Original Article

Predicting self-reported driving speed compliance with the bi-dimensional attitudes

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Abstract

Introduction: Attitudes play a key role in predicting speeding behavior. This study aimed to test: a) whether the positive/negative attitudes towards speeding, and the positive/negative attitudes towards compliance with the speed limit can predict the speed limit compliance behavior; b) which of the positive and negative dimensions of the attitudes have a greater contribution; c) whether the positive/negative attitudes towards compliance with the speed limit can account for variance in the speed limit compliance behavior over and above that explained by the positive/negative attitudes towards speeding.

Materials and Methods: In the present study conducted in September 2020 to March 2021, 202 people who drive daily in the city of Mashhad-Iran voluntarily completed self-report questionnaires measuring their driving experiences, positive and negative attitudes towards speeding and compliance with the speed limit, and past behavior of compliance with the speed limit. The data were analyzed by using multiple regression analysis and SPSS-25 software.

Results: The positive-negative attitudes towards speeding independently accounted for a significant proportion of the variance of speed limit compliance behavior (R2= 0.32, *P*< 0.001), and the negative attitude towards speeding was the stronger predictor (β= 0.35, *P*< 0.001). The positive/negative attitudes towards compliance with the speed limit also accounted for a significant increment (3.6%, *P*< 0.01) to explain variance in speed limit compliance behavior.

Conclusion: The results provide more support for the bi-dimensional attitudes towards speeding in predicting speed limit compliance behavior. It demonstrates that the positive/negative attitudes towards compliance with the speed limit improve the prediction of the behavior independently of the positive/negative attitudes towards speeding. Also, negative attitude has a greater contribution in predicting speed limit compliance behavior.

Keywords: Attitude, Cognition, Health risk behavior, Traffic accidents

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Introduction

The latest reports of the World Health Organization (WHO) indicate that Road Traffic Injuries (RTIs) annually takes the lives of about 1.3 million people and cause serious physical damage to about 50 million people around the world. These reports also demonstrate that 93% of mortalities caused by RTIs are related to low- to middle-income countries. Based on the WHO geographical classification, the Eastern Mediterranean Region (EMR) has the third highest RTI-related mortality rate after Africa and Southeast Asia, with 18 deaths caused by RTIs per 100,000 people. Interestingly, there are national traffic rules and regulations, e.g., speed limit, in most countries in the EMR (1). Iran is one of the middle-income countries in the EMR; the rate of RTI-caused mortalities in Iran in 2019 (25.06 deaths per 100,000 people) was above the average in the region (2). Zakeri et al. found that RTIs account for 167% of Gross Domestic Production (GDP) and 347% of health expenditures (3).

Although RTI is a multifactorial variable influenced by the complex relationship of environmental, technical, and human factors, ample evidence indicates that risky behaviors alone or in interaction with other factors play a major role in traffic accidents (4,5). Based on the 2018 reports by WHO, speeding, drink-driving, and non-use of motorcycle helmets, seatbelts, and child restraints are among the main factors that should be taken into account in comprehensive solutions to prevent RTI-caused deaths (1). In this regard, speeding is one of the most important behavioral factors that increase the risk of an accident and the severity of injuries (6-8).

Speeding means exceeding the speed limit or driving too fast for the road conditions (6). Yu et al. reported that speeding was responsible for 27% of all RTI-caused deaths in the USA in 2016 (equal to 10,111 cases) (9). Yousefifard et al. by conducting a meta-analysis of articles published until the end of 2020 to identify the most important risk factors of road accident-related mortality in Iran, found that the findings of three studies, including 664,291 fatal crashes, indicated that exceeding the speed limit increased the risk of death by 3.16 times (10). In addition to studies that have proven the relationship between attitude and RTIs or risky driving behaviors in general (11,12), some studies have specifically addressed attitudes toward speeding as a key factor in predicting both speeding intention and subsequent behaviors (13,14).

Many studies have commonly viewed "attitude toward speeding" as a unidimensional construct (15,16), whereas others have provided a bi-dimensional view of positive and negative attitudes to predict speeding behavior (17). Studies have shown that the positive and negative dimensions of "attitude toward speeding" can independently predict self-reported speeding behavior (18) and actual speeding behavior (19,20).

