Parents' and peers' contribution to risky driving of male teen drivers

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A B S T R A C T

The current study joins efforts devoted to understanding the associations of parents' personality, attitude, and behavior, and to evaluating the added contribution of peers to the driving behavior of young drivers during their solo driving. The study combines data gathered using in-vehicle data recorders from actual driving of parents and their male teen driver with data collected from self-report questionnaires completed by the young drivers. The sample consists of 121 families, who participated in the study for 12 months, beginning with the licensure of the teen driver. The current examination concentrates on the last 3 months of this first year of driving. The experimental design was based on a random control assignment into three treatment groups (with different forms of feedback) and a control group (with no feedback). Findings indicate that the parents' (especially the fathers') sensation seeking, anxiety, and aggression, as well as their risky driving events rate were positively associated with higher risky driving of the young driver. In addition, parents' involvement in the intervention, either by feedback or by training, led to lower risky driving events rate of young drivers compared to the control group. Finally, higher cohesion and adaptability mitigated parents' model for risky driving, and peers norms' of risky driving were associated with higher risk by the teen drivers. We conclude by claiming that there is an unequivocal need to look at a full and complex set of antecedents in parents' personality, attitudes, and behavior, together with the contribution of peers to the young drivers' reckless driving, and address the practical implications for road safety.

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1. Introduction

Motor-vehicle crashes are the leading cause of fatality and injury among teens (Jacobsohn et al., 2012), with the first months of independent driving posing the greatest risk of crash occurrence (Mayhew et al., 2003). Though much has been written over the years about teen's risky driving, many questions still remain to be answered, among them those concerning various mechanisms underlying parents' contributions to their offspring's driving behavior, and the combined effect of peers' and parents' influence.

Several studies have previously indicated positive correlations between a number of aspects of parents' and teen's driving, such as traffic records (e.g., Ferguson et al., 2001; Wilson et al., 2006), real driving using naturalistic studies (e.g., Farah et al., 2013; Foss and Goodwin, 2014; Lee et al., 2011; Prato et al., 2010; Wu and Jovanis, 2013), and various self-reported measures of driving style

(e.g., Bianchi and Summala, 2004; Miller and Taubman – Ben-Ari, 2010; Taubman – Ben-Ari et al., 2005). While these pieces of information are highly important as a basis for inquiry, more research is needed to fully understand these associations and to figure the psychological mechanisms which motivate them.

We would like to suggest that one should also take into account: (a) the parents' own personality traits, as traits such as sensation seeking, aggression, and anxiety, have been found in the past to contribute to individual's driving preferences (e.g., Oltedal and Rundmo, 2006; Schwebel et al., 2006), but have been less investigated from an inter-generational perspective; (b) the family dynamics, as the parent–teen relationship and the family atmosphere have been found to contribute to the level of risky vs. safe driving adopted by young drivers (e.g., Chen et al., 2008; Taubman – Ben-Ari, 2014; Taubman – Ben-Ari and Katz – Ben-Ami, 2013); (c) the peer norms, as the norms among young drivers' peers have been consistently found to be significant contributors to risky driving (e.g., Allen and Brown, 2008; Shope et al., 2003; Simons-Morton et al., 2011). Notably, while all these elements have been studied before, rarely they have been examined together within one sample of teens and their parents.

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Naturalistic studies of driving behavior have become more and more popular in recent years, and provide observational techniques for actual driving, complementing the traditional self-report measures (e.g., Farah et al., 2013; Foss and Goodwin, 2014; Lee et al., 2011; Prato et al., 2010; Wu and Jovanis, 2013). Naturalistic studies enable not only to measure behavior, but also to monitor and influence drivers' behavior, as for example in-vehicle data recorders (IVDRs) may be also used as a tool for intervention by enabling the provision of feedback to drivers or to those that are responsible for their driving, such as their parents (Farah et al., 2013). Previous studies have shown that providing young drivers and their parents with IVDR-generated feedback can reduce the incidence of risky behavior (Carney et al., 2010; Farmer et al., 2010; McGehee et al., 2007; Musicant et al., 2007; Prato et al., 2010). In the current study, we used the IVDR as both an indicator of drivers' risky behavior and an intervention tool to guide teens and their parents (for more details, see Farah et al., 2014). Previous findings focusing on this intervention showed that the intervention groups recorded significantly lower event rates compared to a control group receiving no intervention or feedback at all (Farah et al., 2014).

