European Transport Research Review (2018) 10: 6
https://doi.org/10.1007/s12544-017-0282-4

ORIGINAL PAPER

The role of fines and rewards in the self-regulation of young drivers

Wafa Elias[1]

Received: 11 August 2016 / Accepted: 7 December 2017 / Published online: 18 December 2017

Abstract

Purpose The current study examined the relations between objective and subjective measures of driving patterns, focusing on traffic violations. In addition, the study explored the potential use of rewards in order to modify driving behaviors and examined the relationship between attitudinal and demographic variables and the frequency of speeding.
Method We acquired subjective and objective data on driving behaviors in a sample of 114 young student drivers in Israel's Southern region. We used a survey to acquire data on the participants' history of violations, self-reported driving behavior, and subjective attitudes towards risks and fines. We then examined the participants' objective driving behaviors using Get Location, a specifically designed smartphone application.
Results We found a substantive gap between subjective and objective data regarding traffic violations, but they were also significantly correlated. The demographic variables, including gender, failed to distinguish between frequent and non-frequent speeders, while attitudinal variables succeeded. Frequent speeders required a significantly higher potential reward, as well as a higher fine to motivate behavioral changes.
Conclusion Self-reported data can serve as a reasonable proxy for measuring the tendency to adopt particular driving patterns, including the tendency to engage in violations. In addition, the use of rewards can complement or possibly replace the reliance on negative sanctions in order to modify behavior.

Keywords Young drivers · Reward · Speeding · Fines · Behavioral change

1 Introduction

One of the central goals of traffic safety interventions is the modification of driver behavior [9, 26]. This requires several related tasks: understanding the motivational factors leading to risky driving behavior, measuring driving behavior in a reliable and valid manner, developing interventions, and evaluating the effectiveness of these interventions. The current paper reports on an exploratory study into the first two steps, namely, understanding motivations and measuring behaviors, in order to promote and support the latter steps.

Studies of driving behavior usually rely on self-reported assessments, but the validity of this method has been questioned [6, 28], in particular with regard to speeding [5]. In order to assess the validity of self-reported assessments, we obtained both objective and subjective data on driving behaviors, including violations. In addition, traffic safety interventions usually seek to change behavior by relying on the deterrence paradigm [21, 23]. We complemented this approach by exploring the potential role of rewards in motivating behavioral change. Finally, we explored the relationship between objective measures of driver behavior and individual-level attitudinal variables. The current study examined driving behavior among 114 young drivers in Israel, focusing on speeding violations (hereafter speeding). Numerous studies conducted in different countries found that young drivers suffer from a disproportionate risk of crashing [15, 32]. In Israel, a recent report by the Israeli National Road Safety Authority (RSA) found that during 2015, 71% of young drivers (aged 24 and below) who were involved in a fatal accident committed a traffic violation, compared to 58% of drivers aged 25–44

This article is part of Topical Collection on The role of planning towards sustainable urban mobility

✉ Wafa Elias
wafael@sce.ac.il; wafate@walla.com

[1] Shamoon College of Engineering, Civil Engineering, 84 Jabotinsky St, 77245 Ashdod, Israel

and 54% of those aged 45–64 years old [12]. A common violation exacerbating both the risk of crashing and the potential of its severity is speeding [26]. In Israel, speeding has been identified as the major cause of fatal accidents amongst 28% of young drivers involved in an accident, compared with only 13% amongst drivers aged 25–64 [12].

The results of the current study show a significant correlation between self-reported assessments of speeding and objective measures, suggesting that self-reports can be used to assess trends in driving behaviors. We also found that the magnitude of rewards necessary to motivate self-regulation was significantly smaller than fines. We discuss the implications for future research and policymaking below.

2 Theoretical background

Much of the information on driving behavior is derived from official documentations of traffic violations, mandated for specific population groups rather than individuals. However, this method fails to account for unreported violations. Alternatively, unrecorded violations may be found in other studies that relied on self-reported behavior. This subjective measure, however, may be biased due to cultural norms or experimenter effect (expectancy bias) [17]. Previous studies have found significant differences between self-reported and observed driving behavior [10]. The current study examined both subjective and objective aspects of driving behavior, using a smartphone application especially designed for the study.

Speeding is common and persistent. For example, over the last decades speeding has increased in the US while other risky behaviors, such as driving without a seatbelt, decreased significantly ([26], pp. 273–4). In 2013, just over 10% of reported traffic violations in Israel was due to speeding [3]. This, most likely, is a significant underestimation. Results from the 2010 survey carried out as part of the SARTRE project (Social Attitudes to Road Traffic Risk in Europe), in which speeding was defined as driving at 20 km/h over the limit, suggest that 24% of Israeli driver claim to enjoy driving above the speed limit. Twenty percent believe that speeding does not increase the risk of being involved in an accident, 36% agree that most of their friends are likely to engage in speeding in a residential area, and 63% believe that car drivers speed very often or always on motorways [24]. As a rule, males tend to speed more than females [25, 33], and some studies have found a significant positive correlation between income and speeding [30].