Based on traditional concepts of attitude, which refer to the positive or negative evaluation of the possible consequences of a behavior, it is assumed that attitudes are unidimensional, i.e., individuals evaluate behaviors considering the positive-negative dimensions and a single bipolar unit. It is assumed that one is more likely to perform a behavior when evaluating it more positively. However, it results in the ambiguity of the midpoint of the bipolar scale. The midpoint in an evaluation involving a range from very positive to very negative can indicate attitudinal indifference (when a behavior is evaluated neither positively nor negatively) or attitudinal ambivalence (when a behavior is evaluated both positively and negatively). To resolve this ambiguity, the split semantic differential technique was proposed to assess separate positive and negative dimensions (bi-dimensional attitudes) (21). Therefore, it is assumed that the probability of performing a behavior increases both when it is evaluated positively and not evaluated negatively (18-20).

The results of studies that have predicted the different positive and negative attitudes toward self-reported speeding behavior (18) and actual speeding behavior (19) have shown, too, that the positive dimension of attitude is significantly stronger than its negative dimension in predicting speeding behavior.

This study hence aims to measure the predictive power of positive and negative dimensions of attitude toward speeding independently and then investigate the potentially greater contribution of the positive dimension of attitude towards speeding than its negative dimension in predicting the speeding behavior of drivers. The findings of other studies demonstrate that practicing cognition (cognition related to acting, such as speeding) and not practicing cognition (cognition related to not acting, such as avoiding speeding or

compliance with the speed limit) are independent constructs (22,23). Letirand and Delhomme showed that attitudes towards exceeding the speed limit and speed limit compliance are independently related to speeding intention and behavior and, as a result, improve their predictability (24). According to this issue, another objective of this study is to test whether the positive and negative dimensions of the attitude toward speed limit compliance can account for variance in speed limit compliance behavior over and above bi-dimensional attitudes toward speeding and whether the positivity bias generalizes to bi-dimensional attitudes toward speed limit compliance.This study aimed to test whether bi-dimensional attitudes towards speeding can independently predict speed limit compliance behavior and which of the positive and negative dimensions of them have a greater contribution so; we intended to test whether the positive and negative dimensions of the attitude toward compliance with the speed limit can account for variance in speed limit compliance behavior over and above bi-dimensional attitudes towards speeding.

Materials and Methods

The optimal sample size for the present study was considered according to Tabachnik and Fidell's (25) recommendation as the required sample size for multiple regression designs. By the convenient sampling method, from a total of 211 residents of Mashhad who voluntarily completed the available online and paper questionnaires from September 2020 to the end of March 2021, the data of 202 people analyzed who met the criteria of the research project, including a minimum age of 19 and a maximum of 59 years, passing at least one year since receiving a driver's license, and having experience driving daily during the past year on the urban roads of Mashhad city and having at least primary education to be able to answer the questions of the questionnaire. Nine samples were excluded because of the distorted questionnaires. 36.6% of the participants were female. The participants' ages ranged from 20 to 59 (M=36.61 and SD= 9.04), and their driving experience ranged from 1 to 39 years. Participants were assured of the anonymity of their responses and were free to leave the study at any stage. The University Committee for Research Ethics, ID IR.UM approved the study.REC.1398.093.

Research instruments

A) Demographic and Driving Experience Questionnaire: The questionnaire collected information on age, gender, level of education, and driving experience before the start of the COVID-19 pandemic. These include the year of possessing a valid driving license, years of driving experience, frequency of driving, length of driving, number of driving offenses, and their type (e.g., speeding, overtaking, not wearing a seat belt, crossing a red light, violating no entry, violating no parking, mobile phone use while driving and other), number of accidents, whether culpable or not. They were also asked if their driving changed after the start of the pandemic.

B) Attitude Scale: Based on Ajzen (26) and Paris and Van den Broucke's study (23), 4 subscales were designed to focus more on the construct of the attitude towards speeding. The scoring method of these subscales was 5-point Likert *(*1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree, and reverse scoring for negative items*)*. Internal consistency coefficients ranged from 0.68 to 0.81. The scores of each subscale indicate an aspect of fast driving attitude and cannot be summarized together and provide a single scale for attitude. The low correlation and overlap between these subscales, as well as the high component load and the satisfactory levels of internal consistency, confirm this claim (23). Subscales were as follows;

-Positive attitude towards exceeding the speed limit- included seven items, "Speeding: 1) Get me to my destination faster, 2) Makes me feel self-sufficient and gives me freedom of action, 3) Gives me self-confidence, 4) Allows me to drive with the flow of traffic, 5) Makes me feel I have control of my car, 6) It saves time, 7) It is exciting". The score on this scale ranges from 7 to 35, the higher score indicating a more positive attitude towards speed (23,26).

