Accident Analysis and Prevention 144 (2020) 105689

Contents lists available at ScienceDirect

Accident Analysis and Prevention

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

Employee perseverance in a “no phone use while driving” organizational road-safety intervention

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ARTICLE INFO

Keywords:
Perseverance
Organizational health and safety (OHS) programs
Phone use while driving
Safety climate
Gender

ABSTRACT

Introduction: This interdisciplinary study explores factors that contribute to the perseverance of participants in an organizational "no phone use while driving" road-safety intervention.
Method: The study sample comprised 200 employees (mean age 43 years; 104 females [52 %], 96 males [48 %]) from 8 organizations in Israel. Subjects completed a 4-month organizational intervention using a smartphone application that monitored smartphone use, operationalized as taps per minute, where each tap represents a single instance of contact with the screen (e.g., touching, tapping or swiping). The app also silenced notifications during the intervention stage. Changes over time in tapping-while-driving behavior were examined through self-report questionnaires and objectively through the application’s monitoring function. Validated measures were used to examine factors associated with perseverance in the program.
Results: Organizational safety climate and gender (male) were positively related to perseverance in the intervention. Contrary to our hypothesis, safety motivation was not found to influence perseverance.
Conclusions: The present intervention is most effective for employees with high safety climate perceptions and for male employees.
Practical applications: The organizational intervention presented in the current study was shown to be effective in reducing smartphone use (touching, tapping or swiping) while driving. Our findings show that people will download and use an app that actively reduces their incentive to use their phones at the wheel by silencing incoming notifications. The findings support calls to harness the positive potential of information and communications technologies for organizational interventions.

1. Introduction

Occupational health and safety (OHS) promotions are strategies designed to improve health- and safety-related behaviors (Anderson et al., 2009; Oliveira et al., 2018). OHS interventions have been shown to be effective in promoting employee health and safety behavior (e.g., Neal and Griffin, 2006; Newnam and Oxley, 2016; Robson et al., 2012; Yoon et al., 2013). Yet such programs often suffer from high drop-out rates, reducing their effectiveness. Perseverance of employees in OHS interventions is not guaranteed even when they choose to enroll voluntarily (Hedlund et al., 2010; Kvorning et al., 2015). This is a concern, as perseverance in the program is a key predictor of a positive intervention outcome (Ball et al., 2006).

Most existing research on perseverance in health and safety interventions has focused on personal health programs conducted outside organizational settings (such as substance abuse treatment – Broome et al., 2002; clinical psychological support programs – Bendelin et al., 2011; and weight loss interventions – Perna et al., 2018). The present study aims to narrow this gap by examining factors that contribute to perseverance in an OHS program. We integrate knowledge accumulated from non-organizational interventions about perseverance with knowledge from organizational psychology to examine possible antecedents of employee perseverance in an OHS road-safety intervention.

The heart of our study is an actual workplace intervention designed to reduce the frequency of smartphone use behind the wheel. Using a phone while driving is well-recognized as a dangerous habit that puts the safety of drivers and other road users at risk (Alli, 2008). The study utilizes a smartphone application that has previously been successfully used to monitor real-time phone use while driving in a naturalistic setting (Albert and Lotan, 2018; Kita and Luria, 2020). Given that any use of a smartphone while driving is distracting, in that it involves removing the hand from the wheel and the eye and attention from the road, the application captures all instances of contact with the screen (touching, tapping or swiping – together referred to as “tapping”),

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https://doi.org/10.1016/j.aap.2020.105689
Received 8 January 2020; Received in revised form 9 July 2020; Accepted 9 July 2020

rather than only one activity, such as texting. We examine three personal and situational parameters – organizational safety climate, safety motivation, and gender – as antecedents of employee perseverance in this safety program.

2. Literature review

2.1. Participant perseverance in OHS interventions

Our study focuses on factors that support participant perseverance in an OHS intervention. In alignment with other studies (e.g., Bower et al., 2014; Brand and Jungmann, 2014; Daykin et al., 2018), perseverance was defined in the current study as compliance with the requirements of an intervention up to the point of completion.

