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Driving locus of control and driving behaviors: Inducing change through driver training

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ABSTRACT

Locus of control perceptions have been used to predict driving safety as a stable, dispositional variable. Based on social learning theory, this study tested whether a defensive driving training program coupled with observer feedback could influence domain-specific locus of control beliefs regarding controllability of accidents and therefore impact driving behaviors. Over a 5-week period, 112 individuals' driving locus of control and driving behaviors were assessed two times, before and after a defensive driving training program and observer feedback. Drivers experienced significant changes in their driving locus of control perceptions. Specifically, drivers reported significantly lower externality and higher internality after training as compared to before training. The changes in driving locus of control predicted an increase in safe driving behaviors. In addition, pretraining motivation to learn predicted a decrease in externality, whereas pretraining self-efficacy predicted the increase in internality. The results indicate that driving locus of control can be influenced by training and observer feedback, and the changes in driving locus of control can predict change in driving behaviors. Findings of the study point to the potential for organizations to enhance driving safety by influencing drivers' locus of control perceptions.

1. Introduction

Motor vehicle accidents have been a leading cause of injury-related deaths in the United States (Heron et al., 2009). Fatal crashes caused more than 110 deaths per day in the years from 1990 to 2007 (US Census Bureau, 2009). Highway accidents are the most frequent work-related fatal events, accounting for almost one out of four fatalities in 2006 (US Bureau of Labor Statistics, 2009). Thus, identifying and designing methods to enhance safe operation of motor vehicles can lead to substantial societal and organizational impact.

Research on traffic safety has identified locus of control as a key variable that predicts safe driving behaviors. Locus of control is proposed to account for individual differences in perceptions of the contingency between individuals' action and subsequent outcomes (Rotter, 1966, 1975). Externals tend to perceive outcomes as the result of external, uncontrollable influences, such as luck, fate, and powerful others, whereas internals tend to interpret outcomes as contingent upon their own behavior. As internals tend to attribute driving outcomes to internal, controllable factors (Hoyt, 1973; Phares & Wilson, 1972), they are more likely to take precautionary measures (Phares, 1978; Strickland, 1977, 1978). Empirical findings have shown that those high on internal locus of control are more likely to use a seatbelt regularly (Hoyt, 1973), be alert while driving (Lajunen & Summala, 1995), and to apply brakes quickly when perceiving potential danger on a driving track

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(Rudin-Brown & Parker, 2004). However, contradicting results have also been reported (e.g., Arthur & Doverspike, 1992; Iversen & Rundmo, 2002; Panek, Wagner, Barrett, & Alexander, 1978; Signori & Brown, 1974).

Montag and Comrey (1987) surveyed male applicants for drivers' licenses in Israel with scales measuring their locus of control beliefs regarding accidents. Based on the empirical findings that locus of control perceptions are multidimensional in nature and beliefs on internal and external dimensions are negatively related but distinct (Collins, 1974; Lefcourt, 1981; Levenson, 1981), Montag and Comrey assessed locus of control on two separate dimensions of internality and externality. They found that applicants who were involved in fatal accidents scored significantly higher on externality and lower on internality than applicants who had no prior record of major accidents. A meta-analytic study based on 13 studies with a total of 1909 participants showed that the average relationship between locus of control and automobile accidents was 0.20 (Arthur, Barrett, & Alexander, 1991). Although the meta-analytic finding suggests that having higher levels of externality and lower levels of internality is associated with higher probability of involvement in accidents, the association has been largely established through postdictive study design. Thus, a reverse causality, that is, involvement in accidents influences locus of control, may have led to the observed correlation (Arthur & Doverspike, 1992; Guastello, 1993).

Research in personality development shows that stable personality traits can be influenced by work and life experiences in one's adulthood (Roberts, 1997; Roberts, Caspi, & Moffitt, 2003; Robins, Caspi, & Moffitt, 2002; Scollon & Diener, 2006). A focus on how locus of control can be shaped or changed by individuals' relevant experience is also consistent with Rotter's (1975, 1990) conceptualization of locus of control within the social learning theory: instead of a fixed trait, Rotter regarded locus of control as a "*relatively* stable" (Rotter, 1990; p. 490) individual difference variable that can display demonstrable situational specificity. Examining the malleable nature of driving locus of control may also contribute to resolving the mixed findings of the effects of locus of control in the driving safety literature.