Numerous studies have argued that young males are more likely to speed compared to other groups, citing reasons as peer pressure, lack of driving experience, a greater tendency for thrill-seeking, or inappropriate parental modelling [2, 4, 18, 27, 29]. Excluding inexperience, all these rationals share the same assumption that young drivers expect some benefits from engaging in risky driving behaviors. Accordingly, interventions seeking to modify such behaviors have usually relied on the deterrence paradigm, suggesting that people fear sanctions and change their behaviors in order to avoid them [21, 23]. The question, according to this formulation, is how to change the equation so that the perceived risks of unsafe driving (e.g. injuries or arrests) will outweigh its potential benefits. Attempts to reduce the potential benefits of risky driving include fines of varying magnitudes, revoking the driver's license, and attempts to modify the social acceptability of such behaviors among the young driver's peer group [34]. However, the potential of rewards as tools for modifying driving behaviors, including speeding, remains understudied.

The potential benefits of using rewards are clear when considering how individuals decide to engage in speeding. As a rule, a full cost-benefit analysis rarely precedes individual decision making, especially given the immediacy in which decisions are made while driving [31]. Rather, individuals make use of cognitive aids and shortcuts such as heuristics. Studies have shown that particular constellations of rewards can influence decision making beyond their objective value in a cost-benefit analysis [13]. Accordingly, the use of rewards may be particularly beneficial to motivate behavioral change.

3 Method and analysis

The population of the study was made up of 114 student volunteers studying at and living near either one of the two campuses of the Shamoon College of Engineering in the south of Israel, Ashdod and Be'er Sheva (see Table 1). All the volunteers responded to a text message invitation sent to their phones. The invitations were sent to all students enrolled at three engineering programs (construction, industrial management and computer). As an incentive, participants were offered 300NIS (3.9:1$) at the completion of the study. The average participant was male, young, unmarried, and with a low income. The average driving experience was about 8 years. As a preliminary study of driving behaviors and the impact of rewards and fines, it is representative of youth in Israel, specifically those who study engineering at the academic level.

The study made use of a unique smartphone application named "Get Location", which monitors the driver's location and speed (see Fig. 1). We asked the drivers to turn on the application whenever they began driving and turn it off when arriving at the destination. We then superimposed data from Get Location on a GIS map of Israel, which includes data on the legal speed on all road segments in Israel. This allowed us to identify when and where had a driver exceeded the speed

Table 1 Socio-demographic characteristics of the participants

Average age (s.d.)	26.1 (3)
Male	81%
Marital status (Married)	17%
Income	
Below average	88%
About average	9%
Above average	3%
Driving experience in years (s.d.)	8.2 (2.4)

limit. We defined a speeding event as passing the speed limit by at least 20 km/h for up to 10 s. Thus, if a certain driver drove over the speed limit for 27 consecutive seconds, Get Location recorded three speeding events in total.

With relation to the frequency of driving we found a gap between the self-reported average number of trips and the data recorded using Get Location (4.2 vs 3.7). This might suggest that Get Location was not used to record all trips made, but rather approximately 88% of them. It could also indicate students' tendency to underestimate how often they drive.