Researchers are in agreement that participant perseverance is imperative for the success of behavior modification interventions (e.g., Ball et al., 2006; Bower et al., 2014; Brand and Jungmann, 2014; Daykin et al., 2018; Sheeran and Silverman, 2003). In general, the literature shows a relationship between time in treatment and improvement, and individuals who persevere in an intervention tend to have better outcomes than those who do not (Baekeland and Lundwall, 1975; Fowler et al., 1985; Simpson et al., 1997). Persevering voluntarily in safety activities and interventions predicts not only improved practices over the short term, but also longer-term effects such as later compliance with mandatory safety rules and regulations (Neal and Griffin, 2006). More generally, low perseverance levels mean that the potential worksite-wide impact of an intervention is not maximized, reducing the program's cost-effectiveness (Linnan et al., 2002; Miller and Brennan, 2015).

A better understanding of factors that positively impact perseverance in different kinds of organizational health and safety interventions could improve the effectiveness of such interventions in various ways. For instance, interventions could be tailored to the participants (or participants to the intervention), with employees being "matched" with interventions where they are most likely to persevere (LaPorte and Stunkard, 1987; Moroshko et al., 2011). Identification of participants at high risk of non-perseverance would also mean that resources (such as extra support) could be directed where they are most needed (Perna et al., 2018). In the current study we examine one organizational antecedent (organizational safety climate), one individual-level psychological antecedent (safety motivation), and one individual differences antecedent of perseverance (gender). We also examine safety knowledge as a control variable.

2.2. Organizational road-safety climate and perseverance

Organizational safety climate is defined as employees' shared perceptions regarding the importance of safety in the work environment (Christian et al., 2009; Grosch et al., 1999; Zohar, 1980). At its core, safety climate refers to the degree to which managers are perceived as prioritizing safety in the organization (e.g., Zohar, 2000). A high safety climate should influence the adoption of safe behaviors and practices by making clear to employees that safety-conscious behaviors are rewarded and supported in the work setting (Zohar and Luria, 2005, 2010). Organizational road-safety climate is a sub-category of organizational safety climate (Luria et al., 2014).

A large body of literature has examined the link between organizational safety climate and safety outcomes (e.g., Gahan et al., 2015; Newnam et al., 2012). Looking at road safety specifically, research has supported the link between road-safety climate and driver behavior in the trucking industry (Huang et al., 2014). Likewise, organizational road-safety climate perceptions have been found to predict driving behavior and driving intentions (Wills et al., 2009), including self-reported distraction when driving (Wills et al., 2006).

Safety-climate perceptions are a source of facet-specific behavior-outcome expectancies (Luria, 2010). When employees perceive that safety is important in their organization (high safety climate), they conclude that they will be rewarded for behaving in a safe manner; and they anticipate that unsafe behaviors will have negative outcomes. Such expectations influence behavioral decision-making, and are the cognitive determinants of motivation (Bandura, 1986) regarding safe/unsafe behavior (Luria, 2010; Zohar and Luria, 2004). It is thus logical to assume that perseverance in organizational health and safety interventions will be higher in organizations with a high safety climate.

H1. *Organizational road-safety climate will be positively related to perseverance in a "no phone use while driving" organizational intervention.*

2.3. Safety motivation and perseverance

Motivation is another behavioral science construct that is often used in connection with positive employee attitudes toward interventions (Baekeland and Lundwall, 1975). Motivation can be broadly defined as the psychological force that causes the arousal, direction, and persistence of behavior (Atkinson, 1964). As such, safety motivation promotes the arousal, direction, and persistence of behavior that reduces the likelihood of occupational injury (Lingard, 2002). Neal and Griffin (2006) define safety motivation as an individual's willingness to exert effort to enact safety behaviors, comply with safe working practices, and participate in safety activities.

Organizational research suggests that the positive effects of a safety intervention are likely to increase to the extent that participants are motivated to promote safety (Griffin and Neal, 2000; Hedlund et al., 2016). However, the importance of motivation with respect to perseverance has been identified mostly in non-workplace interventions. For example, low motivation or readiness to change is associated with lower rates of perseverance in substance abuse treatment (e.g., Broome et al., 2002; De Leon et al., 2000; Dobkin et al., 2002; Fowler et al., 1985; Simpson et al., 1997). Ball et al. (2006), utilizing interview and self-report data, found poor motivation to be one of the most common reasons for clients' failure to persevere with drug abuse treatment. Levels of motivation have also been found to influence perseverance in cognitive behavioral therapy for depression (Bendelin et al., 2011; Gerhards et al., 2011). However, to the best of our knowledge, no studies point to how motivation is related to perseverance in OHS programs.