For the purpose of the present study, we analyzed a sample of 121 young drivers and their parents who recorded their driving behavior on vehicles equipped with IVDRs during the period of 9–12 months from licensure, in which the young drivers were allowed to drive alone in the Graduated Driver Licensing program in Israel. In addition, we measured several perceptions and personality traits through self-report questionnaires to enable us a more comprehensive understanding of teens' driving behavior. The study employed only male teen drivers because of their higher exposure to risky driving and higher chance to be involved in traffic crashes (OECD, 2006; Williams, 2003).

We hypothesized that:

1. Higher risky driving by parents would be positively related to higher risky driving displayed by their offspring.
2. Better perceived family dynamics, and lower levels of parents' sensation seeking, anxiety, and aggressiveness, would be associated with lower teens' risky driving behavior.
3. Higher perception of risky driving as popular among peers would be associated with higher risky driving endorsed by teen drivers.
4. The intervention groups would be characterized by lower levels of risky driving in comparison to the control group.

With the aim of testing these hypotheses, we estimated Poisson-based models within a full hierarchical Bayesian framework while accounting for heterogeneity across young drivers in order to examine the combined contributions to teens' risky driving of parents' personality and driving behavior, family dynamics, driving norms among peers, and interventions.

2. Methods

2.1. Participants

The analysis focused on a sub-sample of 121 young male drivers between 17 and 21.5 years of age (mean = 17.55, st. dev. = 0.68) and their families extracted from 242 families participating in a wider scope longitudinal study (see Farah et al., 2013). The selection criteria for the sample were the following: (i) the young male driver's driving behavior was recorded over the course of 12 months using an IVDR; (ii) at least one of his parents' driving behavior was recorded over the same period of time; (iii) the young male driver completed two questionnaires focusing on family and peer dynamics; (iv) both of his parents completed three personality questionnaires concentrating on sensation seeking, anxiety, and aggression.

Driving behavior was recorded over the course of 12 months for each family participating in the wider scope longitudinal study, including the compulsory 3 months of accompanied driving and the following 9 months of solo driving for the young male drivers under the Israeli Graduated Driver Licensing program. For the purpose of the current analysis, we used the data recorded in the 3-month period between 9 months from licensure and the end of the data collection period, as it is supposed to reflect more stable driving on the part of the young driver. In addition, during the first year, the young male drivers and the families received different type of feedback according to four schemes: (i) no feedback or training provided to either the young drivers or their parents; (ii) feedback provided only to the young drivers; (iii) feedback provided to both the young drivers and their parents; (iv) feedback provided to both the young drivers and their parents, and training program provided to their parents with a focus on parental guidance and training.

2.2. Instruments

Driving behavior was recorded via IVDRs that were mounted on the family's vehicle used by the young driver for all the trips made by that vehicle. Personal magnetic identification keys allowed correctly identifying the driver of each trip, and the IVDRs used G-force based events to identify 20 types of events according to five categories: braking, accelerating, handling turns, handling lanes, and speeding. Events were classified according to risk levels (see, e.g., Toledo et al., 2008; Prato et al., 2010) and risky driving behavior was assessed by taking the natural logarithm of the number of risky driving events per driving time hours and thus defining an overall risk score for each young male driver and each parent driving the same vehicle.

The feedback consisted of both real-time in-vehicle display and post-trip on-line consultation. The real-time feedback provided drivers with information concerning their risky driving level according to a green/yellow/red color scheme for moderate/intermediate/high risk level. The on-line consultation gave drivers information concerning their level of aggressiveness on the basis of the rate of risky driving events recorded during the trip and divided by period of the day. Details concerning the IVDRs and the feedback groups are provided by Toledo et al. (2008), Prato et al. (2010) and Farah et al. (2013).