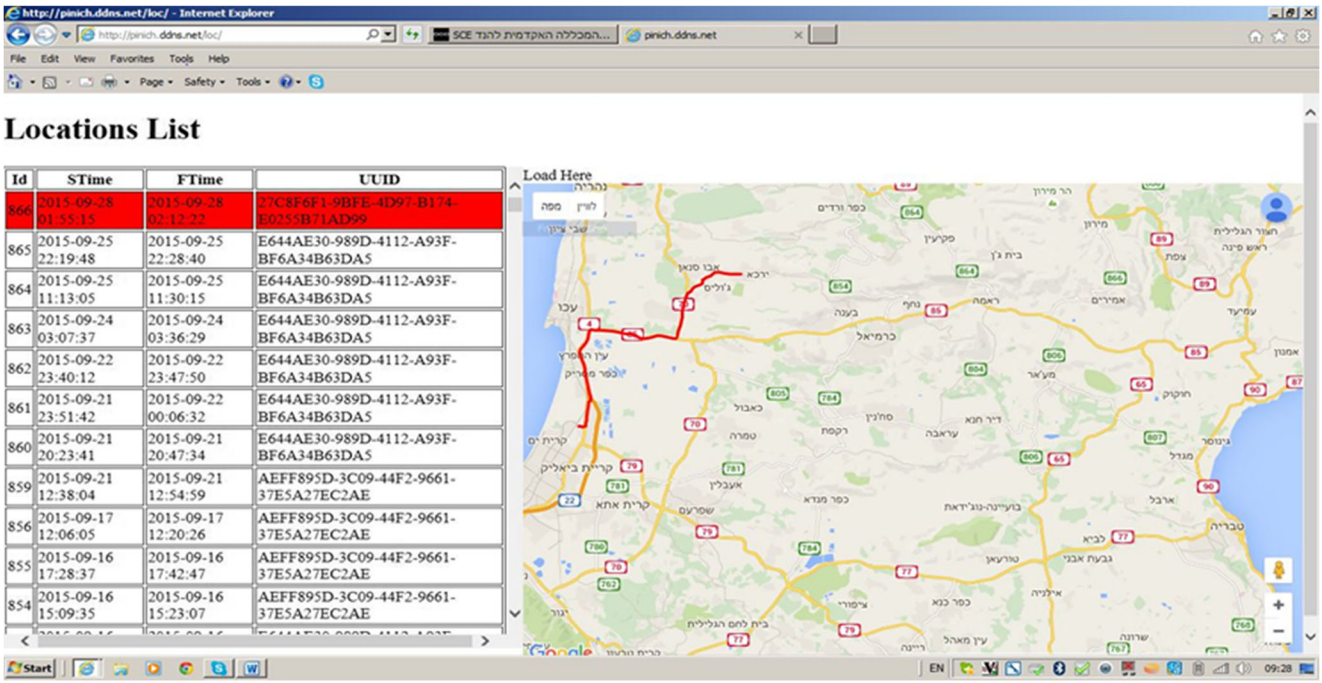
We collected subjective data on driving behaviors using an on-line survey. The survey questions covered driving patterns, attitudes about speeding in various contexts, risk perceptions accompanying each context, risk-taking during driving (measured on a scale of 1 to 7, with 1 being "no chance" and 7 "a high chance"), the frequency of near-accident events, and the perceived effectiveness of rewards versus fines. In addition, we collected data on socio-demographic characteristics to assess their association with self-reported driving patterns. We allocated each participant a unique identifier, allowing us to track his or her performance throughout the research.

The study focused on speeding, which was the most common violation in the sample (see Table 2). We divided the drivers into two groups: high frequency of speeding, including both those who reported speeding often or very often, and low frequency of speeding, including both those who reported speeding rarely or never. We attempted to identify variables associated with these groups, using chi-square tests for categorical variables and t-test to examine such differences for continuous variables.

We conducted a factor analysis, in which 40 attitudinal statements were subjected to principal component analysis with Varimax rotation, and used the results to identify several attitudinal variables. We then examined the influence of these variables and demographic variables on speeding frequency using a logistic regression model.

4 Results

Table 2 describes the frequency of prominent self-reported traffic violations among the participants over the last 3 years. Speeding, defined as driving at a speed of 20 km/h or more over the limit, is the most common type of traffic violation: about a third (35.2%) of the participants never or rarely drove over the speed limit, and a little less than a third (31.5%) drove over the limit very often. In comparison, other violations were significantly rarer: under 2% reported that they "very often" do not yield the right of way, ignore a stop sign, or run a red



Id	STime	FTime	UUID
866	2015-09-28 01:55:15	2015-09-28 02:12:22	27C8F6F1-9BFE-4D97-B174-E0255B71AD99
865	2015-09-25 22:19:48	2015-09-25 22:28:40	E644AE30-989D-4112-A93F-BF6A34B63DA5
864	2015-09-25 11:13:05	2015-09-25 11:30:15	E644AE30-989D-4112-A93F-BF6A34B63DA5
863	2015-09-24 03:07:37	2015-09-24 03:36:29	E644AE30-989D-4112-A93F-BF6A34B63DA5
862	2015-09-22 23:40:12	2015-09-22 23:47:50	E644AE30-989D-4112-A93F-BF6A34B63DA5
861	2015-09-21 23:51:42	2015-09-22 00:06:32	E644AE30-989D-4112-A93F-BF6A34B63DA5
860	2015-09-21 20:23:41	2015-09-21 20:47:34	E644AE30-989D-4112-A93F-BF6A34B63DA5
859	2015-09-21 12:38:04	2015-09-21 12:54:59	AEFF895D-3C09-44F2-9661-37E5A27EC2AE
856	2015-09-17 12:06:05	2015-09-17 12:20:26	AEFF895D-3C09-44F2-9661-37E5A27EC2AE
855	2015-09-16 17:28:37	2015-09-16 17:42:47	AEFF895D-3C09-44F2-9661-37E5A27EC2AE
854	2015-09-16 15:09:35	2015-09-16 15:23:07	AEFF895D-3C09-44F2-9661-37E5A27EC2AE