The theoretical link between motivation and perseverance derives from the fact that activities designed to change behavior, such as organizational interventions, require investment of cognitive and emotional resources. People are willing to spend these resources when the benefits of expending them outweigh the costs (Roskes et al., 2013).

H2. *Safety motivation will be positively related to perseverance in a "no phone use while driving" organizational intervention.*

2.4. Gender and perseverance

Research has exposed marked differences in ICT use between males and females (e.g., Poushter, 2016; Schumacher and Morahan-Martin, 2001; Volman et al., 2005). Differences between the genders in smartphone use have been found in both the *amount of time* spent using smartphones, and in *dependence* on the smartphone, with women showing higher levels of both parameters. In turn, high use rates and high dependence can make it more challenging to persevere in an intervention aimed at reducing smartphone use (i.e., texting) while driving (Guertler et al., 2015).

Previous findings suggest not only that women use smartphones for more hours a day than men do, but that women and men use their phones for different purposes (Goodrich, 2014). Broadly, women are more likely to use their smartphones for maintaining social relationships, while males tend to focus on online gaming and entertainment functions (Andreassen et al., 2016; Dhir et al., 2016; Van Deursen et al.,

2015). More precisely, women tend to spend more time using interpersonal communication-oriented applications, such as texting or instant-messaging and social-networking apps (Anshari et al., 2016; Bianchi and Phillips, 2005; Durkee et al., 2012; Lopez-Fernandez et al., 2017; Thelwall et al., 2010). With respect to smartphone use and road safety, there is evidence that females are more likely than males to use their smartphone while driving (Anshari et al., 2016).

Females are more dependent on their smartphones than males (e.g., Arpaci et al., 2017; Billieux et al., 2008; Kim et al., 2017; Leung, 2008; Lopez-Fernandez et al., 2014; Van Deursen et al., 2015). For example, Lopez-Fernandez et al. (2017) identified being female among several risk factors for self-reported smartphone dependence. This finding is congruent with the fact that high use of mobile social networking applications seems to be a predictor of smartphone addiction (Salehan and Negahban, 2013).

Besides differences between the genders in smartphone use and dependence, gender differences have also been found with respect to perseverance in different types of treatments. For example, women's perseverance is lower relative to males in weight loss interventions (Garrouste-Orgeas et al., 2004; Perna et al., 2018; Sivagnanam and Rhodes, 2010). Kannisto et al. (2017) observed that women were more likely than men to drop out of interventions that utilized mobile health applications to address serious mental health issues. Other findings suggest that physiological differences between women and men can impact perseverance in a treatment. For example, women reported greater cessation fatigue (i.e., tiredness from trying to quit a habit) than men in pharmacotherapy trials (Liu et al., 2013).

Both sets of findings discussed here – i.e., women's greater use of and dependence on smartphones, and women's lower rates of perseverance in other interventions – converge to imply that women should consistently find it more difficult to persevere in the intervention examined here than men. We thus hypothesize that:

H3. *Females' perseverance in a "no phone use while driving" organizational intervention will be lower than that of males.*

2.5. Context and intervention focus

All use of mobile phones while driving is forbidden under Israeli traffic regulations, with an exception for hands-free speaker phones (National Road Safety Association Website, 2020). The regulations specifically state that the driver's hands must be on the wheel at all times. It is general knowledge in Israel that using a mobile phone while driving increases the risk of a road accident. However, within organizational settings, education and training regarding smartphone use at the wheel tends to be aimed toward professional drivers, while the current study focused on the general population of employees in the context of driving to and from work.

3. Methodology

3.1. Research design

The design comprised a three-stage intervention (baseline monitoring, intervention, and post-intervention monitoring) designed to test the efficacy of a smartphone application in reducing phone use while driving among employees who drive to and from work but are not professional drivers. Changes over time in participants' behavior were examined both through self-report questionnaires and objectively through monitoring by the application.

ProtextMe® is a smartphone app available for the Android mobile operating system[1] which has previously been utilized successfully by several researchers (see Albert and Lotan, 2018; Kita and Luria, 2020). The app was configured especially for this study. The ProtextMe application continuously monitors smartphone use while driving by sensing and recording all taps, touches, or swipes on the phone's touchscreen (hereafter: taps per minute) while the vehicle is in operation. Driving is detected via a Bluetooth connection and GPS. In addition, the app contains a silencing function, which silences notifications for incoming messages when the car is in use and triggers a notification to the sender ("I am driving now so can't respond"). Activating the app automatically launches the monitoring function, while the silencing function can be turned on and off.

