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Short communication

Attentional control, high intensity pleasure, and risky pedestrian behavior in college students

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A B S T R A C T

Individual differences in temperament and personality are closely linked to motor vehicle safety. However, 13% of Americans who die in transportation-related injuries are not killed in motor vehicle crashes, but rather in pedestrian injuries. This study was designed to study links between two individual difference measures, attentional control and high intensity pleasure, and pedestrian injury risk among college students, a group at particular risk of pedestrian injury. A sample of 245 students completed a temperament questionnaire and engaged in a street-crossing task within an interactive, immersive virtual pedestrian environment. Individuals scoring high on attentional control (the capacity to focus and shift attention, one facet of conscientiousness) waited longer to choose gaps to cross within and showed some tendency to choose larger gaps after waiting. Individuals scoring high in high intensity pleasure (the tendency to desire novel, complex, and varied stimuli, one facet of sensation-seeking) were more likely to experience collisions with traffic in the virtual environment. Theoretical and applied implications are discussed.

1. Introduction

Individual differences in temperament and personality predict a wide range of injury outcomes. Traits such as sensation-seeking, hostility, impulsivity, and effortful control are associated with occupational safety (Clarke and Robertson, 2005, 2008) and the tendency to safeguard or ignore potentially dangerous environments (Booth-Kewley and Vickers, 1994). Similarly, the field of transportation safety has long recognized the role of individual differences in personality on motor vehicle crash history and risky driving behavior (Dahlen et al., 2005; Schwebel et al., 2006). Literature reviews (Beirness, 1993; Jonah, 1997) and large empirical studies (e.g., Dahlen et al., 2005; Iversen and Rundmo, 2002; Schwebel et al., 2006) indicate a number of individual difference constructs as predictors of risky driving, but two traits emerging prominently and consistently in previous work are conscientiousness and sensation-seeking.

Conscientiousness reflects the tendency toward conscientious, dependable, and cautious behavior. Individuals scoring high on conscientious behave in a dutiful, constrained, and inhibited manner (e.g., Costa and McCrae, 1998). One facet of conscientiousness, attentional control, was of particular interest in this study. Attentional control refers to an individual's capacity to focus and shift attention. It is believed to play a significant role in transportation safety. In the driving literature, for example, higher levels of attentional control appear to lead to more careful, slow, and safe driving, and perhaps to more thorough evaluation of the risks present in the driving environment (Elander et al., 1993).

Sensation-seeking refers to the tendency to desire and seek complex, varied, novel, and rapidly moving or changing sensations and experiences (e.g., Zuckerman, 1994). In this study we were particularly interested in one facet of sensation-seeking, high intensity pleasure, which refers to the tendency to seek and enjoy high-stimulus, exciting, novel, and diverse experiences and stimuli. The construct of high intensity pleasure, which is based in temperament theory (Rothbart et al., 2000), overlaps with both the thrill and adventure seeking and the experience seeking subscales of Zuckerman's (1994) sensation-seeking construct. High intensity pleasure is cited as a correlate to risky driving behavior. Individuals scoring high on high intensity pleasure are more likely to drive quickly, recklessly, or while intoxicated (Dahlen et al., 2005; Schwebel et al., 2006).

Although motor vehicle crashes constitute the largest bulk of transportation-related injuries, they are not the only cause of transportation injury. Of the 47,894 Americans killed in transportation-related injuries in 2005, 6074 or 13% were killed in pedestrian injuries rather than motor vehicle crashes (National Center for Injury Prevention and Control [NCIPC], 2008). College students are at particular risk of pedestrian injury, partly because they have increased exposure – they walk frequently – and partly

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because they have a tendency toward risk-taking, walking while intoxicated, and walking during night time hours. In 2006, nearly 20,000 Americans aged 18–22 suffered serious pedestrian injuries. Over 300 suffered fatal pedestrian injuries (NCIPC, 2008).

Despite these statistics, the role of individual differences in risk for pedestrian injury is poorly understood. With the exception of work studying links between temperament differences to children's pedestrian safety skill development (e.g., Barton and Schwebel, 2007), research examining possible links between individual differences and pedestrian injury risk is quite sparse. Understanding those links would be helpful to educate empirically supported development of interventions that target at-risk individuals or at-risk situations.