Fig. 1 Sample of the Get Location application

Table 2 Self-reported history of traffic violations over the last 3 years

Violation	Never	Rarely	Often	Frequent	% caught
Not yielding the right of way	50.0%	40.7%	7.4%	1.9%	4%
Ignoring a stop sign	72.2%	23.1%	3.7%	0.9%	6%
Ignoring a red light	88.9%	8.3%	0.9%	1.9%	5%
Using a cellular phone	28.7%	30.6%	29.6%	11.1%	6%
Speeding (interurban road)	14.8%	20.4%	33.3%	31.5%	6%

light; less than 12% reported using a cellular phone "very often". This corresponds to the tendencies in Israeli society reported above [24].

We also examined the association between categorical demographic variables and the frequency of speeding based on self-reporting, using a chi square test. Gender, marital status, and the presence of children failed to distinguish between frequent speeders and non-frequent speeders. In addition, we did not find a significant correlation between the frequency of speeding and two continuous variables, age ($p = 0.977$) and driving experience ($p = 0.116$). Using T-test to compare between frequent and non-frequent speeders Table 3 shows the acceptance of risky behaviors. Frequent speeders were significantly more likely than non-frequent speeders to agree with several statements expressing risky behaviors, including driving without enough sleep, speeding to reach destination in time, and using a cell phone for personal purposes while driving. Frequent speeders were also more likely to agree with all other statements examined here compared to non-frequent speeders, but differences were not found to be statistically significant.

Table 4 presents the results of a T-test comparing between tendencies of frequent and non-frequent speeders responding favorably to certain statements (measured on a scale of 1–7). Frequent speeders were significantly less likely to believe that speeding at 20 km/h or 30 km/h over the limit contributes to a higher traffic accident risk factor. We also used a chi-square test to compare the distribution of perceived risk of being apprehended as a factor of speeding frequency (Fig. 2), however significant differences were not found ($\chi 2 = 6.074$, df = 4, $p = 0.194$).

Table 5 reports on a comparison between the attitudes of frequent speeders and non-frequent speeders towards the magnitudes of fines and rewards necessary to modify behavior, using Univariate Analysis of Variances. Sums are reported in New Israeli Shekels (NIS; 1 USD was equivalent to about 3.7 NIS during the study period). Frequent speeders demanded significantly higher rewards to motivate behavioral change – an average of 2905 NIS compared to 933 NIS among non-frequent speeders (F = 4.82, Partial Eta = 0.043, $p = 0.03$). Similarly, frequent speeders required a higher fine to deter them from speeding – an average of 3041 NIS compared to 831 NIS among non-frequent speeders (F = 14.73, Partial Eta = 0.124, $p = 0.000$). Frequent speeders also showed a higher variance with regard to the magnitudes of both fines and rewards deemed necessary to influence their behavior.

Next, we examined the association between self-reporting on speeding in the survey and the objective measures acquired using Get Location, calculated for the sample as a whole. Using a Pearson Correlation Test, we found a statistically significant correlation between the reported tendency to engage in violations and the actual number of violations recorded ($r = 0.294$, $p = 0.027$). In other words, drivers who committed more speeding violations were also more likely to report more

Table 3 Degree of agreement with statements indicating risky behavior, in relation to the frequency of speeding

Statement	General sample	High frequency ($n = 54$) (avg. ± s.d.)	Low frequency ($n = 55$) (avg. ± s.d.)	*P* value
Sometimes I drive even though I did not get enough sleep	**4.22 (1.83)**	**4.72 (1.67)**	**3.73 (1.85)**	***.004***
I use my cellular phone to make personal calls while driving	3.27 (1.96)	3.63 (2.08)	2.91 (2.91)	*.055*
I use my cellular phone to make work-related calls while driving	3.11 (1.90)	3.43 (1.93)	2.80 (1.51)	*.086*
Sometimes I am less focused on driving due to personal problems	3.27 (1.88)	3.39 (1.98)	3.15 (1.79)	*.503*
Sometimes I drive even though I know that the air pressure in my tires is low	2.96 (1.80)	3.24 (2.04)	2.69 (1.52)	*.113*
Sometimes I drive over the speed limit to reach my destination on time	**4.53 (1.86)**	**5.32 (1.64)**	**3.77 (1.76)**	***0.000***
Sometimes, when traffic is congested, I drive on the shoulder to reach my destination on time	1.40 (1.02)	1.33 (0.99)	1.47 (1.05)	*.478*
Sometimes I drive backwards (in reverse) while listening to loud music	2.02 (1.49)	2.24 (1.66)	1.82 (1.23)	*.140*
Sometimes I accelerate before a traffic light in order to pass it while it is green, and then I almost hit the car in front of me	2.11 (1.44)	2.35 (1.66)	1.87 (1.14)	*.082*