3.2. Participants and procedure

Following receipt of approval from the Haifa University ethics committee (approval number 238/15), organizations were recruited for the study. We approached organizations across Israel, based on a contact list supplied by Or Yarok (a non-profit association that campaigns for road safety in Israel), supplemented by personal contacts of the authors and social media links. Eight organizations agreed to participate in the study. The participating organizations comprised two Israeli academic institutions, four multinational organizations with locations in Israel (including a producer of personal care products and a developer of special-purpose chemical products), one service organization (a sea and air mail logistics company), and one museum. All eight organizations had an existing awareness of safety, and indeed, their willingness to take part in the intervention indicated a desire to promote safety among their employees. However, prior to this study most of their focus had been on defining safety promotion regulations and procedures. The study introduced an additional approach – that of voluntary participation in a behavioral change intervention designed to increase safety awareness and safe behaviors.

All the participating organizations were given full details about the study's protocol, including the stages, requirements for participation, methods of data retrieval, and steps taken to ensure confidentiality. Once organizational approval was obtained, employees were sent a letter by their employer explaining the intervention, highlighting its voluntary nature, and inviting them to participate. To be eligible, employees had to drive to and from work, and they had to have a smartphone that ran on an Android operating system (to enable the intervention technology to function). Participating employees were required to download the application to their own phones; they were not given special phones for the study. All participating employees signed a letter consenting to have their data collected and monitored via the application. It was explained to participants that they could leave the study at any time, and that participants who completed the full intervention would receive a small token of appreciation (monetary value 50 Israeli shekels).

Two hundred and fifty-seven employees from the eight organizations initially enrolled in the study. The final database included 200 employees (see Section 4). The participating employees worked in a range of roles and levels (managers and employees, administrative and professional roles) in areas including law, finance, computing and engineering, sales and marketing, academic faculty and administration, organizational consulting, and client services. Ninety-six (48 %) of the participants in the final sample of 200 were male and 104 (52 %) were female. Participants' average age was 43 years (SD = 10). On average, they had completed 15 years of education (SD = 4), and their average tenure in the current organization was 10 years (SD = 9). Eighty-two percent of the participants were married, and the same percentages were employed in full-time positions.

As mentioned above, participants were not professional drivers but did drive at minimum to and from work on a daily basis. However, the application was designed to run whenever they were driving, during both work hours and personal time. The application detected driving automatically and worked continuously in the background of participants' mobile phones (see Section 3.1); there was no need for the driver

[1] https://play.google.com/store/apps/details?id=ok.driver_care_auto.

to activate it unless it had previously been deactivated. Participants were instructed to deactivate the application when abroad, as technical issues prevented us from gathering accurate data at those times. They were also instructed to alert the app that they were not the driver if they were on a bus, or if they were a passenger in another vehicle.

3.3. Intervention protocol

The intervention had three stages, as follows:

3.3.1. Stage 1 – baseline (1 month)

At the start of the experiment, employees filled out a questionnaire containing a self-report measure of the frequency at which they typically used their phone while driving, the independent variables and control variable (see below), and demographic data. They then downloaded the ProtextMe® application to their phones. At this stage, only the monitoring function of the application was activated.

3.3.2. Stage 2 – intervention (2 months)

In Stage 2, both the monitoring and silencing functions of the application were activated. In addition, the "don't touch your phone while driving" message was reinforced in two ways. First, organization-level data on taps per minute while driving (without employee names) were gathered and shared as feedback with participants about four times during the intervention stage. This feedback allowed participants to track improvements in taps per minute among employees at their organization. Second, between these updates, we sent participants driving safety messages via email and SMS/WhatsApp. For example, one text read "Good job focusing on your safety – your family is waiting for you!" These safety messages also included a short video that was made for the study, in which a driver was shown debating what to do after being notified of a text. The driver in the video was shown asking himself "Should I answer? What could it be?", and then saying, "It can wait."

3.3.3. Stage 3 – post-intervention (1 month)

At the end of Stage 2, employees were notified that the final stage of the study would begin. This stage then commenced immediately. During this stage, the application's silencing function was deactivated, and the monitoring function was used to measure the effect of the intervention. Finally, employees again filled out the self-report phone use frequency measure.

