

Article

Judgement of Transport Security, Risk Sensitivity and Travel Mode Use in Urban Areas

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Abstract: The current study aims to examine judgement of security in public transport and, more specifically, the role of the priority of security and risk sensitivity in the use of public travel modes versus car among an urban public. The results are based on a self-completion questionnaire survey conducted among residents above 18 years of age in the six most urbanised areas in Norway ($n = 1043$). The respondents were randomly obtained from the Norwegian population registry. The results showed that priority of security as well as risk sensitivity was significant predictors of travel mode use among an urban public when demographic factors were controlled for. In studies carried out previously, risk sensitivity was conceived to be a predictor of risk perception. The large proportion of explained variance in perceived risk reported in previous studies could be partly due to the use of risk sensitivity as a predictor variable, which is coincident with the criterion variable. It is suggested that the risk perception concept could be replaced with perceived risk evaluations, which cover the intuitive cognitive judgements of probability of an event with negative consequences as well as the severity of consequences if such an event takes place. It is proposed that risk sensitivity could be the main concept, covering the perceived risk evaluations, including intuitive judgments of probability as well as severity of consequences across a set of risk sources.

Keywords: security; public transport; risk sensitivity; priority of security; travel mode use; judgement of transport security; risk sensitivity; and travel mode use in urban areas

1. Introduction

To promote the use of public travel modes, measures aimed at increasing the frequency of use of bus, tram and subway and to reduce the use of private motorised modes, have high priority. This is especially true in urban areas due to the negative consequences of private motorised travel modes, for example, congestions, air pollution and noise [1–3]. In addition, private motorised travel modes have higher accident rates than public transportation [4]. Use of public travel modes is conceived as a more pro-environmental behaviour. Therefore, more knowledge is needed to understand the urban public's use of private and public travel modes as well as how future choices could be moved into a more pro-environmental direction by use of public transport as well as walking and cycling (active transportation). The current study focuses on use of public travel modes versus car among an urban public.

The focus of the current study was restricted to demographic, temporal and psychological factors hypothesized to influence urban passenger transport and especially individual-level decisions about travel mode use. Ebrahimi and Tadic [5] focus on the challenges of transport of dangerous goods in such areas. They also presented a new model for handling such risks.

Frequency of public travel mode use versus car use may be associated with risk perception related to safety as well as security issues. In accordance with Hudspith [6], perceived risk is conceived

to be a cognitive construct consisting of the subjective assessment of probability of an event as well as the judgement of severity of consequences if such an accident should take place. As a pure cognitive concept risk perception has also been found to be related to emotions and feelings (worry) [7]. The association between judgment of severity of consequences and worry was found to be larger and more significant compared to the association between probability assessment and worry. In accordance with the risk-as-feelings perspective [8] anticipated or direct emotions, that is, emotions that are not cortically mediated, are hypothesised to be associated with risk perception and perceived risk with anticipatory worry, that is, cortically mediated feelings.

Rundmo and Nordfjærn [9] found no support for the hypothesis that perceived risk is a formative indicator of subjective assessment of assessment of probability and judgement of severity of consequences. Instead these two aspects seemed to be independent from each other and not related to one abstract underlying concept. Risk perception is therefore not an adequate concept for describing cognitive processes in judgement of risk. In the present paper such judgements are entitled perceived risk evaluations.

Several studies have investigated the role of perceived risk evaluations in use of public versus private motorised travel modes. In a representative sample of the Norwegian urban public, Nordfjærn, Lind, Şimşekoğlu et al. [10] showed that the more frequently public travel modes were used, the larger the respondents perceived the probability of an accident in public transport. Similarly, the more frequently the respondents used car the higher were the perceived risk evaluations of accidents when using car. Priority of safety and security was also found to be associated with travel mode use. Lind, Nordfjærn, Jørgensen and Rundmo [11] also showed that accidental risk evaluations were related to travel mode use. In a study of stated preferences for willingness to change travel modes from car to public transportation and walking it was shown that perceived risk evaluations of pedestrian accidents was a significant predictor variable [12]. In addition to associations between perceived evaluation of accidental risk and travel mode use it is also interesting to examine the role of risk perception in non-accidental risks. Due to several episodes of acts of terror and other negative security risks at public transportation, the current study extends previous work by a focus on the associations between perception of security risks and travel mode use.