The purpose of this paper is to examine a training intervention focused on changing a driver's locus of control so as to positively impact safe driving behaviors. We review the locus of control construct within the context of social learning theory and argue that perceptions of driving locus of control are subject to change as experience in driving safety accumulates. We then discuss the potential for interventions and individual level factors to impact driving locus of control and driving behaviors.

1.1. Locus of control

The construct of locus of control (Rotter, 1954; Rotter, Chance, & Phares, 1972) was developed to account for the observed variation across people in their expectancies of the contingency between their behavior and outcomes (Rotter, 1966). Most of the literature on locus of control has focused on the "relatively stable, cross-situational individual differences" (Rotter, 1990, p. 490). Researchers have also sought to better predict active/passive beliefs of individuals in relation to the specific domains or contexts. Rotter (1975) posited that narrower, more specific expectancies by context should predict corresponding behaviors within a domain more accurately. Some researchers have even argued that locus of control should be treated as a domain-specific construct (Lachman, 1986; Lefcourt, 1991; Mischel & Mischel, 1979). Various locus of control scales have been developed within specific domains, such as work (Spector, 1988), safety (Jones & Wuebker, 1985), career development (Fournier & Jeanrie, 1999), and health (Wallston, Wallston, & DeVellis, 1978).

The contextualized approach has been adopted to investigate the effects of locus of control on driving outcomes (Montag & Comrey, 1987; Ozkan & Lajunen, 2005). Jones and Foreman (1984) compared scores on a safety locus of control scale between 21 high risk drivers (having two or more convictions for unsafe driving) and 25 safe drivers. The high risk drivers reported to be significantly more external than the safe drivers.

1.2. Change in locus of control

Intervention programs have been shown to effectively influence individuals' domain-specific locus of control as a means to enhance the participants' ability to cope with adverse events. Various interventions have enhanced perceptions of internal control or reduced the sense of external control in individuals who were coping with alcoholism (Griess, 2001; Sharp, Hurford, Allison, Sparks, & Cameron, 1997), panic attack (Katerndahl, 1991), breast cancer (Cohen & Fried, 2007), and memory loss (Hastings & West, 2009). Attributional retraining, a therapeutic approach to reinstating perceived control over outcome, has been found to induce a more internal locus of control (Menec et al., 1994), enhance achievement (Perry & Penner, 1990) and increase career decision self-efficacy (Luzzo, Funk, & Strang, 1996). Further, Weissbein, Huang, Ford, and Schmidt (in press) demonstrated that an intervention focused on enhancing locus of control perceptions specific to an interpersonal training can lead to greater transfer of training.

Two studies on driving provide some initial support for the notion that driving locus of control may be influenced by driving experience and learning history. Kouabenan (2002) found that the attributions individuals made regarding the cause of accidents depended on their occupations and past exposure to road risks and accident prevention programs. Further, Stanton, Walker, Young, Kazi, and Salmon (2007) evaluated changes of drivers' knowledge, skills and driving locus of control associated with an 8-week advanced driver's competency coaching system, using a quasiexperimental design, where the intervention group consisted of self-selected trainees and two control groups recruited from the public. After being individually coached on driving knowledge, skills, and attitudes, drivers in the intervention group reported significantly lower externality, in addition to demonstrating increased driving knowledge and skills, but their internality perception did not change significantly. In contrast, drivers in either control groups showed no improvement of driving knowledge and skills and no significant change of internality or externality.

Following Stanton et al.'s (2007) findings that driving locus of control may be modified by an intervention and the two dimensions of internality and externality can change independently, two research questions remain to be addressed. First, it remains to be seen whether a driving intervention can influence perceptions on both externality and internality. Second, research has yet to examine whether changes in driving locus of control are associated with changes in actual driving behaviors. Although drivers in the intervention group reported lower externality after the training as a whole in Stanton et al. (2007), it is unclear whether trainees who had larger decrease in externality also showed greater improvement in driving knowledge and skills. Building on Stanton et al. (2007), the current paper addresses these two questions to elucidate the potential role of driving locus of control in driver training programs.

1.3. Research focus

We propose a research model (Fig. 1) that serves two purposes: (a) demonstrating how driving locus of control may be influenced by learning experiences and (b) identifying the antecedents and consequence of changes in driving locus of control and changes in driving behaviors. Using a longitudinal design, the research study measured domain specific driving locus of control before and after learning interventions. We conceptualized locus of control as consisting of two negatively correlated dimensions of externality and internality (e.g., Collins, 1974; Lefcourt, 1981; Montag & Comrey, 1987). Driving behaviors were also assessed prior to and after the training intervention. Fig. 1 shows a path model in which we propose that motivation to learn and pretraining self efficacy along with the learning experiences can impact changes in externality and internality, which, in turn, influence change in driving behavior. In particular, we posit four research hypotheses consistent with the model presented in Fig. 1.