3.4. Measures and tools

Participation perseverance was measured as a dichotomous (yes/no) dependent variable defined by whether the participant completed all three parts of the study (baseline, intervention, and post-intervention check). Those who did not complete all three stages were considered as not having persevered in the intervention.

Organizational safety climate was measured by a 5-item group-level safety climate scale adapted from Katz-Navon et al. (2005) and Naveh and Katz-Navon (2015). Items were measured on a 5-point Likert scale (1 = very low extent, 5 = very high extent). A sample item: "To what extent is road safety an important value in your organization?" Cronbach's alpha for this scale was 0.92.

Driving safety motivation was measured using Vinodkumar and Bhasi's (2010) 5-item scale adapted for road safety. Items were measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). A sample item: "It is important to maintain safety when driving at all times." Cronbach's alpha for this scale was 0.84.

Driving safety knowledge was measured using Vinodkumar and Bhasi's (2010) 11-item scale adapted for road safety. Items were measured on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). A sample item: "I know how to maintain or improve workplace road safety." Cronbach's alpha for this scale was 0.73. This variable was used as a control parameter, because we assumed that most people know it is illegal and unwise to text while driving – however, they do not necessarily implement their knowledge and translate it into action.

Phone use while driving (self-report). Following Weller et al. (2013), participants were asked the proportion of car trips during which they typically used a mobile phone for any purpose while driving. The response scale for these variables was as follows: Never, Less than half of all trips, About half of all trips, Most trips, All trips.

Phone use while driving (objective monitoring – taps per minute) was obtained using the ProtextMe® smartphone application described above (see also Albert and Lotan, 2018; Kita and Luria, 2018, 2020). As noted above, activating the app automatically launches the monitoring function, which records every instance when drivers touch, tap, or swipe their screen for any purpose while driving. These data were collected and represented as taps per minute. Collected information was transferred online and in real time to a central server (specially developed for this study) where all the data for each organization was stored securely.

3.5. Data analysis

In the first stage of analysis we tested the effectiveness of the intervention. Because the employees were nested within organizations, we used a regression analysis based on linear mixed models in R software, with period as a fixed-effect independent variable. The organization is the random effect that controls for the nesting of employees. To test for a decline in phone use while driving, we compared the first period (the baseline) with the second and third periods.

In the second stage we tested the hypotheses. For this purpose we conducted a logistic regression using a generalized linear mixed model procedure in R, controlling for the nested effect of employees within organizations (a random effect). We predicted whether an employee persevered in the intervention (the dependent binary variable) based on the three independent variables, namely climate, motivation and gender (fixed effects).

4. Results

The collected data from the 257 participants totaled 46,290 h (2,777,400 min) of driving. As a first step in the analysis, we conducted careful screening for unreliable or incomplete data. Three categories of data were removed: data where driving could not reliably be ascertained (e.g., because of a faulty GPS connection); data from trips of less than three minutes' duration; and data from employees with too many missing answers in the first questionnaire. In addition, we removed most of the data from one company which failed to follow the study protocol. The final database used for analysis encompassed 466,000 min of driving from 19,400 separate trips by 200 employees.

The raw data were then normalized so that data could be compared for participants who did different amounts of driving, and descriptive statistics of the dependent variables were tabulated and examined. The participants in the final sample took on average 97 trips during the study period, with an average total driving time of 2330 min. Of the 200 employees in the final sample, 119 completed the full intervention and 81 dropped out at varying stages.

4.1. Validation of intervention effectiveness

The effectiveness of an intervention is measured by the proportion of a target population showing a desired behavior change (Geller et al., 1990). In the current study, effectiveness of the intervention can be assessed by comparing the number of taps per minute in Stages 2 and 3 (intervention and post-intervention) to the baseline number. Regression analysis of the data, with mixed methods procedures controlling for the nesting of employees within organizations, showed that the intervention was indeed effective. As can be seen in Table 2, both Stage 2 and Stage 3 saw a decline in taps per minute while driving compared to the

baseline (Stage 1). The table makes clear that the reduction (relative to the baseline) is smaller for Stage 3 than for Stage 2. Nonetheless, in both cases the decline relative to the baseline is significant. These findings mean that even when the silencing function of the application was not active, and participants had to remember on their own to avoid using their phone at the wheel, they were still able to reduce their phone use.

In addition, we calculated two measures of R^2 for mixed models regressions (squared correlation and conditional R^2, reported below Table 2). These analyses measure the association between the predicted values and the actual values of the dependent variables. Both show a relatively strong effect for the studied model.