The present study was designed to study links between individual differences and pedestrian injury risk in college students. We chose to focus on attentional control and high intensity pleasure because (a) they are traits correlated to motor vehicle safety, a domain we view to have many parallels to pedestrian safety because they require similar cognitive, perceptual, and behavioral tasks; (b) they are traits that appear, from a face validity perspective, to be relevant to safe pedestrian behavior; and (c) they are easily measured through reliable and valid self-report instruments. A sample of 245 college students completed a self-report temperament questionnaire and engaged in a street-crossing task within an interactive and immersive virtual pedestrian environment. We hypothesized low levels of attentional control and high levels of high intensity pleasure would relate to risky pedestrian behavior. We also examined the interaction of the two traits, expecting the combination of both individual differences might particularly increase pedestrian injury risk.

2. Methods

2.1. Participants

Archival data were used. Participants were 245 college students (62% female) enrolled in introductory psychology courses at University of Alabama at Birmingham. They were recruited to participate in one of three studies (Schwebel et al., 2008; Stavrinos et al., in preparation) as a way to fulfill a course requirement. The sample was 51% White, 34% African American, 8% Asian American, and 7% multiracial or of other races/ethnicities. Most participants were of traditional college age (median = 19 years, mean = 21.48 years, SD = 6.71). All protocols, including this secondary data analysis, were approved by the university IRB and all participants provided informed consent to participate.

2.2. Virtual pedestrian environment

Specifics of the hardware, software, and experience within the virtual environment are published elsewhere (Schwebel et al., 2008). Briefly, participants are immersed in an environment displaying a 180° perspective on three monitors arranged in a semi-circle in front of them. The environment includes a mid-block crosswalk, with traffic moving from both directions. Ambient and traffic noise is delivered through speakers. The environment is interactive, such that when the user steps off the curb, the perspective changes from first- to third-person and they view themselves crossing the street, witnessing the safety or risk of the crossing. The virtual environment validly represents real-world pedestrian behaviors in both children and adults (Schwebel et al., 2008).

2.3. Protocol

Students participated individually, for a single experimental session. Following informed consent procedures, they were taken to a straight hallway and asked to walk along a line several times, at the speed they would normally use to walk across a street. Walking times were recorded by stopwatch, and the average of the walks was used as the participants' walking speed within the virtual environment. Participants were then taken into the virtual environment for familiarization. A research assistant demonstrated two street-crossings within the virtual environment, one successful and the other a purposeful failure to reduce participant curiosity about the consequences of being "hit" in the virtual environment. Finally, participants completed familiarization street-crossings in the virtual environment themselves.

Test trials were composed of 8 or 10 (depending on the study) virtual street-crossings by each participant. As detailed below under "Measures," the mean of pedestrian behaviors across all crossings was used for analysis. Participants also completed individual differences and demographic questionnaires, as detailed below.

2.4. Measures

2.4.1. Demographics

Participants completed a brief demographic report which included items concerning gender, age, and race/ethnicity.

2.4.2. Individual differences

Individual differences were assessed by the short form of the Adult Temperament Questionnaire (ATQ; Rothbart et al., 2000), a 77-item measure yielding scores on 13 scales that fall into four broad factors. All items are answered using a 7-point Likert scale. The ATQ has good internal consistency and convergent validity (Rothbart et al., 2000).

Of particular interest were participants' scores on two subscales of the ATQ, attentional control and high intensity pleasure. The attentional control scale has five items (Cronbach's alpha = 0.67 in this sample and 0.73 in the sample used for instrument development (Rothbart et al., 2000)) such as, "When I am trying to focus my attention, I am easily distracted." Higher scores reflect higher levels of control. The high intensity pleasure subscale has seven items (Cronbach's alpha = 0.57 in this sample and 0.68 in the sample used for instrument development (Rothbart et al., 2000)), such as "I would enjoy watching a laser show with lots of bright, colorful flashing lights." Higher scores reflect higher levels of high intensity pleasure.

2.4.3. Pedestrian behavior

Four indicators were computed to assess pedestrian behavior:

(a) average wait time, or the time (in seconds) a participant waits before identifying a gap to cross within and initiating crossing;
(b) attention to traffic, or the number of times a participant looks left plus right before crossing, divided by waiting time;
(c) perceived gap, or the temporal gap (in seconds) a participant crosses within, adjusted for perception. Thus, if a participant enters the crosswalk as a vehicle is passing in the far lane, that vehicle is considered to have passed already and forms the beginning of the safe gap. Similarly, if a vehicle passes in the near lane as the participant is approaching the curb in the far lane, that passing vehicle is considered the end of the gap that was crossed within; and
(d) hits, or the average number of instances when the participant would have been struck by a vehicle in the real environment (transformed to estimated number of hits per 100 crossings).