Table 4 Perceived contribution of different causes to the risk of being involved in a car crash in relation to the frequency of speeding

Statement	High frequency ($n = 54$) (avg. ± s.d.)	Low frequency ($n = 55$) (avg. ± s.d.)	P value
I believe that speeding at 20 km/h over the limit in an interurban road contributes to the risk of being involved in a traffic accident	2.87 ± 1.78	3.60 ± 1.78	*0.035*
I believe that speeding at 30 km/h over the limit in an interurban road contributes to the risk of being involved in a traffic accident	3.61 ± 1.93	4.64 ± 1.77	*0.005*

violations. We also found a positive and significant correlation between the magnitude of the sum required for a fine to deter drivers from speeding and the distance driven while speeding ($r = 0.415$; $p = 0.001$). In other words, drivers who cover more distance while speeding are more likely to require a higher fine to deter them from speeding. However, we did not find the same correlation between the distance driven while speeding and the magnitude of the reward necessary to deter one from speeding. We found no significant correlations between self-reported frequency of speeding and the distance covered while speeding or between the duration of speeding and the perceived level of risk.

Finally, we conducted a factor analysis to identify the relationship between attitudinal variables and the frequency of recorded speeding. After excluding one factor (Self-Control) which failed to demonstrate internal reliability (Cronbach's Alpha > 0.65), we maintained seven factors: (1) Speeding Risk perception, (2) Friends' driving behaviour, (3) Friends' acceptance, (4) Friends' subjective norms, (5) Parents' subjective norms, (6) Risk taking, (7) Near accident. The components of these variables are summarized in Table 6.

Table 7 presents the estimated results of the frequency of speeding model. The table includes a list of variables and their description, the estimated coefficients, and the t-test values of these estimators and the significance value. The demographic variables, including gender, marital status, and the presence of children failed to have significant impact on the frequency of speeding and were therefore excluded from the model. Higher income was significantly and negatively correlated with frequency of speeding when examined for observed behavior. Six attitudinal variables influenced the frequency of observed speeding violations significantly. Risk perception was inversely correlated with speeding. In contrast friends' driving behavior exerted a significant positive impact on speeding. This suggests that friends' driving behavior may influence the driver's behavior. Similarly, participants having a higher frequency of risk taking, involvement in near accident events are more likely to speed over the limit. We also found a significant and negative correlation between speeding and agreeing with the following statement: "I believe I need to maintain a reasonable speed even if I am driving with friends who usually speed over the limit", used to assess self-control.

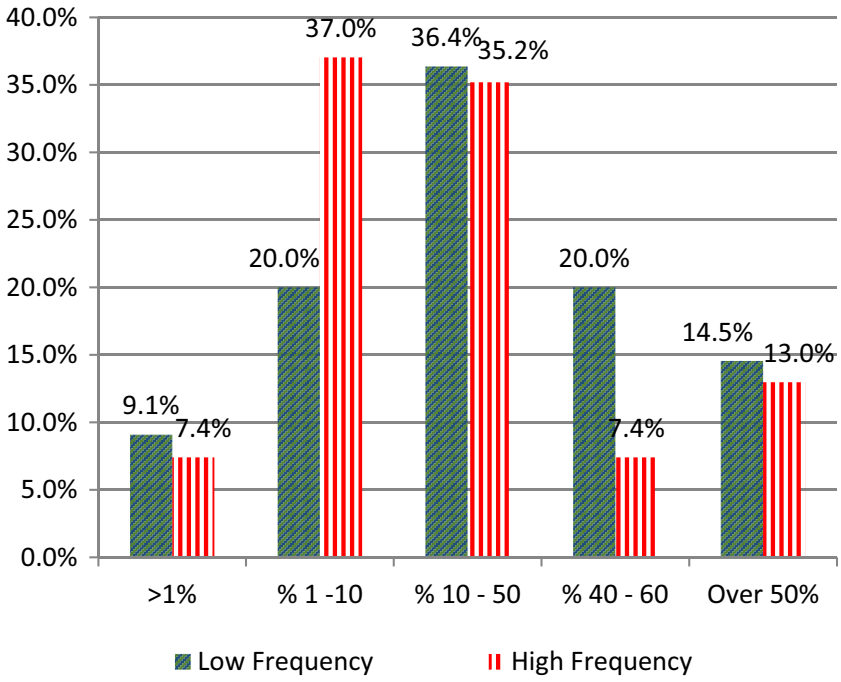


Fig. 2 Perceived risk of being apprehended by the police while committing a traffic violation on an interurban road in relation to the frequency of speeding