The self-report survey results support the positive impact of the intervention on reducing phone use at the wheel. A Wilcoxon signed-ranks test with continuity correction found a statistical reduction in the proportion of trips where the participant admitted to phone use at the wheel ($V = 618$, $p < 0.05$) between the baseline and post-intervention questionnaires.

4.2. Hypothesis testing

In order to test the hypotheses, we conducted a logistic regression using a generalized linear mixed model procedure controlling for the nested effect of employees within organizations (see Table 3). We predicted the dependent variable, employee perseverance in the intervention (1 = the participant completed the intervention successfully and 0 = the participant dropped out during the intervention), based on the independent variables climate, motivation and gender (fixed effects). The tests of the model reported below Table 3 revealed satisfactory levels. The percentage of correct predictions was high, and the Hosmer-Lemeshow chi-squared measure showed no significant difference between the predicted values under the model and the data.

Hypothesis 1 suggested that there would be a positive relationship between organizational road-safety climate and persevering in a "no phone use while driving" workplace intervention. This hypothesis was supported. Safety climate was significantly and positively related to participants' perseverance in the intervention. More precisely, we calculated that the odds of perseverance increase by 1.58 when the safety climate score increases by one unit.

Hypothesis 2 predicted that employees reporting higher safety motivation would have higher perseverance rates in the intervention. This association was not significant, meaning the hypothesis was not supported.

Hypothesis 3 predicted that gender would be associated with perseverance in the intervention, and specifically that rates of completion would be lower for females than for males. This hypothesis was supported, as reported in Table 3. As can be seen in Fig. 1, more female participants dropped out of the intervention than completed it, and more men completed the intervention than dropped out of it.

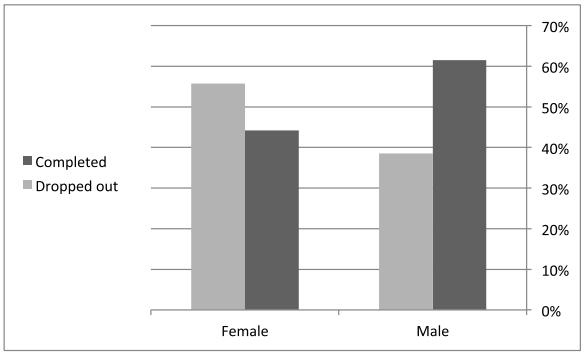

Fig. 1. Male and female intervention completion and drop-out percentages.

5. Discussion

This study contributes to our theoretical and practical understanding of what factors promote the perseverance of employees in an OHS program, using an organizational road-safety intervention as test case. We examined perseverance in an intervention designed to reduce phone use at the wheel within a naturalistic setting. We found that organizational safety climate and male gender were positively related to perseverance in the intervention. Surprisingly, safety motivation was not found to influence perseverance.

To our knowledge, a relatively small body of literature has explored perseverance in organizational interventions in general, and in road-safety interventions in particular. The current study is the first to explore a specific intervention focused on reducing phone use while driving in an organizational setting. Thus, the findings provide insight into road-safety practices in an increasingly technology-based society. In addition, this research reveals how organizations can successfully play a role in promoting driver safety, and specifically in reducing phone use while driving.

We found a connection between higher levels of organizational safety climate and perseverance of employees in the intervention program. This finding makes sense in light of social cognitive theory (Bandura, 1986), which suggests that environmental and personal factors interact to influence people's behavior. As such, individuals seeking to change bad health and safety habits (including phone use at the wheel) are more likely to succeed if they do so within the context of a supportive social environment.

Our results also showed lower rates of perseverance among females than males, confirming our hypothesis. These findings add to existing literature pointing both to women's greater use of and dependence on smartphones compared to men (Anshari et al., 2016; Lopez-Fernandez et al., 2017), and to women's lower perseverance in some other health-related interventions such as weight loss interventions mental health improvement interventions (Kannisto et al., 2017; Perna et al., 2018).

Contrary to our expectations, safety motivation was not associated with perseverance in the safety program. However, it should be stressed that we measured safety motivation only at the start of the intervention. Previous research (e.g., Hedlund et al., 2016) suggests that the relationship between safety motivation and OHS interventions may be one of mutual feedback: participation in a program may increase participants' safety motivation, which may then encourage perseverance in the program. It is therefore possible that the safety motivation of our participants rose during the second and third stages, and that this eventually translated into higher levels of perseverance. Further research is needed to explore this possibility.