Family dynamics were investigated at the baseline by asking the young male drivers to complete the *Family Adaptability and Cohesion Evaluation Scales III* (Olson, 1986). Specifically, the focus was on family cohesion, i.e., the perception of the degree of bonding between family members, and family adaptability (or flexibility), namely the perception of the level of balancing between stability and change within the family. Respondents were presented with a 20-item questionnaire, where they were asked about their agreement with a series of statements about family dynamics on a 5-point Likert scale ranging from "almost never" to "almost always". As Cronbach's alpha values for both cohesion (0.85) and adaptability (0.78) were reasonable, the responses were averaged over the respective items to produce two scores for each participant, with higher values reflecting respectively higher degree of bonding and higher level of balancing between stability and change in the family.

Peer dynamics were studied at the baseline by means of the *Perceived popularity of risky driving among friends* (Taubman – Ben-Ari and Lotan, 2011), measuring the young male drivers' perception of the degree of popularity of risky driving behaviors among their friends. Respondents were given 8 items, on a 5-point Likert scale ranging from "very unpopular" to "very popular". Given a

reasonable internal consistency (Cronbach's alpha = 0.77), the responses on the 8 items were averaged for each participant to generate a score, with higher values implying higher popularity of risky behavior among peers.

Personality traits of the parents were investigated by administering to both fathers and mothers the *Sensation Seeking Scale* (Zuckerman, 1994), the *Trait Anxiety Inventory* (Spielberger et al., 1970), and *the Trait Anger Expression Inventory-2* (Spielberger, 1999) at the baseline. The version of the *Sensation Seeking Scale* used in the present study consisted of 10 items focusing on the thrill and adventure seeking, namely the tendency to participate in risky activities where speed and gravity defiance play a relevant role. Respondents were asked for each item to select one of two contradictory statements that better described their search for thrill. The version of the *Trait Anxiety Inventory* administered in the present study included 20 items investigating the cognitive, affective, and behavioral manisfestations of anxiety. Respondents were requested to note for each item the extent of agreement on a 4-point Likert scale ranging from "totally disagree" to "totally agree". The version of the *Trait Anger Expression Inventory-2* used in the present study comprised 10 items measuring the tendency of the individual to become angry in a variety of circumstances. Respondents were asked to express their feelings on a 4-point Likert scale from "almost never" to "almost always". As Cronbach's alpha values for both parents were satisfactory for sensation seeking (0.73 for mothers, 0.81 for fathers), anxiety (0.70 for both mothers and fathers), and aggression (0.77 for mothers and 0.79 for fathers), the responses were averaged over the respective items to produce three scores for each participant. Higher values in these three scores for mothers and fathers expressed higher tendency to search for thrill, higher level of trait anxiety, and higher level of trait aggression.

2.3. Model

The present study investigated the relationship between the rate of risky driving events for the young male drivers and the rate of risky driving events for their parents, the perception of family dynamics in terms of cohesion and adaptability, the perception of risky driving as popular among peers, the personality traits of fathers and mothers in terms of sensation seeking, anxiety, and aggression, and the effect of the feedback provided to teens and families.

The rate of risky driving events is expressed as the natural logarithm of the ratio between the number of risky driving events and the driving time as mentioned in the description of the instruments. A Poisson-based model within a full hierarchical Bayesian framework (Spiegelhalter et al., 2002) was selected for model estimation for three reasons: (i) the numerator is a count variable and hence a count data model is the appropriate selection; (ii) in the case that variables in the sample are not normally distributed, the Bayesian estimator is an asymptotically efficient estimator that relaxes the normality assumption of maximum likelihood estimation; (iii) in the case that the sample size is small, the Bayesian estimator allows estimating parameters without any constraint imposed on their distribution as well as considering over-dispersion and heterogeneity across observations. The base form of the Poisson-based model was expressed as:

$$E_i \sim \text{Poisson}(\lambda_i) \tag{1}$$

$$\log(\lambda_i) = \log(d_i) + \alpha + \boldsymbol{\beta}\boldsymbol{X_i} + v_i \tag{2}$$

where, for young male driver i, E_i is the observed number of risky driving events, λ_i is the expected Poisson event rate, d_i is the driving time, $\boldsymbol{X_i}$ is a vector of explanatory variables, v_i is a random term that captures the heterogeneity across drivers. The parameters to be estimated were the intercept α and the elements of vector $\boldsymbol{\beta}$, and it should be noted that the parameter for the driving time was constrained to be equal to one in order for the model to normalize the number of risky driving events by the actual driving time of the young male driver.