Table 5 frequency of speeding in relation the magnitude of fines/rewards in motivating a behavior

	Frequent speeders; $n = 54$	Non-frequent speeders; $n = 55$	p value
What size of a monthly reward would motivate you to avoid any speeding of 20 km/h or more over the limit?	2905.07 ± 1633.02	933.18 ± 728.25	0.03
What size of a fine would deter you from ever speeding 20 km/h or more over the limit?	3045.09 ± 2354.23	831.13 ± 703.72	0.00

We also found a positive correlation between speeding and the size of the fine required to modify a behavioral change and the more speeding the higher the fine needed. In other words, the more a participant speeds, the higher the fine needs to be to change their travel behavior.

5 Discussion

The current study used an innovative method to obtain objective measures for driving violations at the individual level by using a self-application that monitored the participant's driving patterns *in situ*. The objective measures were coupled with a subjective self-reported assessment of the frequency of violations. In addition, the study examined the relationship between attitudinal and demographic variables and the frequency of self-reported speeding, and explored the potential use of rewards to motivate behavioral change that will reduce such driving behavior. Finally, we explored the relationship between objective driving behavior and individual-level data on attitudes and demographic characteristics.

We found a significant correlation between self-reporting on the tendency to engage in speeding and the objective measures acquired using Get Location. This suggests that studies can rely on self-reported data to identify trends in driver behaviors, including violations. However, given the well-established tendency of drivers to overestimate their driving capabilities [1, 7, 20], data derived from such self-reporting should be used to evaluate driving trends but not the actual magnitude of these phenomena. At the same time the ease at which participants used the application suggests that existing technological platforms have already created self-monitoring services that are in wide use. Thus, research the same type of methodology could be used to better understand driving behavior at the individual level.

Table 6 Summary of the factor analysis

Factor	Mean	Variance	Cronbach's Alpha
Risk perception	3.684	1.746	0.864
Friends' driving behavior	3.242	1.281	0.746
Friends' acceptance	3.242	0.020	0.870
Friends' subjective norms	2.263	0.419	0.735
Parents' subjective norms	5.972	0.166	0.814
Risk taking	3.402	1.012	0.784
Near accident	2.263	0.213	0.769
Self-Control	5.147	0.468	0.468

The results of the estimation model demonstrate that none of the demographic variables proved to be efficient in trying to distinguish between frequent and non-frequent speeders. This includes gender, which is in contrast to previous studies [14, 22, 33]. However, this finding should be viewed with caution given the low proportion of females in the sample (19%). We did not examine age due to homogeneity of the sample in that dimension. In contrast to previous studies [30], our results show a negative relationship between income and speeding. This result may derive from the fact that the participants were students, whose income distribution is different from those of other population groups.

Attitudinal and interpersonal variables proved efficient in distinguishing between frequent and infrequent speeders. Drivers who viewed speeding as less risky, were more likely to speed, [11, 25]. In addition, friends' driving behavior, as perceived by the driver, was shown to have a significant and positive correlation with the risk of being a frequent speeder, and so did risk perception in general; in other words, people who believe that their friends tend to speed, and people who tend to take more risks in general, were more likely to become frequent speeders. We found that a higher level of self-control was correlated with speeding, perhaps demonstrating the tendency to overestimate one's driving capabilities as discussed above. The relationship between attitudinal and interpersonal variables is of significance when viewing it from the complementary qualities of the objective and subjective measures and tools used. Self-monitoring application on personal devices use a similar model and in away normalize the corresponding behaviors of self-monitoring and self-reporting. The strong reliance on interpersonal considerations suggests the possible advantage of using data gathering techniques that already exist in society at large.

Finally, we found evidence that the use of rewards can influence driving behaviors, including speeding. This is consistent with several previous studies that exhibited their usefulness in reducing speeding tendencies [8, 19]. To stress the matter further, this approach follows the model for human behavior used by the deterrence paradigm [21, 23], but utilizes it in order to underlie the potential benefits