The result that safety knowledge was not statistically significant supports the assumption that using the smartphone while driving is not a phenomena resulting from lack of knowledge about the dangers involved and the prohibition of using the phone when driving. People use the phone while driving as they are not able to ignore the temptation even though they are knowledgeable about the dangers. Therefore, knowledge did not impact the perseverance of the participants in the studied intervention.

Finally, the successful outcome of the intervention extends previous studies (Albert and Lotan, 2018; Kita and Luria, 2018) which demonstrate the effectiveness of using a smartphone app as an objective monitoring mechanism. Our study supports this relatively new use of accessible and cost-effective information and communications technologies in safety research.

5.1. Practical implications

The present study used a smartphone application to measure and influence participants' behavior. The findings thus support previous calls (Dyreborg et al., 2015; Stibe, 2015; Tulusan et al., 2012) to increase the use of technologies such as smartphones and social media for

Table 1
Means and standard deviations for study variables in participating organizations.

Participating organization	Gender (%male)	Safety climate Mean(SD)	Safety motivation Mean(SD)	Safety knowledge Mean(SD)	Taps per minute Mean(SD)	Employee perseverance (% stay)
Org1	47 %	4.25 (0.64)	4.71(0.42)	4.41 (0.55)	1.13 (1.08)	70 %
Org2	17 %	3.54 (1.17)	4.24 (0.63)	4.72 (0.41)	1.48 (1.40)	56 %
Org 3	32 %	3.17 (1.00)	3.98 (0.62)	4.64 (0.60)	1.01 (1.04)	47 %
Org 4	88 %	4.68 (1.00)	4.80 (0.31)	4.60 (0.39)	0.82 (0.62)	75 %
Org 5	33 %	3.88 (1.14)	5.00 (0)	4.24 (0.62)	1.89 (2.04)	67 %
Org 6	62 %	4.42 (0.66)	4.73 (0.46)	4.39 (0.36)	0.90 (1.13)	30 %
Org 7	58 %	4.73 (0.60)	4.73 (0.40)	4.51 (0.52)	2.17 (2.18)	49 %
Org 8	22 %	3.27 (0.99)	4.81 (0.35)	4.12 (0.58)	1.14 (1.13)	44 %
Total	48 %	4.10 (1.04)	4.73 (0.44)	4.33 (0.56)	1.41 (1.60)	50 %

Table 2
Mixed model regression comparing taps per minute during the baseline period with taps per minute during and after the intervention.

	Baseline	Stage 2	Stage 3
Mean (SD) taps per minute	1.66 (1.87)	1.20 (1.31)	1.31(1.49)
Comparison to baseline, β (SD)		−0.51(0.1)***	−0.26(0.13)*

*p < .05, **p < .01, ***p < .001; β values are based on mixed methods estimates; R^2 measured with squared correlation = .81 and with conditional R^2 (Nakagawa et al., 2017) = 0.69.

Table 3
Mixed models logistic regression predicting perseverance.

Fixed effect	B	Odds ratio	CI
Organizational safety climate	0.46(.20)*	1.58	1.05 − 2.36
Safety motivation	0.68(.40)	1.97	.90 − 4.31
Safety knowledge	−0.49(.34)	0.61	.32 − 1.2
Gender (Female)	−0.80(.33)*	0.47	.25 − .91

*p < 0.05; β = Estimate of mixed models logistic analysis; percentage of correct predictions = .59; Hosmer-Lemeshow chi-squared = 13.939; p = .083.

organizational interventions, for example by providing feedback channels and personalized messages. Beyond that, our findings show that people will download and use an app that actively reduces their incentive to text at the wheel by silencing incoming notifications. Studies have shown that traditional educational and enforcement efforts, including public service announcements, state bans, and fines, have not been sufficient in mitigating phone use at the wheel (e.g. Gormley, 2016; Parnell et al., 2017). Given that people have become dependent on their smartphones, and are not likely to unilaterally take the initiative to stop using them while driving (Galitz, 2018), our findings offer encouragement that technology can be harnessed in positive ways to reduce its own negative effects.

More broadly, improving our understanding of factors associated with perseverance in OHS programs can facilitate improvements in their design and increase their effectiveness for the benefit of the employee and organization. Our findings point to an organizational factor – organizational safety climate – that is measurable, and that can be increased to promote perseverance in a safety program. A safety program that is not aligned to organizational practices which reflect an actual (not only declared) commitment to safety will not achieve its goals.