-Negative attitude towards exceeding the speed limit- included 3 items, "Speeding: 1) Causes trouble for other drivers, 2) Increases the risk of serious accidents, 3) Causes serious damage to the vehicle and the environment". The score on this scale ranges from 3 to 15, the higher score indicating a more negative attitude towards speed (23,26).

-Positive attitude towards compliance with speed limit- Included 4 items, "Observing the speed limit: 1) Reduces the risk of an accident, 2) Keeps me calm while driving, 3) Makes me

feel I have control of my car, 4) Allows me to react better in unforeseen circumstances while driving". The score on this scale ranges from 4 to 20, the higher score indicating a more positive attitude towards observing the speed limit (23,26).

 -*Negative attitude towards compliance with speed limit*- included 6 items, "Observing the speed limit: 1) It is not necessary on a secluded road and low volume of traffic, 2) It is boring, 3) It is not necessary on the road that I am familiar with, 4) Causes waste my time, 5) Restricts my freedom of action, 6) It does not allow me to drive with the flow of traffic". The score on this scale ranges from 6 to 30, the higher score indicating a more negative attitude towards observing the speed limit (23,26).

 C) Compliance with Speed Limit Behavior: Seven items instead of one, as in Paris and Van den Broucke's study (23), were designed to measure observing speed limit behavior with a retrospective approach. These include "In the last six months; 1) I observed the speed limit, 2) I observed the speed limit on the city highways, 3) I observed the speed limit on the main streets of the city, 4) I observed the speed limit on the side streets of the city, 5) I did not observe the speed limit on a secluded road and the low volume of traffic, 6) I did not observe the speed limit on a familiar road, and I use to drive on it often, 7) I did not observe the speed limit on the roads with no speed cameras." The scoring method of this scale was 5-point Likert *(*1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree, and reverse scoring for negative items*)*. The score on this scale ranges from 7 to 35, the higher score indicating higher observing speed limit behavior. The internal consistency of this scale was 0.86.

 At first, to assess the internal consistency of the attitude and compliance speed limit behavior scales, a pilot study was implemented on 60 subjects between February 2020 and June 2020. After eliminating defects that were observed (among these modifications was the removal of items that increased the internal consistency of each subscale, as well as the addition of more items to measure the speed limit compliance behavior compared to what was found in the cognitive determinants of speed questionnaire- validated in the study of Paris and Van den Broucke (23)-, the main data collection started between September 2020 and March 2021. With the convenience sampling

method, the participants were mainly employees working in public and private sectors (employees of the university, Gas organizations, banks, investment companies, engineers, etc.), freelancers (doctors, psychologists, counselors, car exhibitors, etc.) as well as students and homemakers. The self-report questionnaire of the research project was prepared according to the code of ethics approved by the National Committee for Research Ethics which includes: anonymity, privacy, publication of the results in groups, and permission to leave the project at any stage of accountability. First, information on demographic characteristics and the driving experience was presented. Then, before presenting the propositions related to the attitude and speed limit behavior scales to the participants, necessary explanations were provided about the important terms used in these propositions. In such a way, "speeding" means that, for example, if you are driving on a road where the speed limit is 50 km/h, your vehicle has a minimum speed of 60 km/h. Moreover, "compliance with the speed limit" means not exceeding the posted speed limit according to each category of urban roads (highway, main street, side street, alley, etc.). The average time required to complete the questionnaire was 7 minutes.

 As the hypothesis sought to assess the predictive value of bi-dimensional attitudes toward speeding to predict the compliance speed limit behavior furthermore to determine if the bi-dimensional attitudes toward compliance with speed limit predicted additional variance over and above the bi-dimensional attitudes toward speeding, multiple regression analysis was undertaken whereby the bi-dimensional attitudes toward speeding were entered into block 1. The bi-dimensional attitudes toward compliance with the speed limit were entered into block 2 for predicting the past self-reported compliance speed limit behavior. Significance testing was assessed at $P < 0.05$, and all data analysis processes were performed using the SPSS 25 software version.