Two model formulations were tested by using the software package Openbugs (Lunn et al., 2009), namely a Poisson-lognormal and a Poisson-gamma model that were different in the specification of the error term v_i. In both models, a uniform prior distribution was assigned to the intercept α and a highly non-informative normal prior was assigned to all β's with zero mean and 100,000 variance (see, e.g., Spiegelhalter et al., 2002). In the Poisson-lognormal model, the prior distribution for the uncorrelated heterogeneity term v_i was a normal prior with $N(0, \tau_v^2)$ where τ_v^2 is the precision (i.e., the inverse of the variance)

Table 1
Means and standard deviations of study variables among young drivers and their parents.

Variable	Variable	Mean	st. dev.	Min	Max
Driving behavior	Number of risky driving events – young driver (events/hour)	105.582	153.759	2	1081
	Driving time – young driver (hours)	37.516	26.850	6.275	126.983
	Rate of risky driving events – young driver (events/hour)	2.940	4.380	0.060	37.980
	Rate of risky driving events – representative parent (events/hour)	1.380	1.620	0.060	9.060
	Intervention condition 1 – feedback to young drivers	0.238	0.427	0.000	1.000
	Intervention condition 2 – feedback to young drivers and their parents	0.762	0.427	0.000	1.000
	Intervention condition 3 – Parental training	0.508	0.502	0.000	1.000
Young driver	Family cohesion[a]	3.908	0.531	2.000	4.930
	Family adaptability[a]	3.447	0.452	1.930	4.600
	Peer risky driving[a]	1.788	0.461	1.000	3.130
Fathers	Sensation seeking[b]	1.423	0.272	1.000	2.000
	Anxiety[c]	1.446	0.299	1.000	2.800
	Aggression[c]	1.485	0.364	1.000	3.000
Mothers	Sensation seeking[b]	1.246	0.226	1.000	1.900
	Anxiety[c]	1.595	0.317	1.000	2.600
	Aggression[c]	1.567	0.359	1.000	2.900

[a] Scale 1–5.
[b] Scale 1 and 2.
[c] Scale 1–4.

with a vague gamma prior Gamma(0.5,0.001). In the Poisson-gamma model, the prior distribution for the $\exp(\nu_i)$ was gamma distributed as Gamma(φ,φ) where φ was assigned to a non-vague hyper prior with Gamma(0.1,1.0). All models were estimated using the Markov Chain Monte Carlo (MCMC) method under the full hierarchical Bayesian framework, and the deviance information criterion (DIC) was used to compare the goodness-of-fit and select the best model (Spiegelhalter et al., 2002).

The two model formulations were tested with the same vector X_i of explanatory variables including the observation of driving behavior and the answers to the scales administered to the young male drivers and their parents. Considering the observation of driving behavior, explanatory variables included the rate of risky driving events of the parents and the indicators relative to the different feedback schemes. Considering the answers of the young male drivers to the *Family Adaptability and Cohesion Evaluation Scales III*, averages were computed over the items relative to family cohesion and family adaptability. Considering the answers of the young male drivers to the *Popularity of Risky Driving among Friends*, averages were calculated over the items relative to the propensity of their peers to engage in risky driving behavior. Last, considering the answers of fathers and mothers of the young male drivers to the *Sensation Seeking Scale*, the *Trait Anxiety Inventory*, and the *Trait Anger Expression Inventory-2*, averages were assessed for each parent over the items relative to their sensation seeking tendency, level of anxiety, and level of aggression. Interaction terms between the explanatory variables were also considered in the final model specification.

3. Results

3.1. Sample characteristics

The sample included 121 young male drivers satisfying the prerequisites for the analysis and focused on the relation of their driving behavior with the driving behavior of their parents, their perception of family and peer dynamics, and the personality of their parents.