Table 7 Estimation results of the speeding violations model

Variable	β	t-statistic	Sig.
Constant	−3.68	2.69	.007
Income (Ordinal variable)	−1.59	2.43	.015
Speeding Risk perception	−.369	2.29	.022
Friends' driving behavior	.633	2.34	.020
Risk taking	.455	2.04	.041
Near accident	.634	2.10	.036
Self-control (I believe I need to maintain a reasonable speed even if I am driving with friends who usually speed over the limit).	.259	1.93	.053
What magnitude of a fine would convince you to never drive at 20 km/h over the limit?	.001	5.00	.006
Initial value of Likelihood =146.909	Statistical summary		
Final Value of Likelihood = −98.227			
Number of Observations = 113			

of using rewards. The re-organization of insurance schemes can prove to be a fruitful way to achieve this goal, for example by reducing the premiums for safe drivers. Furthermore, this study presents a different model, one that relies on self-monitoring, self-reporting and the behavioral response to rewards and fines. These platforms already exist in various forms throughout the Hi-tech industries, suggesting that future studies could pursue collaboration with existing companies that develop and rely on technologies that gather big data on personal behaviors. This would consequently lend itself to incorporating reward/fine principles that rely on scientific research that could help people modify their driving behavior. The introduction of in-vehicle monitoring devices would also promote such goals. However, the former would circumvent the low social acceptability regarding mandatory monitoring technologies [16].

The study had three main limitations. First, the study did not compare the use of rewards and fines to influence behavior in practice, but only in theory. Future studies should address these issues by trying out different schemes that would improve the understanding of fines, rewards, and various possible combinations, on driving behavior.

Second, the study used a relatively small and homogenous sample. Women were significantly underrepresented in the sample. Ideally, future studies should use larger and more diverse samples, which would be followed for a longer period so the effect of experimenter's desirability would be reduced. In addition, the participants could decide not to turn on the application before certain trips. However, it should be noted that Get Location recorded approximately 88% of the trips (when compared to the results of the online survey, representing an average week of driving), during which drivers committed a considerable number of violations, even regardless of being aware of the use of the monitoring application. Thus, the bias due to intentional misrepresentation of driving patterns would be minimal.

Third, the participants had to turn the application on whenever they began a trip. We included this feature to increase the participants' willingness to use the application; however, this allowed participants to avoid recording all their trips. It is possible that participants intentionally chose to avoid using Get Location before particular trips in which the drivers planned to commit violations. However, given the high number of violations recorded overall, we believe that most unrecorded trips were due to forgetfulness.

The main strength of this study was the use of an in-vehicle recording system to obtain objective data on individual level driving behavior, including traffic violations. The study demonstrates the need to use objective measures in order to assess the magnitude of particular driving behaviors in general and traffic violations in particular. Furthermore, with a growing population that is technology savvy and familiar with similar methods, makes the application of this method particularly useful. In addition, the study's results support future explorations of the use of rewards to modify speeding and driving behavior in general. With the advent of new methodologies for the study of big data, the advantage of cellular-application based methodologies is clear. The impact, however, on risky driving behavior has yet to have been comprehensively studied.