Results

 After excluding disrupted questionnaires, data from 202 individuals were analyzed. Table 1 shows the demographic and driving experience of participants. As shown, 69.8% of participants drove daily, and 33.2% stated that

applied restrictions due to the corona outbreak did not affect their daily driving time. Speeding accounted for the largest portion (42.6%) of the

reported traffic violations, and more than half of the participants (55.4%) reported at least one accident in the last three years.

Table 1. Participant's demographics and driving experience

Variables		n (%)	M (SD)	Range
Age (Year)		202 (100)	36.61 (9.04)	20-59
Gender	Male	128 (63.4)		
	Female	74 (36.6)		
Level of education	Under diploma and diploma	26 (12.9)		
	Undergraduate	5 (2.5)		
	Less postgraduate	7 (38.6)		
	Postgraduate	93 (46)		
Licensed years		202 (100)	14.69 (8.37)	1-40
Years of driving experience		202 (100)	12.21 (8.08)	1-39
Average time of driving during one week (Hour)		202 (100)	7.86 (6.36)	1-48
Number of accidents over the past three years	No accidents	90 (44.6)		
	1-2 accidents	98 (48.5)		
	3 or more accidents	14 (6.9)		
Number of driving offenses during the last three years	No offenses	62 (30.7)		
	1-2 offenses	62 (30.7)		
	3 or more offenses	78 (38.9)		
Type of offenses	Speeding	86 (42.6)		
	Overtaking	20 (9.9)		
	Not wearing a seat belt	45 (22.3)		
	Crossing a red light	24 (11.9)		
	Violating no entry	9 (4.5)		
	Violating no parking	54 (26.7)		
	Mobile phone use while driving	28 (13.9)		
	Other offenses	22 (10.9)		
Frequency of driving excluding restrictions on corona prevalence	Daily	141 (69.8)		
	Once every two days	30 (14.9)		
	Once a week	15 (7.4)		
	Once every two weeks & less	16 (7.9)		
Impact of restrictions on corona prevalence on driving time	Very much increased	8 (4)		
	Increased	19 (9.4)		
	Very much decreased	51 (25.2)		
	Decreased	57 (28.2)		
	No effect	67 (33.2)		

Relationship between the speed limit compliance behavior and bi-dimensional attitudes toward speeding and compliance with the speed limit. The sample means, standard deviations, and correlations for the bi-dimensional attitude measures and the compliance speed limit behavior are shown in Table 2. The sample mean for the positive attitude dimension toward speeding was below the scale midpoint (i.e.,21), which indicates that the participants did not, on average, evaluate the positive outcomes of exceeding the speed limit very positively. On the other hand, the sample means for the negative attitude dimension toward speeding was over the scale midpoint (i.e.,9), indicating that the participants evaluate the negative outcomes of exceeding the speed limit relatively negatively on average.

The sample mean for the positive attitude dimension toward compliance with the speed limit was greater than the scale midpoint (i.e.,12), which indicates a positive evaluation of the positive consequences of speed limit compliance. The sample mean for the negative attitude dimension toward compliance with the speed limit was below the scale midpoint (i.e.,18), which indicates that the participants did not, on average, evaluate negative outcomes of the speed limit compliance very negatively. The mean on the speed limit compliance behavior measure was greater than the scale midpoint (i.e.,12), indicating that the participants complied with the speed limit on urban roads.

The correlations in Table 2 show that, as expected, the positive and negative dimensions

of attitude toward speeding were negatively correlated, meaning that the more the participants evaluated the positive outcomes of exceeding the speed limit as being positive, the less they evaluated the outcomes as being negative. The correlation coefficient of less than 0.70 between these two dimensions of attitude toward speeding indicates that these constructs are independent (25). Similarly, there is a significant negative correlation between the positive and negative dimensions of the attitude toward compliance with the speed limit. The observed correlation coefficient (less than 0.70) indicates the independence of these two constructs from each other (25).