The dataset characteristics are presented in Table 1. The number of events per driving time hours has an average value equal to 2.940, a standard deviation equal to 4.380, and its distribution presents a very strong asymmetry as indicated by a skewness equal to 5.043. When considering the natural logarithm of this ratio, the average is 2.952, the standard deviation is 4.391, and asymmetry emerges as a tail towards negative values as suggested by a skewness equal to 5.038. A Kolmogorov–Smirnov test ($D_{121, max} = 0.301 > D_{121,0.05} = 0.129$, n.s.) rejected the hypothesis of normal distribution of the natural logarithm of the number of events per driving time hours, thus rejecting the possibility of estimating hierarchical regression models or structural equation models (SEM) and accepting the suitability of count data models for the observed data. It should also be noted that the Bayesian estimator was suitable for small sample sizes that further rejected the possibility of estimating SEM (Westland, 2010).

From the driving behavior perspective, data were recorded for both parents only in 70 families out of the 121 sampled in this study. However, families mostly owned two cars and designated one as the experimental car with the IVDR installed. Accordingly, one parent usually drove the same car used by the young male driver, while the other parent drove another car. For the purpose of understanding the relationship between risky driving behavior of the young male drivers and one of their parents, the present study considered the risky driving behavior of the parent actually setting the example by driving the same car as the young male driver and defined this parent as the representative one.

From the questionnaire perspective, higher values in the averages of the answers to the family cohesion, family adaptability and peer risky driving items indicated for young male drivers a propensity to perceive stronger bonding in the family, greater equilibrium between stability and change, and higher popularity of risky driving among peers. Higher values in the averages of the answers to the sensation seeking, anxiety, and aggression indicated for both fathers and mothers a higher tendency to look for thrill, to manifest anxiety, and to become angry. For the purpose of understanding the relationship between risky driving behavior of the young male driver and his parents' personality traits, the present study considered the traits of both parents.

3.2. Model estimates

Model estimation aimed at finding the best specification to explain the risky driving behavior of the young male drivers and the best formulation to fit the observed data. The best specification was searched for by testing for significance several explanatory variables and their interactions, while the best formulation was looked for by calculating the DIC. Notably, the comparison of the DIC with every model specification always resulted in better fit for the Poisson-gamma model, and hence results will be presented only for the best specification of the Poisson-gamma model.

The best model was specified as:

$$\begin{aligned}
\log(\lambda_i) = {} & \log(d_i) + \alpha + \beta_{\mathrm{rrde}} \times \ln(\mathrm{rrde}_i) + \beta_{\mathrm{famfb}} \times \mathrm{famfb}_i \\
& + \beta_{\mathrm{partr}} \times \mathrm{partr}_i + \beta_{\mathrm{famcoh}} \times \mathrm{famcoh}_i + \beta_{\mathrm{famad}} \\
& \times \mathrm{famad}_i + \beta_{\mathrm{rrpfamcoh}} \times \mathrm{famcoh}_i \times \ln(\mathrm{rrp}_i) + \beta_{\mathrm{rrpfamad}} \\
& \times \mathrm{famad}_i \times \ln(\mathrm{rrp}_i) + \beta_{\mathrm{peer}} \times \mathrm{peer}_i + \beta_{\mathrm{fss}} \times \mathrm{fss}_i + \beta_{\mathrm{fanx}} \\
& \times \mathrm{fanx}_i + \beta_{\mathrm{faggr}} \times \mathrm{faggr}_i + \beta_{\mathrm{mss}} \times \mathrm{mss}_i + \beta_{\mathrm{manx}} \\
& \times \mathrm{manx}_i + \beta_{\mathrm{maggr}} \times \mathrm{maggr}_i + \nu_i
\end{aligned} \quad (3)$$

where rrde_i is the rate of risky driving events of the representative parent, famfb_i is equal to 1 if the family received feedback (and 0 otherwise), partr_i is equal to 1 if the parents received training (and 0 otherwise), famcoh_i and famad_i are the averages of the items relative to family cohesion and adaptability, peer_i is the average of the items relative to peer risky driving, fss_i and mss_i are the averages expressing the respective sensation seeking tendency for father and mother of young driver i, fanx_i and manx_i are the averages representing the respective anxiety level for father and mother of young driver i, and faggr_i and maggr_i are the averages conveying the respective level of aggression for father and mother of young driver i.