Driver attributions as to the causes of accidents may be influenced by various factors (Köhnken & Brockmann, 1987; Tennen & Affleck, 1990). We contend that learning experiences such as a defensive drivers training program and observer feedback can provide drivers with information regarding the relationship between safe driving behaviors and the potential for traffic accidents (*cf.* Stanton et al., 2007). Providing drivers with knowledge of traffic accident prevention and skills to avoid accidents, these experiences can influence their driving locus of control.

Hypothesis 1. Drivers will have higher internal locus of control and lower external locus of control after being provided with observer feedback on their driving behaviors and attending a defensive drivers training program.

As drivers shift their driving locus of control from external, uncontrollable causes to internal, controllable causes, they are likely to be more cautious and more responsible when driving the vehicle. Changes in locus of control have been linked to changes in performance. Anderson (1977) examined locus of control and performance in 64 managers over a two and a half year period following a natural disaster. Their findings indicated that locus of control initially influenced performance, which in turn served as a feedback mechanism to impact future locus of control perceptions. More external locus of control perceptions were related to a reduction in performance. Similarly, it can be expected that the more a driver changes his/her driving locus of control (lower externality, higher internality), the more improvement in his/her safe driving behaviors can be expected.

Hypothesis 2. Drivers' increase of internal locus of control and decrease of external locus of control will be associated with improvement in safe driving behavior.

Motivation to learn and pretraining self-efficacy have been identified as important precursors to training performance and transfer (Blume, Ford, Baldwin, & Huang, 2010; Colquitt, LePine, & Noe, 2000). For example, motivation to learn prior to learning experiences has been found to affect knowledge and skill acquisition in a variety of domains such as supervisory skills (Warr & Bunce, 1995), performance appraisal and feedback (Baldwin, Magjuka, & Loher, 1991), and complex computer simulation (Quiñones, 1995). In particular, Stanton et al. (2007) suggested that trainees' motivation may influence outcomes of a driver coaching program. Similarly, pretraining self-efficacy has been found to affect learning and transfer for sales (Frayne & Geringer, 2000), technical/professional (Tziner, Fisher, Senior, & Weisberg, 2007), and managerial jobs (Tews &

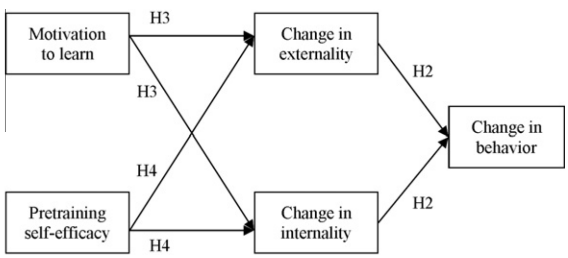

Fig. 1. Hypothesized model.

Tracey, 2008). We expect that drivers who are motivated to learn are more ready to embrace the information provided during the defensive driving training. Drivers who have higher self-efficacy to master the training material are more likely to feel comfortable taking more responsibility for his/her driving behaviors and be willing to apply the training to the driving task.

Hypothesis 3. Motivation to learn will predict drivers' increase of internal locus of control and decrease of external locus of control.

Hypothesis 4. Pre-training self-efficacy will predict drivers' increase of internal locus of control and decrease of external locus of control.

2. Method

2.1. Participants

The participants in this study consisted of adults enrolled in a truck drivers training program that prepares trainees towards obtaining a commercial driver's license (CDL). A total of 112 of the possible 152 trainees provided useable data (74% response rate) for this study. Of the participants, 93.3% was male, and their age ranged from 18 to 56 years old ($M = 36$, $SD = 10$). Sixty-five percent of the trainees were Caucasian, 22% were African American, and 4.5% were Hispanic. Participants included in the study did not significantly differ in age, gender, race, or driving experience from the nonparticipants.