Several studies carried out previously have examined perceived risk related to security (probability of violence, acts of terror, etc.) in public transport. Roche-Cerasi, Rundmo, Sigurdson and Moe [13] showed that there were differences in overall perceived risk evaluations between frequent users of private and public travel mode users in representative samples in Paris and Oslo. The group including those who most frequently used public travel modes perceived the probability of experiencing violence and acts of terror on public travel modes to be larger compared to those who most frequently used car. Frequent public travel mode users were also found to be more worried about security issues on public transportation. In a representative sample of the Norwegian public, Rundmo, Nordfjærn, Iversen et al. [14] also reported differences in perceived risk evaluations and worry with regard to criminality and acts of terror on public travel modes when comparing a group of respondents who used public travel modes most frequently with a group of respondents who most frequently used private motorised travel modes. There were differences in perceived risk between these travel mode user groups on short as well as long travels. Frequent users of public transport perceived the security problems to be more probable compared to frequent users of own car. Nordfjærn, Şimşekoğlu, Lind et al. [15] showed in a study of a representative sample of commuters in six urban areas in Norway that perceived risk evaluations and worry related to terrorism, sabotage, theft, harassment and other uncomfortable episodes, as well as violence significantly predicted travel mode use.

The studies presented above primarily examined the role of perceived risk and worry in travel mode use. Accordingly, the current study also hypothesises perceived risk evaluations and worry to be significant predictor variables of travel mode use, that is, use of public travel modes versus car. In addition, perceived risk evaluations have been distinguished from risk sensitivity [16]. Risk sensitivity is the general tendency to perceive all risks as large or small. Consequently, risk sensitivity

is linked to perceived risk. The current study aims to examine coincidence between perception and sensitivity in risk judgements.

Rundmo and Moen [7] showed that perceived risk evaluations in various types of transport were significantly associated. Those who perceived the risk to be large concerning one type of transport also perceived the risk to be large in other areas and vice versa. Sjøberg [17] found that risk amplification-attenuation was a significant predictor variable of personal as well as general perceived risk evaluation. The risk amplification-attenuation framework attempts to explain the process by which risks are amplified, receiving public attention or attenuated, receiving less public attention. In a random sample of the Swedish public, Sjøberg [16] showed that risk sensitivity was a significant predictor variable of general perceived risk evaluations among other factors, for example, trust in authorities, attitudes and the pooled original psychometric dimensions [18]. In these studies, perceived risk evaluations and risk sensitivity were distinguished. However, if risk is rated to be high in one domain it is more likely to be rated as high in another domain, which implies risk sensitivity. Thus, it could be that risk sensitivity is identical to perceived risk evaluations. This may also partly explain why “risk sensitivity” explained as much as 65 per cent of perceived risk in Sjøberg’s [16] study. Common method variance could also be part of the explanation.

In the current study risk sensitivity is conceived to be pooled perceived risk evaluations. While risk evaluations have been found to be equal to hazard perception [9], risk sensitivity adds to the understanding of the concept by introducing an element of perceived risk that is a general tendency in risk perception which is independent of the object that is perceived. Thus, perceived risk evaluations consist of two elements. The first is linked to the characteristics of the object that is perceived (i.e., subjective assessment of the probability of experiencing a negative event and judgement of severity of consequences if it should occur) and a general characteristic reflected in the sensitivity of risk in general. Risk sensitivity should also be distinguished from perceived risk consistency. Respondents may vary in risk sensitivity, that is, the level of perceived risk when judging a number of risk sources, as well as in risk consistency, that is, how consistent or stable the risk level of all the sources is perceived. The current study hypothesises that risk sensitivity and risk stability significantly predict travel mode use.

Several risk perception studies carried out previously have also shown that there were differences in perceived risk due to gender [19–22], age group [23–26] and level of education [27]. Additional factors which could be important for mode use are annual income, car access and frequency of previous use of public travel modes [14]. In the current study these factors are incorporated as control variables in multivariate analyses.

Hitherto, very few studies have investigated all the above-mentioned factors in an integrated model to predict travel mode use. However, several of the prediction variables have been examined in studies aimed to explain risk behaviour in transport as well as precautionary action and demand for risk mitigation. The role of risk perception is most frequently included as a predictor variable in previous research aimed at explaining risk behaviour. However, there are a few, if any studies aimed at focusing and integrating these factors in a model aimed at predicting travel mode use. To gain more insight into the relative importance of these factors may be important in order to promote the use of pro environmental public transportation in urban areas instead of motorized private travel modes. The aim of the study is to investigate the role of priority of security and risk sensitivity in use of public travel modes versus car among an urban public. An additional objective is to discuss the relationship between risk perception and risk sensitivity.

2. Methods

2.1. Sample

The results of the current study are based on a self-completion questionnaire survey carried out among residents above 18 years of age in the six most urbanised areas in Norway. A sample was

randomly obtained from the Norwegian population registry restricted to the inclusion criteria of geographic location of the urbanised areas and age ($n = 7000$). A total of 1043 respondents (18%) replied to the questionnaire. In population studies low response rates have now become quite common [28,29]. Low response rates may be caused by the fact that the research topic is salient only for a small part of a randomly selected sample.

