in Israel in crashes is extremely low. However, as the solo un-supervised driving phase begins, crash rates rise drastically. Afterwards, crash rates gradually decline. Similar trends in crash involvement statistics were observed elsewhere (Mayhew et al., 2003; McCartt et al., 2003). At the individual level, Simons-Morton et al. (2011) equipped vehicles driven by teens with an advanced data acquisition system. They observed a general decrease in crash and near-crash involvement along the first 18 months of driving. They also found changes in specific behaviors over time (a decline in rapid starts and an increase in hard turns). The results of these studies indicate that the problem of novice drivers' crash involvement is most acute immediately after the transition from supervised to independent driving.

The literature shows substantial differences between young males and females with respect to involvement in road crashes. Male drivers, and in particular drivers in the 16–18 years age group, are significantly more involved in fatal crashes per miles driven (Lewis-Evans, 2010; NHTSA, 2009; OECD, 2006). This difference may be partly explained by more aggressive driving behaviors, stronger inclination towards risk taking, sensation seeking and anti-social behaviors, a higher tendency to over-estimate their driving abilities and higher susceptibility to the influence of peers of young male drivers compared to females (Farah, 2011; OECD, 2006; Prato et al., 2010). The higher crash involvement rates for young males led us to include only male teen drivers in this study.

In recent years significant advances have been made in measuring and communication technologies. These led to considerable growth in development and use of in-vehicle data recorders (IVDR) to monitor and influence drivers' behavior, not only in the context of post-crash data, but also as tools to assist in crash prevention. As a measurement tool, IVDR facilitate observing naturalistic driving behavior. As a tool for intervention, it supports reducing risky behaviors by providing feedback to drivers or to those that are responsible for their driving. The "100 cars naturalistic study" (Dingus et al., 2006; Neale et al., 2002) was a major research effort in this direction that used elaborate and expensive monitoring equipment. It involved equipping vehicles with IVDRs that continuously measured and recorded the location, speed and acceleration of the vehicles using GPS and accelerometers. In the Drive-Atlanta experiment (Ogle, 2005) 172 vehicles were instrumented with IVDRs that included a GPS and connected to the vehicle's on-board computer. The data collected in this experiment included high resolution vehicle locations, speeds and accelerations and parameters of the engine and vehicle systems, such as the use of seatbelts, emissions, and the positions of the gas and brake pedals.

At the same time, more affordable commercial IVDR systems have also been introduced. Lotan et al. (2010) used a g-forces based IVDR system in various experiments. This system analyses the raw measurements to identify various maneuver events that the vehicle has undertaken, such as hard braking and acceleration, turns and lane changes. Toledo and Lotan (2007) and Toledo et al. (2008) showed that the rates of these events can be used as indicators of the risk to be involved in road crashes. Lerner et al. (2010) also found a connection between aggressive driving maneuvers and involvement in crashes and near-crashes. Prato et al. (2010) and Toledo and Lotan (2007) used these g-based events to study the driving behavior of novice drivers within the graduate driving licensing (GDL) system.

As noted above, IVDRs may be used not only for measurement, but also as tools to provide feedback to drivers and others (e.g. parents, fleet managers) about their driving. Several studies provide empirical evidence to the positive effect of monitoring through IVDR systems on driving behavior and safety (Musicant et al., 2007). In the context of young drivers, Carney et al. (2010) used a one group (18 drivers) pretest–posttest quasi-experimental design to compare the rate of coachable error events per 1000 miles. In this study video recordings were triggered by safety-relevant events. Teen drivers and their parents reviewed these videos together weekly. It was found that the review process and parental feedback resulted in significant decrease in the number of events that the young drivers generated. McGehee et al. (2007) also used a quasi-experimental design and equipped 26 vehicles of young drivers with an event-triggered video device. Data collection took place in three phases over the course of one year, baseline (no feedback from device or parents), intervention, and second baseline. It was found that feedback from the device combined with parental weekly review of safety-relevant incidents resulted in a significant decrease in events for the more at-risk teen drivers. Farmer et al. (2010) and Prato et al. (2010) also reported that providing young drivers and their parents with IVDR-generated feedback can reduce the incidence of risky behaviors. However, previous studies suffer from some methodological limitations. For example, the studies by Carney et al. (2010) and McGehee et al. (2007) did not include a control group in the study design and used relatively small samples. The study by McGehee et al. (2007) also could not address the critical first months of driving. The study by Farmer et al. (2010), on the other hand, randomly assigned participants to four study groups, including a control group, and monitored young drivers' behaviors over a baseline, intervention, and post-intervention periods. Additionally, the sample of participants was larger, consisting of 85 participants.

A large body of literature links various aspects of parental monitoring and family safety climate to the prevention of risky behaviors among young drivers (Simons-Morton et al., 2002; Taubman-Ben-Ari and Katz-Ben-Ami, 2012, 2013). These studies showed that young drivers of families that are committed to safety and with more authoritative parenting adopt more careful driving style, while those with less authoritative parenting and less commitment to safety adopt more risky driving style. Young drivers are also influenced by their parents' driving behavior through imitation (Taubman-Ben-Ari et al., 2005). However, many parents that were offered the opportunity to monitor the young drivers' driving behavior using IVDRs did not make full use of it, or even rejected it completely (Farmer et al., 2010; Guttman and Gesser-Edelsburg, 2010; Guttman, 2013). In Farmer et al. (2010), parents tended to check the young driver driving record through their website a few times at the beginning, but then lost interest. The authors suggest