In line with expectations, the positive dimension of attitude toward speeding and the negative dimension of attitude toward compliance with the speed limit were negatively correlated with the speed limit compliance behavior. Moreover, the negative dimension of attitude toward speeding and the positive dimension of attitude toward compliance with the speed limit were positively correlated with the speed limit compliance behavior. In other words, the more positive the attitude towards speeding or the more negative the attitude towards compliance with the speed limit, the more participants exceeded the speed limit and vice versa.

Table 2. Descriptive statistics and correlations for all attitude measures and speed limit compliance behavior

	No. of items in the scale	Cronbach's α	Mean (SD)	Range	1	2	3	4	5
1. Speed limit compliance behavior	7	0.86	26.31 (3.10)	7-35	1	-0.47**	0.47**	0.39**	-0.48**
2. Positive attitude to speeding	7	0.81	18.44 (5.08)	7-35		1	-0.35**	-0.31**	0.56**
3. Negative attitude to speeding	3	0.69	12.03 (2.01)	3-15			1	0.48**	-0.45**
4. Positive attitude to compliance with the speed limits	4	0.68	16.20 (2.38)	4-20				1	-0.43**
5. Negative attitude to compliance with the speed limits	6	0.78	15.78 (3.71)	6-30					1

**P< 0.001, *P< 0.01

Prediction of the past self-reported speed limit compliance behavior

To test both hypotheses 1 and 2, multiple regression analysis was conducted in two blocks (see Table 3). The dependent variable was the measure of the past self-reported speed limit compliance behavior, and the independent variables in block 1 were positive and negative attitudes toward speeding. The positive and negative dimensions of attitudes toward compliance with the speed limit were added to the regression in block 2.

In support of hypothesis 1, Table 3 shows that 32% of the variance in speed limit compliance behavior accounted for in block 1 of the regression model, $F_{(2,199)}= 48.31$, $P< 0.001$. Both the positive ($\beta= 0.34$, $P< 0.001$) and the negative ($\beta= 0.35$, $P< 0.001$) dimensions of attitudes toward speeding are independently significant predictors of speed limit compliance behavior. Since the overlap of their 95% confidence intervals of the positive dimension (CI= -0.221 to -0.466) and the negative

dimension of attitude toward speeding (CI= 0.228 to 0.474) was more than 50% (27), they have no significant differences in predicting speed limit compliance behavior. In this way, the greater predictive power of the positive attitude dimension is not confirmed. To measure the difference between two standardized regression coefficients, Cumming (27) demonstrated that two-point estimates are not likely statistically significantly different from each other when the corresponding 95% confidence intervals overlap by more than 50% (95% confidence intervals for beta coefficients were calculated using the bootstrapping analysis and 1,000 re-samples).

In support of hypothesis 2, Table 3 also shows a 3.6% increase to explained variance in speed limit compliance behavior in block 2 of the regression model, R2change= 0.036, Change $_{(2,197)}= 5.61$, $P< 0.01$. The entire model remained significant ($F_{(4,197)}= 28.08$, $P< 0.001$), and accounted for 35% of the speed limit compliance behavior variance. The positive and negative dimensions of attitude toward speeding

were still significant independent predictors of behavior in block 2. In this block, while the negative attitude toward compliance with the speed limit was a significant predictor of the speed limit compliance behavior (β= -0.18, $P<$ 0.05), the positive attitude toward compliance with the speed limit was not significant. Thus contrary to the proposed hypothesis, the positive attitude toward compliance with the speed limit does not have greater predictive power than the negative dimension toward speed limit compliance behavior.

Table 3. Multiple regression predicting the speed limit compliance behavior from bi-dimensional attitudes toward speeding and compliance with the speed limit

Predictor variables	Adjusted R^2	R^2_{change}	F_{change}	B	S.E.	β	t	P	95% CI for B	
Block 1	0.320	0.327	48.312						Lower bound	Upper bound
Positive attitude to speeding				-0.270	0.049	-0.344	-5.531	0.000	-0.466	-0.221
Negative attitude to speeding				0.698	0.124	0.351	5.646	0.000	0.228	0.474
Block 2	0.350	0.036	5.610							
Positive attitude to speeding				-0.189	0.055	-0.241	-3.469	0.001	-0.378	-0.104
Negative attitude to speeding				0.501	0.136	0.252	3.687	0.000	0.117	0.387
Positive explicit attitude to compliance with the speed limits				0.187	0.113	0.112	1.658	0.099	-0.021	0.244
Negative attitude to compliance with the speed limits				-0.198	0.080	-0.184	-2.479	0.014	-0.331	-0.038

Discussion

The study found that attitudes whether it is towards speeding or towards compliance with the speed limit; accounted for a significant proportion of the variance of speed limit compliance behavior. The study findings on the first hypothesis are consistent with the results of Elliott et al. (18) in predicting self-reported speeding behavior and the results of McCartan and Elliott (19) and McCartan et al. (20) in predicting objective speeding behavior.