Our findings also point to variance in how females vs. males approach interventions, with males having a higher perseverance rate in the current study. Orji (2014) examined ten strategies that are commonly employed in interventions aimed at changing health behaviors. She found that females and males respond differently to some behavior change strategies, and that in general females appear to be more receptive to most of the strategies examined. Orji concluded that gender-dependent approaches to designing health behavior change support systems are to be preferred over a one-size-fits-all approach. Future research should continue to investigate the effectiveness of strategies that are commonly employed in OHS interventions with respect to possible gender effects.

5.2. Limitations and future research

Our study is subject to a number of limitations. First, as noted above, we measured safety motivation and safety climate only at the start of the intervention. It is possible that these dynamic measures changed over time as a result of the intervention. Future studies should measure these variables using a longitudinal design. Such a design might reveal an association between safety motivation and behavior change which was not captured in this study.

Second, the ProtextMe® smartphone application used in the present study served as an objective and validated (e.g., Kita and Luria, 2018) measure to monitor smartphone use while driving, and compensated for the limitations of self-report methods (e.g., poor recall, denial, and other self-report biases). Nevertheless, the application has a defined scope of capability, in that the monitoring is valid only if the participant has turned on their phone's GPS. In addition, the application cannot identify whether the movement detected is a result of the participant driving a vehicle (versus taking public transportation or sitting beside the driver). More important, the application could not capture activity such as time spent reading text messages – only taps or swipes on the screen. It is possible that some of our measured taps derived from drivers opening a message or scrolling down, but we had no way of measuring the amount of time drivers looked at their phone without touching it. While measures were taken to minimize these risks, a more advanced application would allow for more comprehensive data collection.

Third, organizations that agreed to participate in the study had strong commitment from management. It is reasonable to assume that these organizations all had relatively high safety climates (see Table 1) compared with firms that were approached and did not agree to participate. Future studies are needed to examine our findings within non-safety-oriented organizations.

Last, the participating organizations were very large, each with hundreds of employees. Participation in the study was voluntary, and ethical considerations prevented us (or the organizations) from pressuring employees to take part in the intervention. As a result, our final sample of 200 represents a relatively low participation rate (only 3% of the population). We hope that research on voluntary interventions will encourage organizations to conduct organizational wide interventions.

In this vein, our findings suggest several possible new avenues for future research. In particular, it has been established through considerable research that leaders play a critical role in supporting safety at work. For example, leaders affect the degree to which employees voluntarily participate in safety-related activities (e.g., Clarke and Ward, 2006; Hofmann et al., 2003; Mullen and Kelloway, 2009). Griffin and

Hu (2013) found that safety-inspiring behavior by team leaders increased employees' safety compliance; and Zohar (2000, 2002) found that team leaders shape employee safety performance by translating values and goals from senior levels, and by providing direct guidance for team members. With respect to road safety in particular, leaders may serve a crucial function by identifying situations in which their employees may be at risk on the road (e.g., if they are tired, stressed, or under pressure), and managing these situations through effective safety leadership (e.g., Huang et al., 2014; Newnam and Oxley, 2016). There is strong evidence to suggest that communication between supervisors and drivers plays a key role in driver safety outcomes (Newnam et al., 2012, 2002). Future studies should probe the mechanisms by which different aspects of leadership or the leader-employee relationship influence employee perseverance in safety intervention programs in relation to theories such as Leader–Member Exchange (LMX; e.g., Graen and Uhl-Bien, 1995) or theories of transformational leadership (e.g. Bass, 1995). These theories could be studied in relation to the parameters studied in the current paper (safety climate, safety motivation and gender) and other variables.

Author statement

Both authors contributed equally to this manuscript.

The manuscript has not been published previously and is not under consideration for publication elsewhere.

The publication is approved by all authors.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in the paper.

Acknowledgments

We would like to thank the companies and employees who were willing to participate in this unique study. Special thanks to the Israel Science Foundation (ISF) for the generous financial support (grant application no. 380/15) and Or Yarok for recognizing the importance of this project and providing additional funding. Special thanks to Dr. Tsippi Lotan for her world-class expert advice throughout the project, to Sasha Harel for statistical consulting, and lastly to Tomer Chen and Vika Beckerman, ProtextMe creators for their collaboration and innovative spirit.

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