Average wait time, perceived gap chosen, and hits were computed electronically by processing the data collected in the virtual environment. Attention to traffic was computed by review of video

Table 1
Descriptive data and intercorrelations ($N = 245$).

Variable	*M* (SD)	2	3	4	5	6	7	8
1. Age (years)	21.48 (6.71)	0.04	0.21**	−0.26**	0.13*	−0.05	0.14*	−0.06
2. Gender (1 = male; 2 = female)	37% male		−0.00	−0.16*	−0.04	−0.17**	0.08	0.13*
3. Attentional control (7-point scale)	4.06 (1.11)			−0.10	0.16*	−0.05	0.14*	0.02
4. High intensity pleasure (7-point scale)	4.32 (1.01)				0.05	0.09	−0.03	0.12
5. Wait time (s)	8.66 (8.30)					−0.19**	0.69**	0.07
6. Attention to traffic (looks/wait time)	0.59 (0.16)						−0.31**	−0.06
7. Perceived gap (s)	37.73 (9.42)							0.11
8. Hits (per 100 crossings)	2.76 (5.60)							

* $p < 0.05$.
** $p < 0.01$.

taken while participants engaged in the virtual environment. Interrater reliability in coding attention to traffic was high, with at least 20% of the sample coded independently by two coders in all studies, and $r > 0.95$ reliability obtained in all cases.

3. Results

Table 1 displays descriptive data and intercorrelations for all variables. Because age correlated with both individual difference measures, and gender with high intensity pleasure, both age and gender were controlled in subsequent analyses. When relations between individual differences and pedestrian behavior were considered in bivariate correlations, attentional control was related to higher levels of wait time ($r = 0.16$, $p < 0.05$) and selection of larger perceived gaps ($r = 0.14$, $p < 0.05$). High intensity pleasure was not related to any of the four pedestrian behavior measures in bivariate analyses.

Table 2 displays results from hierarchical linear regression models predicting the four pedestrian behavior outcomes. In each, demographics (age and gender) were entered in the first step, followed by the two individual difference traits (attentional control and high intensity pleasure) and then the interaction between the two individual difference traits (attentional control by high intensity pleasure). Attentional control was reversed and both variables centered through standardization prior to computation of the interaction variable.

As shown in Table 2, Step 1, and replicating the findings in bivariate correlations, older participants tended to wait longer before crossing and to choose larger perceived gaps to cross within. Men tended to attend to traffic less carefully and experience hits in the virtual environment more frequently. When individual differences were added to the models in Step 2, higher levels of attentional control emerged as a predictor of longer waiting time, and higher levels of high intensity pleasure as a predictor of hits in the virtual environment. Neither individual difference trait predicted attention to traffic or perceived gap entered. The interaction effect was not significant in any of the models when entered in Step 3.

4. Discussion

Participants' attentional control was positively related to time waited to cross a virtual street; those individuals with higher levels of attentional control waited longer before crossing. High intensity pleasure was positively related to hits in the virtual environment. Those individuals with higher levels of high intensity pleasure were more likely to be struck by vehicles in the virtual environment.

The results offer both theoretical and applied implications. Theoretically, they highlight the fact that pedestrian behavior is not a single behavior, but rather the concatenation of several different cognitive, perceptual, behavioral, and motor tasks. Each is likely to be influenced by different sets of individual differences. We discovered, for example, that waiting time was related to attentional control. Individuals who wait for safe traffic gaps are likely to be safer pedestrians, and this might be influenced by individual differences in attentional control. Attention to traffic was not related to either attentional control or high intensity pleasure in our study. This may be because attention to traffic is influenced more directly

Table 2
Stepwise regression models predicting pedestrian behavior ($N = 245$).