The second part of hypothesis 1, which indicates the greater power of positive attitudes compared to negative attitudes in predicting speed limit compliance behavior, still needs to be confirmed. Nevertheless, similar previous studies have shown that the positive dimension of attitude was significantly stronger than its negative dimension in predicting speeding behavior. For example, Elliott et al. found that the positive dimension of attitude outperforms the negative dimension in predicting self-reported speeding behavior on rural and urban roads (18). In another study, McCartan and Elliott reported that the positive dimension of attitude was a better predictor of objective speeding behavior than its negative dimension in a driving simulator (19). McCartan et al. also showed that the standard regression coefficient of the positive dimension of explicit attitudes

was significantly greater than that of the negative dimension in predicting objective speeding behavior (20). The difference between the results of this study and the findings of other studies regarding the greater power of positive attitudes in predicting speeding behavior can be attributed to the way the positive and negative attitudes were measured.

The participants in such studies are usually asked to think of and rank the pleasant or unpleasant consequences of exceeding the speed limit (e.g., How pleasant are the positive outcomes of speeding? or How unpleasant are the negative consequences of speeding?). However, since the pleasant or unpleasant consequences in emotional and cognitive dimensions were presented to the participants as pre-specified propositions in our study, the participants have probably managed to visualize negative consequences, which cannot be easily retrieved from memory as compared to positive outcomes. As a result, the negative dimension of attitude moderated the greater power of the positive dimension of attitude in predicting behavior (18-20).

The finding on hypothesis 2 demonstrates that cognition related to avoiding a behavior (attitudes toward compliance with the speed limit) is an independent construct of cognition related to performing the same behavior

(attitudes towards exceeding the speed limit) (22-24). Based on the second part of hypothesis 2, the assumption of the greater power of the positive dimension of attitude in predicting speeding behavior still needs to be confirmed. This asymmetry between the positive and negative attitudes toward compliance with the speed limit in predicting speed limit compliance behavior is derived from the negativity bias. This means that the negative outcomes of compliance with the speed limit (e.g., the tediousness of speed limit compliance or wasting time) are more probable and more urgent than the positive outcomes (e.g., a sense of control and keeping calm) (18).

While this study has important implications for theory and practice, some limitations must be considered when interpreting the data. First, the mere focus of this study was on explicit attitudes. Explicit attitudes influence behaviors through exploratory processing, although behaviors such as driving are habitual, controlled by automatic processes, and implicit attitudes can further influence this behavior (28). In future studies, it is necessary to measure the effects of implicit attitudes on driving behaviors.

On the other hand, explicit attitudes are usually measured using self-report questionnaires, which can expose the results to cognitive biases (21). Nevertheless, some previous studies have reported a high correlation between self-reported and objective measures of speeding behavior (29).

Another limitation of this study was that the attitudes and self-reported behavior measures were included in the same questionnaire and measured simultaneously.

In contrast, similar studies usually measure constructs such as attitude at first and then measure speeding behavior prospectively after a while (18,19,28). As such, we measured past behavior and not subsequent behavior, which would have caused consistency bias and resulted in an artificial increase in the relationships between attitudes and behavior.

Conclusion

This research shows that the positive and negative dimensions of attitude towards speeding play independent and different roles in predicting speed limit compliance behavior. This finding can serve as a basis for behavior-change interventions. Another major finding of this study demonstrated the increasing contribution of bi-dimensional attitudes toward compliance with the speed limit as a construct independent of attitudes towards speeding in predicting speed limit compliance behavior. Therefore, it seems necessary to evaluate the cognition related to the avoidance of behavior and the evaluation of the cognition related to performing the same behavior to strengthen attitude measurement tests.

Acknowledgments

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