2.2. Procedure

Individuals were invited to participate in this study at the beginning of a defensive driving course. The course was provided by a nonprofit truck safety organization based in the Midwest of the United States. Although participation in the course is voluntary, the truck driving school did encourage individuals to take the course. The defensive driving course was structured into two 2-h classroom sessions that were approximately a week apart. The classroom sessions covered materials essential for truck drivers to engage in safe driving and to avoid traffic situations that could lead to an accident. In addition to the classroom sessions, the trainees participated in two road course evaluations that involved driving a tractor–trailer on a predetermined route. The first road course occurred approximately 2 weeks prior to the first classroom training session, and the second road course occurred approximately 2 weeks after the second classroom session. During the road course, each trainee was accompanied by a trained observer who provided navigational directions and recorded the trainee's driving behaviors using a standardized evaluation form. A total of eight observers who had extensive training on driving performance evaluation conducted the observations. After each road course, which took approximately 90 min to complete, the observer provided feedback based on the completed evaluation form to the trainee. The feedback stressed the strengths and weaknesses in the trainee's driving behaviors displayed in the road course. Each feedback session lasted approximately 30 min.

2.3. Training program

The defensive driving program focused on actions that truck drivers can take that increase or decrease the probability of an accident occurring while on the road. The sessions emphasized information that had direct application to the safe and skillful operation of the truck. In particular, it focused on issues of situational awareness and close calls, how driving tasks and driving behaviors interrelated, and issues of search, speed, direction control and timing (see Vanosdall, Irwin, & Ring, 2000, for a detailed discussion of the program). The instructional content included mini-lectures, class discussion, videos, and case analyses. Given that all participants had been through the on-the-road course, some of the content referenced this driving experience.

2.4. Observation session

A series of observations were made by trained raters on a standardized 32 km driving route which included urban, suburban, rural, residential, and freeway driving. In this way, a wide variety of driving behavior could be observed. As noted in a validation study by Forbes, Nolan, Schmidt, and Vanosdall (1975) on this road test, the standardized route was divided into a set of discrete driving segments (e.g., driving towards and past a rural intersection or driving onto a freeway).

The observers were trained to use a standardized assessment form. To ensure proper use of the instrument, observers attended classroom discussion of all phases of the procedure, practice observing and recording information on the form, as well as experience in rating drivers with an experienced observer present and discussion following about the quality of the ratings made.

The observers explained the predetermined route to the driver prior to starting the driving session. There were 17 driving segments where the driver's behaviors were evaluated. Drivers were given ample instructions on what to do next prior to reaching the next driving segment. For example, one segment required the driver to exit off a highway and merge into a second highway. The observer told the driver ahead of time of the next segment and then rated search, speed control and direction control and provided an overall accident reduction rating for each segment driven. For example, the driver was rated as unsatisfactory in these three areas if the driver only searched ahead, maintained the same speed and/or did not activate their turn signal. The driver was given a satisfactory rating across the three dimensions if they searched left and right, decelerated gradually for conditions, and signaled for the right turn. The observer did not provide any feedback during the driving segments but just recorded the behaviors that they saw. The feedback session after the driving segments were completed focused on the assessments across the driving segments. The provision of specific and detailed feedback in summary form immediately after performance is consistent with research that has demonstrated such feedback results in enhanced skill retention and improvement (Schmidt, Young, Swinnen, & Shapiro, 1989; see Schmidt & Bjork, 1992 for a review).

2.5. Measures

Measures were taken at four different points in time for this study. Prior to the pretraining road course evaluation, trainees filled out questionnaire pertaining to their internal/external driving locus of control and driving self-efficacy. They reported their motivation to learn immediately before each classroom session. Finally, prior to the posttraining road course evaluation, trainees responded to scales that measured their posttraining internal/external driving locus of control, and driving self-efficacy. Responses to self-report measures were made on five-point Likert scales ranging from (1) "Strongly Disagree" to (5) "Strongly Agree" unless noted otherwise. The drivers were then assessed on the posttraining road test.

2.5.1. Driving locus of control

Perceptions of driving locus of control were measured using items from Montag's Driving Internality and Driving Externality scales (Montag & Comrey, 1987). Consistent with Montag and Comrey as well as other authors (e.g., Abrahamson, Schludermann, & Schludermann, 1973), we adopted the internality/externality two-dimensional conceptualization of driving locus of control. Specifically, we selected seven items from the driving externality scale and five items from the driving internality scale based on high loadings on their respective factors reported by the authors. Example items are "Most accidents happen because of lack of knowledge or laziness on the part of the driver" and "Driving with no accidents is mainly a matter of luck." Confirmatory factor analysis on responses to the twelve items supported the expected two-factor structure both before training (CFI = 0.90, RMSEA = 0.06) and after training (CFI = 0.93, RMSEA = 0.07). Cronbach's alphas for the Internality and Externality scales were 0.76 and 0.69 for the first administration and 0.83 and 0.70 for the second administration.