Variable	Wait time			Attention to traffic			Perceived gap			Hits		
	B	SE	*β*	*B*	SE	*β*	*B*	SE	*β*	*B*	SE	*β*
Step 1: Demographics												
Age	0.17	0.08	0.13*	−0.00	0.00	−0.05	0.19	0.09	0.13*	−0.06	0.06	−0.07
Gender (1 = male)	−0.83	1.14	−0.05	−0.06	0.02	−0.17**	1.52	1.29	0.08	1.73	0.76	0.15*
Step 2: Individual differences added												
Age	0.16	0.09	0.13	−0.00	0.00	−0.02	0.16	0.10	0.11	−0.04	0.06	−0.04
Gender (1 = male)	−0.52	1.14	−0.03	−0.06	0.02	−0.16*	1.65	1.30	0.08	1.99	0.77	0.17*
Attentional control	1.08	0.50	0.14*	−0.01	0.01	−0.04	1.09	0.57	0.13	0.26	0.34	0.05
High intensity pleasure	0.76	0.56	0.09	0.01	0.01	0.06	0.19	0.63	0.02	0.77	0.37	0.14*
Step 3: Interaction added												
Age	0.16	0.09	0.13	0.00	0.00	−0.01	0.17	0.10	0.12	−0.04	0.06	−0.04
Gender (1 = male)	−0.53	1.14	−0.03	−0.06	0.02	−0.17*	1.64	1.30	0.08	1.98	0.77	0.17*
Attentional control	1.05	0.51	0.14*	−0.01	0.01	−0.06	1.06	0.58	0.12	0.25	0.34	0.05
High intensity pleasure	0.79	0.56	0.10	0.01	0.01	0.07	0.23	0.64	0.02	0.78	0.38	0.14*
Att. Cont. × HIP	−0.22	0.52	−0.03	−0.02	0.01	−0.11	−0.34	0.59	−0.04	−0.09	0.35	−0.02

Note: Wait time: Step 1 $R^2 = 0.02$, Step 2 $\Delta R^2 = 0.03$, Step 3 $\Delta R^2 = 0.00$. Attention to traffic: Step 1 $R^2 = 0.03$, Step 2 $\Delta R^2 = 0.01$, Step 3 $\Delta R^2 = 0.01$. Perceived gap: Step 1 $R^2 = 0.02$, Step 2 $\Delta R^2 = 0.02$, Step 3 $\Delta R^2 = 0.00$. Hits: Step 1 $R^2 = 0.03$, Step 2 $\Delta R^2 = 0.02$, Step 3 $\Delta R^2 = 0.00$. Att. Cont. × HIP = attentional control by high intensity pleasure interaction, with attentional control reversed and both variables centered through standardization.

* $p < 0.05$.
** $p < 0.01$.

by individual differences in cognition and perception, rather than the temperament-based individual differences we studied.

From an applied perspective, one might envision intervention programs on campuses that target at-risk pedestrians, as identified through temperament or personality profiles. Even though such a prospect holds appeal in many ways, it is pragmatically very challenging. Both students and activists are likely to resist personality profiling, and the effort involved is probably outweighed by the potential benefit. A more feasible alternative is to target all pedestrians for at-risk behaviors that at-risk individuals might engage in most frequently. College students are by nature a challenging population to target in safety interventions. They tend to behave in impulsive, risky manners, and retain the "optimism bias" that they are invincible from and invulnerable to danger (Weinstein, 1980, 1984). College students also have increased risk because of their high exposure opportunity – they cross streets frequently – and their simultaneous risk-taking behaviors, such as engaging in pedestrian activity while intoxicated and engaging in pedestrian behavior while distracted talking using mobile phones.

Nonetheless, recognition that individual difference traits such as poor attentional control are linked to increased pedestrian safety risk suggests campus-based interventionists might consider ways to increase attentional control of students crossing streets near their university campuses. Barriers to prevent mid-block crossings, strict enforcement of jaywalking laws, use of aural as well as visual signals to represent safe crossing opportunities at intersections, and traffic calming, are all strategies that might increase attentional control even among individuals who have poor attentional control capacity.

In closing, we mention strengths and limitations of our research. This is one of the first studies to systematically study links between individual differences and pedestrian behavior in college students. The sample was large and relatively diverse. We studied pedestrian behavior in a virtual world validated to present real-world behavior, but could measure only pedestrian behavior during a mid-block street-crossing. Our work does not address topics such as pedestrian route selection, walking while intoxicated, or walking while distracted. Future research should consider other temperament and personality traits (e.g., anger, impulsivity) that might correlate to pedestrian behavior, further investigate the causal mechanisms behind pedestrian risk-taking, and consider how these findings might be utilized in intervention development. Finally, our individual difference measures were only via self-report, and had only moderate internal reliability. Future work might use alternative measures of individual difference constructs in replication attempts.

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