References

1. Amado S, Arıkan E, Kaça G, Koyuncu M, Turkan BN (2014) How accurately do drivers evaluate their own driving behavior? An on-road observational study. Accid Anal Prev 63:65–73
2. Arnett J (2002) Developmental sources of crash risk in young drivers. Inj Prev 8(suppl 2):ii17–ii23
3. CBS (2014) Driving convictions and convicted drivers 2013. Central Bureau of Statistics, Israel
4. Cestac J, Paran F, Delhomme P (2011) Young drivers' sensation seeking, subjective norms, and perceived behavioral control and their roles in predicting speeding intention: how risk-taking motivations evolve with gender and driving experience. Saf Sci 49(3): 424–432
5. Corbett C (2001) Explanations for "understating" in self-reported speeding behaviour. Transport Res F: Traffic Psychol Behav 4(2): 133–150
6. De Craen S, Twisk DAM, Hagenzieker MP, Elffers H, Brookhuis KA (2011) Do young novice drivers overestimate their driving skills more than experienced drivers? Different methods lead to different conclusions. Accid Anal Prev 43(5):1660–1665
7. Dogan E, Steg L, Delhomme P, Rothengatter T (2012) The effects of non-evaluative feedback on drivers' self-evaluation and performance. Accid Anal Prev 45:522–528
8. Elvik R (2014) Rewarding safe and environmentally sustainable driving: systematic review of trials. Transp Res Rec J Transp Res Board 2465:1–7
9. Evans L (1996) The dominant role of driver behavior in traffic safety. Am J Public Health 86(6):784–786
10. Galovski TE, Blanchard EB (2004) Road rage? A domain for psychological intervention? Aggress Violent Behav 9(2):105–127
11. Hatfield J, Fernandes R, Job RS (2014) Thrill and adventure seeking as a modifier of the relationship of perceived risk with risky driving among young drivers. Accid Anal Prev 62:223–229
12. Israel National Road Safety Authority (2015) Traffic safety trends in Israel 2015. Israel. Retrieved from https://www.gov.il/BlobFolder/reports/trends_2015/he/trends_2015.pdf (2012, December 27). Thinking about life during sylvester: driving under the influence of alcohol. Israel Road Safety Authority. Retrieved from www.rsa.gov.il/hasbara/kampeinim/documents/newsletter_alkohol.pdf
13. Kahneman D, Tversky A (1984) Choices, values, and frames. Am Psychol 39(4):341
14. Kelley-Baker T, Romano E (2010) Female involvement in US non-fatal crashes under a three-level hierarchical crash model. Accid Anal Prev 42(6):2007–2012
15. Klauer SG, Guo F, Simons-Morton BG, Ouimet MC, Lee SE, Dingus TA (2014) Distracted driving and risk of road crashes among novice and experienced drivers. N Engl J Med 370(1):54–59
16. Lahrmann H, Agerholm N, Tradisauskas N, Berthelsen KK, Harms L (2012) Pay as you speed, ISA with incentives for not speeding: results and interpretation of speed data. Accid Anal Prev 48:17–28
17. Lajunen T, Summala H (2003) Can we trust self-reports of driving? Effects of impression management on driver behaviour questionnaire responses. Transport Res F: Traffic Psychol Behav 6(2):97–107
18. Mast MS, Sieverding M, Esslen M, Graber K, Jäncke L (2008) Masculinity causes speeding in young men. Accid Anal Prev 40(2):840–842
19. Mazureck U, Hattem J (2006) Rewards for safe driving behavior: influence on following distance and speed. Transp Res Rec J Transp Res Board 1980:31–38
20. McKenna FP, Stanier RA, Lewis C (1991) Factors underlying illusory self-assessment of driving skill in males and females. Accid Anal Prev 23(1):45–52
21. Nazif JI (2011) Testing and contrasting road safety education, deterrence, and social capital theories: a sociological approach to the understanding of male drink-driving in Chile's metropolitan region (Vol. 55, p. 313). Presented at the Annals of Advances in Automotive Medicine/Annual Scientific Conference, Association for the Advancement of Automotive Medicine
22. Oppenheim I, Oron-Gilad T, Parmet Y, Shinar D (2016) Can traffic violations be traced to gender-role, sensation seeking, demographics and driving exposure? Transport Res F: Traffic Psychol Behav 43:387–395
23. Pratt TC, Cullen FT, Blevins KR, Daigle LE, Madensen TD (2006) The empirical status of deterrence theory: a meta-analysis. Taking Stock Status Criminol Theory 15:367–396
24. SARTRE consortium (2014) European road users' risk perception and mobility: the SARTRE 4 survey. Retrieved from http://www.attitudes-roadsafety.eu/index.php?eID=tx_nawsecuredl&u=0&file=uploads/media/Sartre-4-report.pdf&t=1469281917&hash=f94a7cef7dd4665380aaae59a792efff
25. Scott-Parker B, Hyde MK, Watson B, King MJ (2013) Speeding by young novice drivers: What can personal characteristics and psychosocial theory add to our understanding? Accid Anal Prev 50: 242–250
26. Shinar D (2007) Traffic safety and human behavior (vol. 5620). Elsevier, New York
27. Simons-Morton BG, Ouimet MC, Chen R, Klauer SG, Lee SE, Wang J, Dingus TA (2012) Peer influence predicts speeding prevalence among teenage drivers. J Saf Res 43(5):397–403
28. Sundström A (2008) Self-assessment of driving skill – A review from a measurement perspective. Transport Res F: Traffic Psychol Behav 11(1):1–9. https://doi.org/10.1016/j.trf.2007.05.002
29. Taubman-Ben-Ari O (2014) The parental factor in adolescent reckless driving: the road ahead. Accid Anal Prev 69:1–4
30. Tseng C-M (2013) Speeding violations related to a driver's social-economic demographics and the most frequent driving purpose in Taiwan's male population. Saf Sci 57:236–242
31. Vaa T (2001) Cognition and emotion in driver behaviour models: Some critical viewpoints. In Proceedings of the 14th ICTCT workshop, Caserta. Citeseer. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.334.7495&rep=rep1&type=pdf
32. WHO (2015) Global status report on road safety 2015. World Health Organization, New York
33. Yagil D (1998) Gender and age-related differences in attitudes toward traffic laws and traffic violations. Transport Res F: Traffic Psychol Behav 1(2):123–135. https://doi.org/10.1016/S1369-8478(98)00010-2
34. Israel National Road Safety Authority. (2012). Thinking about life during sylvester: driving under the influence of alcohol. Israel Road Safety Authority. Retrieved from http://www.rsa.gov.il/hasbara/kampeinim/documents/newsletter_alkohol.pdf