2.5.2. Driving self-efficacy

Driving self-efficacy was measured using a six-item scale adapted from Ford, Smith, Weissbein, Gully, and Salas (1998). The items were modified to be consistent with the road course evaluation. An example item was "I have the ability to handle the situations that arise during the driving performance measurement." Cronbach's alpha for the scale was 0.92 for pretraining self-efficacy and 0.93 for posttraining self-efficacy. Posttraining self-efficacy was included to examine the competing explanation that change in self-efficacy, as a result of the training intervention, causes change in driving performance.

2.5.3. Motivation to learn

Participants' motivation to acquire knowledge and skills covered in the training program was measured using an eight-item scale adapted from Noe and Schmitt (1986). An example item was "I am motivated to learn the skills emphasized in this training program." Motivation to learn was assessed immediate before each classroom session (Cronbach's alpha = 0.87 and 0.89, respectively). Participant's motivation score was calculated by averaging two scale scores.

2.5.4. Safe driving behaviors

Safe driving behaviors were assessed using trainees' driving course evaluations. Arthur et al. (1991) encouraged the use of driving simulation as an additional criterion to driving safety, as driving simulation provides a finer operationalization and measurement of safe driving behaviors within a compressed timeframe. In addition, assessing trainees' safe driving behaviors using the same preset route allowed for a standardized measurement of driving safety without the confounds of road condition and driving distance.

The route for driving evaluations included both city and highway driving and contained 17 distinct segments of approximately equal lengths. Trainees performed various standard driving tasks, such as shifting lanes, merging, stopping, and making turns. The trained observers rated the extent to which trainees successfully performed in four areas: search, speed control, direction control, and overall accident reduction. Trainees' behavior was rated as either (0) "unsatisfactory" or (1) "satisfactory" in each of the 17 segments on each performance area, using well-defined driving performance criteria (Gustafson, Bradshaw, & Vanosdall, 1981). Each rating scale was anchored by behaviorally descriptive statements that corresponded to the scales of speed control, search, and direction control. A comprehensive study of this process found that there was high interrater agreement between observers/raters (Forbes et al., 1975). A subsequent study also found that the road test measures exhibited high interrater and intrarater reliabilities with reliabilities ranging from 0.61 to 0.94 with a mean of 0.82 (Gully, Whitney, & Vanosdall, 1995).

In the current study, an exploratory factor analysis on ratings in four areas revealed a clear one-factor solution for both pretraining and posttraining assessments. This is consistent with the findings of Gully et al. (1995). Therefore, trainees' ratings in all areas were averaged as an overall score for driving behaviors. No significant between-rater difference was found on driving behaviors after controlling for trainee demographics and testing conditions.

2.6. Change scores

To capture the amount of change on each of the constructs of interest, change scores were calculated by subtracting pre scores from corresponding post scores for externality, internality, and driving behaviors, as well as self-efficacy. Raw change scores, rather than residualized change scores (i.e., partialing out pretraining scores from corresponding posttraining scores), were selected for the following three reasons: (a) raw change scores represent unbiased measures of change (Allison, 1990; Willett, 1988); (b) raw change scores can be reliable measures of change when nonnegligible individual differences in change are present (Rogosa, Brandt, & Zimowski, 1982; Rogosa & Willett, 1983; Williams, Zimmerman, Rich, & Steed, 1984; Zimmerman & Williams, 1982); and (c) correlating residualized change scores with other variables can be problematic (Campbell & Kenny, 1999; Rogosa, 1988) and lead to improper statistical inferences (Jamieson, 1994). Prior to calculating raw change scores, we examined the skewness of the pre and post measures to ensure they were not severely skewed (see Jamieson, 1999). To rule out potential competing explanations of the associations between change scores (see Gardner & Neufeld, 1987), we conducted an exploratory factor analysis on the eight scales that were used to compute the change scores, including pre and post measures of externality, internality, driving behaviors, and self-efficacy. A clear four factor solution emerged after varimax rotation, with corresponding pre and post measures of each construct loading on the same factor.