The posterior means and standard deviations of the intercept α, the β's for the explanatory variables and the standard deviation of the error term accounting for heterogeneity were estimated using the MCMC method. Two chains were simulated with different initial values and the initial 25,000 iterations were discarded as burn-ins to reach convergence of the two chains. Additional 75,000 iterations for each chain were run in order to calculate the posterior means and standard deviations of the estimated parameters. Table 2 presents the results of the model estimation by reporting for each parameter the mean of the estimate, the standard deviation of the estimate, and the significance level that indicates whether 90% or 95% of the distribution of the estimate has the same sign. Moreover, Table 2 presents an interpretation of the average effect size by considering that the exponential of the mean estimate expresses the average effect.

The posterior mean of the standard deviation of $\exp(\nu)$ is significantly different from zero, thus suggesting that heterogeneity exists in the driving behavior observations. Moreover, the comparison of the DIC between the Poisson-gamma and the Poisson-lognormal for the best model specification confirms that the former is the best model with a value equal to 580.987 that is

Table 2
Mean, standard deviation, significance level and effect size of the parameter estimates for the Poisson-gamma model.

Parameter	Variable	Mean	st. dev.	Sig.	Effect
β_{rrde}	Rate of risky driving events of the representative parent	1.255	0.347	*	3.508
β_{famcoh}	Family cohesion	−0.377	0.176	*	0.686
β_{famad}	Family adaptability	−0.101	0.184		0.904
$\beta_{rrpfamcoh}$	Rate of risky driving events of the representative parent × family cohesion	−0.372	0.159	**	0.689
$\beta_{rrpfamad}$	Rate of risky driving events of the representative parent × family adaptability	−0.243	0.153	*	0.784
β_{fss}	Father's sensation seeking	0.337	0.157	**	1.401
β_{fanx}	Father's anxiety level	0.329	0.167	**	1.390
β_{faggr}	Father's aggression level	0.253	0.148	*	1.288
β_{mss}	Mother's sensation seeking	0.203	0.187		1.225
β_{manx}	Mother's anxiety level	0.403	0.160	**	1.496
β_{maggr}	Mother's aggression level	−0.140	0.144		0.869
β_{peer}	Perception of peer risky driving	0.356	0.098	**	1.428
β_{famfb}	Feedback to young drivers and their parents	−0.263	0.121	**	0.769
β_{partr}	Parental training	−0.274	0.103	**	0.760
α	Intercept	1.437	0.732	*	
Sigma(ν)	Heterogeneity	0.599	0.038	**	

* Statistically significant difference from zero (90% credible set shows the same sign).
** Statistically significant difference from zero (95% credible set shows the same sign).

lower than the value equal to 593.957 for the latter. The estimates for feedback being given to young drivers and parents and training being provided to parents confirm previous findings about intervention groups contributing in lowering event rates compared to a control group receiving no intervention (Farah et al., 2014).

Table 2 indicates that, in line with our hypothesis, the risky driving behavior of young male drivers is strongly correlated with the one of the representative parent. In accordance with our hypothesis, family dynamics are also associated with the risky driving behavior of young male drivers. Whereas only the perception of higher family cohesion has a significant main effect on lower rates of risky driving events for young male drivers, both cohesion and adaptability of the family have an interaction effect with the example set by the representative parent. Both interaction effects are negative, as to suggest that family cohesion and adaptability mitigate the impact of the risky behavior by the representative parent. In partial confirmation of the research hypothesis, personality traits of the parents are also correlated with the risky driving behavior of young male drivers. Interestingly, the three traits investigated are all significant only for the fathers, while only the anxiety level is significant also for the mothers. The signs of the parameter estimates for these variables are all positive to indicate that a larger number of risky driving events is recorded per unit of driving time when the parents manifest a higher level of sensation seeking, anxiety, and aggression. Again in line with our hypothesis is the finding that risky driving behavior of the young male drivers is positively related to the perception that their peers take risks on the road. Finally, partially in line with the research hypothesis, presenting feedback to teens reduces their rate of risky driving events only when the parents are involved, either more passively in the consultation of their offspring's driving behavior or more actively in the participation in a parental training program.