3. Results

Table 1 presents descriptive statistics and intercorrelations for study variables. The demographic variables of age, gender, and prior driving experience did not significantly correlate with any study variables. Initial examination of the change scores revealed that changes in internality and externality were independent, and their relationships with change in driving behaviors were significant in the hypothesized direction. Moreover, changes in internality and externality were unrelated to change in self-efficacy, suggesting that each of the change variables captured the unique change in each construct rather than systematic response bias.[1]

We conducted paired-sample *t* tests to examine the changes of internality and externality due to the learning interventions. Posttraining internality was significantly higher than the pretraining levels, $t = 8.15$, $p < 0.001$, $d = 0.80$, and posttraining externality was significantly lower than the pretraining levels, $t = -3.56$, $p < 0.001$, $d = -0.34$. Thus, the results supported Hypothesis 1. For comparison purposes, we also conducted paired-sample *t* tests for both the constructs of self-efficacy and for driving behaviors. There was a significant increase in self-efficacy from pretraining to posttraining, $t = 4.54$, $p < 0.001$, $d = 0.43$, as well as a significant increase in driving behaviors, $t = 8.89$, $p < 0.001$, $d = 0.84$.

To simultaneously examine Hypotheses 2–4, we conducted a path analysis using AMOS 17.0 (Arbuckle, 2008). Fig. 2 presents the path model with standardized estimates. A similar model controlling for the demographic variables of age, gender, and prior experience yielded almost identical results and thus is not presented here. The model provided very good fit to the data, partially due to the simplicity of the model: $\chi^2(3) = 0.18$, *n.s.*; CFI = 1.00; RMSEA = 0.00. We further fitted a revised model by removing nonsignificant paths (see *Fig. 3*): $\chi^2(5) = 0.27$, *n.s.*; CFI = 1.00; RMSEA = 0.00.

We next focused on the interpretation of the parameter estimates. Changes in externality and internality were each significantly associated with change in driving behaviors in the expected direction. Trainees who had a larger decrease in externality and larger increase in internality improved to a larger extent in driving safety. Together, the change in driving locus of control accounted for 12% variance in improvement in safe driving behaviors. Thus, Hypothesis 2 was fully supported.

Regarding the predictors of change of driving locus of control, motivation to learn predicted change in externality while pretraining self-efficacy predicted change in internality. Trainees who were more motivated to master the materials covered in the training courses tended to have a larger decrease in externality, whereas trainees who were more efficacious toward performing well in the driving assessment tended to have a larger increase in internality. Therefore, Hypotheses 3 and 4 were partially supported.

We further examined the relationship between change in self-efficacy and change in driving behaviors to rule out the potential alternative explanation that changes in driving locus of control merely reflected trainees' assessment of their increase in knowledge and skills over the course of the two learning experiences. Not only was change in self-efficacy unrelated to change in driving behaviors ($r = -0.11$, *n.s.*), the changes in internality and externality remained significant predictors of change in driving behaviors after controlling for change in self-efficacy ($\beta = 0.20$, $p = 0.03$ and $\beta = -0.28$, $p < 0.01$, respectively).

[1] It might be interesting to note that externality, but not internality, shared significant variance with self-efficacy before training, whereas the pattern reversed after training, with internality, but not externality, sharing significant variance with self-efficacy. However, the changed pattern of correlations does not speak to the concurrence of changes.

Table 1
Descriptive statistics and intercorrelations for study variables.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age	–															
2. Gender	0.14	–														
3. Prior experience	0.32	−0.09	–													
4. Motivation to learn	0.03	−0.13	−0.10	–												
5. Pre internality	0.05	0.10	−0.02	0.22	–											
6. Pre externality	−0.06	0.14	0.07	−.23	0.00	–										
7. Pre self-efficacy	0.01	−0.02	0.03	0.34	0.08	−0.21	–									
8. Pre performance	−0.13	−0.03	0.08	−0.04	−0.01	−0.09	0.02	–								
9. Post internality	0.00	0.05	−0.10	0.33	0.61	−0.03	0.29	−0.13	–							
10. Post externality	−0.13	0.14	−0.05	−0.37	−0.16	0.53	−0.16	0.07	−0.20	–						
11. Post self-efficacy	−0.10	0.05	−0.05	0.45	0.16	−0.09	0.52	0.17	0.34	−0.10	–					
12. Post performance	−0.16	0.05	−0.06	0.01	−0.10	−0.10	0.09	0.36	−0.01	−0.24	0.14	–				
13. Change in internality	−0.05	−0.06	−0.09	0.12	−0.43	−0.04	0.24	−0.14	0.45	−0.05	0.20	0.10	–			
14. Change in externality	−0.09	0.02	−0.12	−0.19	−0.18	−0.36	0.02	0.16	−0.19	0.60	−0.03	−0.17	−0.02	–		
15. Change in self-efficacy	−0.012	0.07	−0.08	0.09	0.08	0.13	−0.52	0.15	0.04	0.06	0.46	0.05	−0.05	−0.05	–	
16. Change in performance	0.00	0.07	−.12	0.05	−0.07	0.00	0.05	−0.69	0.11	−0.25	−0.06	.43	.21	−0.28	−0.11	–
M	35.90	0.93	1.40	4.34	3.53	2.46	4.18	0.76	3.94	2.25	4.40	0.86	0.41	−0.21	0.22	0.10
SD	10.44	0.25	4.50	0.49	0.57	0.59	0.54	0.12	0.58	0.68	0.52	00.09	0.51	0.62	0.52	0.12

Note. N = 104–112. Gender: female = 0 and male = 1. For $|r| > 0.19$, $p < 0.05$; for $|r| > 0.25$, $p < 0.01$.

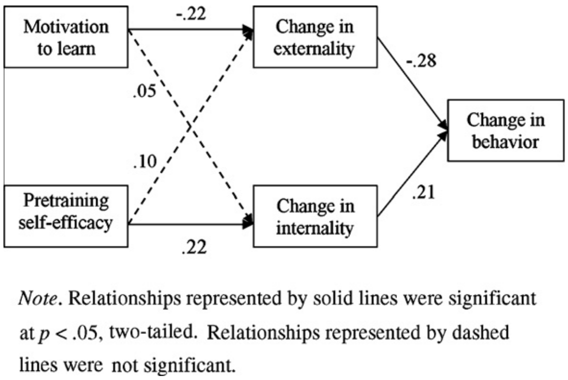

Fig. 2. Path model of hypothesized relationship. *Note*. Relationships represented by solid lines were significant at $p < 0.05$, two-tailed. Relationships represented by dashed lines were not significant.

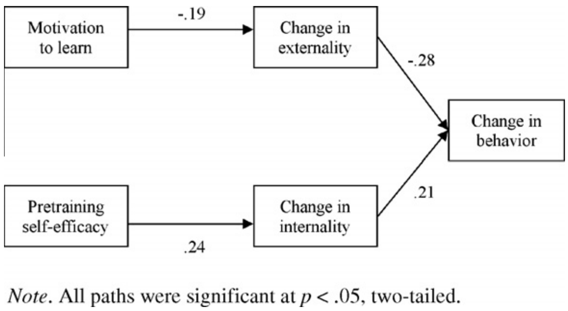

Fig. 3. Revised path model. *Note*. All paths were significant at $p < 0.05$, two-tailed.

4. Discussion

Although researchers have studied the effects of dispositional factors on automobile accidents and driving safety (e.g., Burns & Wilde, 1995; Clarke & Robertson, 2005; Furnham & Snaipe, 1993), offering organizations a mechanism to select safe drivers, much less has been done from the training and development perspective to purposefully influence drivers' stable perceptions regarding driving safety. Grounded in Rotter's social learning theory, the present study demonstrated that drivers experienced significant change in both externality and internality of their driving locus of control perceptions after a learning experience that included feedback from an observer and a defensive drivers training program. Specifically, the drivers reported significantly lower externality and higher internality after the learning experiences as compared to before these interventions. More importantly, the decrease in externality and increase in internality independently predicted an improvement in safe driving behaviors, highlighting the need to examine and influence both internal and external dimensions of driving locus of control. The study also shed light on the antecedents of changes in driving locus of control perceptions when the drivers were provided with structured learning experience specific to driving: motivation to learn and pretraining self-efficacy predicted a decrease in externality and an increase in internality respectively.

The study contributes to the literature by highlighting the nature of driving locus of control perceptions. In contrast to the belief that individual differences in attitudes towards driving are difficult to modify through training (Lee, 2008; Schuster, 1970), Stanton et al. (2007) successfully decreased drivers' externality perceptions. Further extending Stanton et al. (2007), our study shows that it is possible to induce meaningful changes in both dimensions of driving locus of control, and more importantly that those changes can impact driving behaviors. Future studies on driving safety and driving locus of control perceptions need to focus on the extent to which individuals' learning history and driving experience may shape their driving locus of control perceptions. Organizations that aim to reduce work-related traffic accidents might begin to consider the various ways to target changing an individual's locus of control perceptions as a leverage to enhancing driving safety.