4. Discussion

The current study aimed at taking a step forward and offer a multi-faceted regard to the contribution of parents to their offspring's driving. More specifically, it took a deeper look at a set of associations between teens' risky driving and parents' personality, family dynamics, and perceived popularity of risky driving among peers, while controlling for the parent's driving behavior. To this purpose, the study combined self-report tools with an actual measure of driving behavior obtained by an IVDR.

The findings generally confirmed our hypotheses. More specifically, higher risky driving by parents was found to be positively related to higher risky driving by their male offspring, in accordance with earlier studies (e.g., Prato et al., 2010; Taubman – Ben-Ari et al., 2005; Wilson et al., 2006). In addition, the importance of the family relationships (Simons-Morton et al., 2003) is highlighted in the current study, as teens' perceptions of positive family dynamics seem to mitigate negative role modeling by the parents. Thus, beyond the benign strength associated with higher cohesion in the family, when the young driver feels a stronger bonding within the family and perceives his family as more adaptable to different situations, these positive aspects of the family atmosphere moderate potential negative effects of parents' driving behavior.

Moreover, parents' own personality, and especially the one of the father, was associated with the male young drivers' risky driving. Thus, fathers who reported higher sensation seeking and higher levels of anxiety and aggression, as well as mothers who reported to be more anxious, contributed to the higher endorsement of risky driving by their offspring. While these personality traits are known to be related to the individual's own risky tendencies (e.g., Oltedal and Rundmo, 2006; Schwebel et al., 2006), it is evident that the parents' personality, to which young drivers are exposed their entire lives, also contributes to their style of driving (e.g., Miller and Taubman – Ben-Ari, 2010). The importance of the parents' role in teen drivers' risk taking is also evident from the finding that any kind of parents' involvement in their offspring's driving, by either receiving feedback from the IVDR or undergoing parental training, brings about a reduction in the rate of the teens' risky driving events as compared to a control condition.

Finally, the perception of risky driving as popular among peers is also associated with teens' risky driving. This finding is in line with the literature (e.g., Shope et al., 2003; Taubman – Ben-Ari and Katz – Ben-Ami, 2012), and establishes the importance of a holistic outlook on the phenomenon of young drivers' tendency to drive recklessly as a multifaceted problem embedded in their close environment. This understanding points to the need to design interventions that are both specifically oriented at driving as well as more generally dealing with family and social relations that may be combined and inter-related.

The current findings offer important insights into the contribution of parents to the risky driving of young drivers by highlighting the need to work with parents to reflect on how they drive, their own behavior (which is revealed more generally in their personalities and more specifically in their actual driving), and the atmosphere at home. Thus, it seems that truly effective interventions would not start when teens are eligible to receive a driving license, but much earlier in the educational process – while helping parents build positive, resourceful relationships with their children, which may provide the basic shield against risky behavior over the years.

5. Limitations and conclusions

5.1. Strengths and limitations

It is important to note that the current study is unique as it brings to light the complex nature of parents' influences, comprising both parents' and young drivers' points of view, consisting on tryads (father, mother, son) within the family, and using objective behavioral measures (IVDR) as well as self-report instruments. It also examines the associations of both parents' and peers' in the same statistical model. However, a limitation of the study is that it is based on a non-representative sample, with a bias toward educated and medium-to-high economic status, and only male young drivers. Future studies would do well to ascertain the ability to generalize these findings to more representative samples, and to find ways to address different population characteristics including referring to women. Further studies employing additional personality and attitudinal measures may be able to provide a fuller picture of family dynamics and their interactions with peer influences as contributors to the risky driving of young drivers.

5.2. Conclusions

Our study joins previous research (e.g., Taubman – Ben-Ari and Katz – Ben-Ami, 2013; Taubman – Ben-Ari et al., 2014) in showing that, beyond the parents' driving behavior, the family climate and the family members' attitude toward road safety significantly contributes to teens' driving behavior. They also validate previous findings regarding the importance of the peer norms as contributors to risky driving (e.g., Allen and Brown, 2008; Shope et al., 2003; Simons-Morton et al., 2011).

We are confident that this understanding would help professionals to design productive interventions, which stress the importance of parents' commitment to road safety, while not ignoring the important role peers play as models for risk taking behavior. We believe that parents who are able to design empowering and positive relationships with their children, will in fact provide the elementary buffer against their risky driving behavior.

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