The present study also provided some indication as to the process by which locus of control perceptions undergo changes. Although the drivers went through the same learning experiences, their levels of change in driving locus of control were not identical; rather, the change was found to be associated with individual difference variables: Individuals who were more motivated to learn had a larger decrease in driving externality, whereas individuals with higher pretraining self-efficacy had a higher increase in driving internality. Overall, the proposed model was supported by our findings. The present findings offer a tentative outlook for interventions towards safety and other domain-specific locus of control perceptions. Future studies could explore the extent to which safety related locus of control perceptions (e.g., hearing protection locus of control; Lusk, Ronis, & Kerr, 1995) can be influenced in a similar manner through safety training programs and observer feedback on safety behavior on the job.

The malleable nature of driving locus of control also provides a potential explanation for the inconsistent effects of locus of control on driving safety. Arthur and Doverspike (1992) noted that the drivers in the study by Montag and Comrey (1987) were all involved in fatal accidents and thus their locus of control perceptions may be influenced by the accidents, resulting in the association between locus of control and driving outcome. Thus, difference in drivers' experience across previous studies may have contributed to the inconsistent findings. In the present study, the correlation between internality and externality was 0.00 before training and −0.20 after training, and the correlation between externality and driving performance was −0.09 before training and −0.24 after training. Although the difference in correlation coefficients were not statistically significant (ps = 0.13 and 0.25, respectively), the pattern of correlations seems to indicate that the associations were influenced by driver experience in the training program. Furthermore, the change of correlations between internality/externality and self-efficacy also appears to support the same notion.

The study findings must be considered in terms of some limitations of this research design. First, the study participants were drivers who intended to apply for a commercial driver's license and also had a reasonable amount of driving experience. It is possible that these drivers were more motivated to learn and thus were more open to the possibility of seeing accidents as controllable relative to drivers in the general population. Future investigation can determine the generalizability of the findings—whether similar type of driver training programs may change the driving locus of control perceptions and driving behaviors of noncommercial drivers.

Second, the current research design does not allow firm conclusions of causality. In particular, practical constraints prevented a random assignment of participants into a control group. Thus, the conclusion of Hypothesis 1 that driver training combined with observer feedback can lead to changes in internality and externality may need to be tempered by potential alternative explanations. However, for results of Hypotheses 2–4, we took two steps to strengthen the design and enhance internal validity, following Shadish, Cook, and Campbell's (2002) three components of causal inference: (a) temporal precedence; (b) covariance; and (c) absence of plausible alternative explanation. First, the measurement of variables was temporally sequenced in a longitudinal design: pretraining self-efficacy and motivation to learn were measured prior to change of internality and externality, which further preceded change in driving performance. Thus, it is unlikely that reverse causality existed in the mediation model. Second, we assessed the relationship between change in self-efficacy and change in driving behaviors to rule out the possibility that an increase in self-efficacy attributed to improvement in driving behaviors. Thus, results shown in the path model (Fig. 3) possess reasonable internal validity.

Third, due to practical constraints, we could only implement two waves of measurement and, thus, were only able to examine the hypothesized effects using change scores. Although we examined the components of change scores to ensure interpretability, more waves of measurement would enable the modeling of trends. Fourth, as locus of control was the primary focus, we did not include other types of predictors that have been studied in relation to driving safety, such as information processing and cognitive ability (e.g., Arthur & Day, 2008; Arthur et al., 1991). Thus, it remains unknown whether other variables may exert influence on or interact with the effects we found. Nevertheless, the main purpose of the study was to determine if one could change driving locus of control and to test a process model of how individual level factors can affect changes in driving locus of control and driving behaviors. Future research can investigate the pattern of relationships between motivation to learn and self-efficacy and changes in driving locus of control perceptions. More research is needed to understand the dynamic process by which locus of control perceptions may change and how to further maximize the changes.

In conclusion, this study demonstrated that a training program on defensive driving paired with observer feedback could influence drivers' locus of control perceptions regarding driving safety. The increase on internal locus of control and decrease on external locus of control independently predicted changes in safe driving behaviors. Organizations may design training interventions targeted on drivers' locus of control beliefs to enhance driving safety.

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