A total of 56 per cent of the respondents were female. The average age was 41.40 years and ranged from 18 to 74 years. Concerning educational level 4 per cent reported basic education (primary/secondary school) to be their highest educational level, 13 per cent general secondary education (high school equivalent), 22 per cent a bachelor's degree or equivalent and 43 per cent a master's degree. There were no significant differences in demographic characteristics between the six subsamples and the target population [15].

2.2. Questionnaire

The respondents were asked to assess the occurrence probability of a security problem on a seven-point evaluation scale ranging from 'not at all probable' to 'very probable.' Separate responses were required for theft, blind violence, sexual assault, harassment, being too late at work, sabotage of travel mode and act of terror [14]. Transport mode use was measured by asking the respondents about their weekly ordinary use of transport modes. Seven travel modes were included and the respondents were asked to indicate their frequency of use for each of them [14]. Public motorised travel modes included train, bus, tram and metro and private motorised modes were car, motorcycle and moped/scooter. A six-point evaluation scale was applied, which varied from 'five days per week or more' to 'zero times per week.' Few respondents used motorcycles, mopeds and scooters. Hence, these travel modes were excluded from further analysis. The questionnaire also contained questions about the demographic characteristics of the respondents, including gender, age, level of education and car access. They were also asked about whether they themselves had been victimised due to a security-related problem when using public transportation and how they prioritised security measures to prevent theft, harassment and acts of terror. The latter evaluations were also measured on a seven-point evaluation scale ranging from "very important" to "not at all important." Seven-point evaluation scales were applied for the measurements because research carried out in this area previously, have used seven-point scales instead of five-point Likert type scales.

2.3. Statistical Analysis

Multivariate analysis of covariance (MANCOVA) was applied to examine differences in risk probability assessments due to travel mode use and past risk exposure. In all the MANCOVA analyses the covariates were gender, age group, level of education, annual income, distance from residence to the closest public transport point and car access. A hierarchical cluster analysis was used to determine the number of clusters of travel mode user groups and k -means cluster analysis was used to find the ideal cluster solution of mode users. A median split on risk sensitivity as well as risk stability was carried out to identify groups of risk sensitive and risk stable respondents. To examine whether priority of security and risk sensitivity was associated with travel mode use (public travel modes versus car) logistic block regression analysis was used. Analysis was carried out separately for leisure and work travels in order to explain travel mode use. In both analyses travel mode use was the dependent variable, while the independent variables were entered in three blocks. In previous research [10] it was found that demographic variables were associated with travel mode use. Demographic variables (gender, age, education, annual income) were therefore entered as control variables in the first block. Security risk experience as well as spatial and transport availability (minutes to walk from own residence to the nearest public transport point and car access) were also entered into this block. Priority of security (to prevent theft, harassment, terror) was entered as the second block and risk sensitivity was entered in the third block. Concerning the third block, the cluster of risk ignorant respondents was judged to be least risk sensitive of all the four groups ($n = 342$), the cluster groups two and three

had a mediocre risk sensitivity and the fourth group of respondents was judged to consist of the most risk sensitive respondents.

3. Results

3.1. Perception of Security in Public Transport

Table 1 shows the respondents' probability assessments of experiencing a security-related problem when using public transport, including theft, blind violence, sexual assault and so forth. Integer 1 implies low probability and integer 5 very high probability of security problems in public transport. The respondents assessed the probability of "theft" and "harassment" to be larger compared to the other types of security problems that were measured. The probability of "sexual assault" and "terrorism" was perceived to be low. A MANCOVA aimed to examine differences in the respondents' assessment of probability for experiencing security problems in such transport was carried out (significant differences shown in bold). Those who most often used public travel modes were compared to those who most frequently used car. Columns two to eight in Table 1 shows the mean values of the respondents' assessments of probability for each of the seven security risk factors. There was a significant overall difference in judgement of security problems (Wilks' $\lambda = 0.95$, $p < 0.001$). Gender, age group and educational level were covariates in the analysis. The frequent public travel mode users perceived the probability of security problems in general to be larger compared to the group of frequent users of private motorised travel modes. This was the case for assessment of the probability for "theft" ($F = 9.17$, $p < 0.01$), "sexual assault" ($F = 7.68$, $p < 0.01$), "harassment" ($F = 7.20$, $p < 0.01$) and "terrorism" ($F = 9.37$, $p < 0.01$). There were also tendencies, however not significant, in the same direction for assessments of "blind violence" and "sabotage." Thus, respondents who most frequently used public travel modes assessed the security problems related to use of such modes to be larger compared to less frequent users.

Table 1. Differences in probability assessment of security risks in public transport—frequent users of private motorised travel modes (car) and public travel modes compared. Results of MANCOVA (gender, age group and education as covariates) (significant differences in bold) (scale 1 = not at all probable, / = very high probability).

Frequent Users of:	Travel Mode Probability Assessments						
	Theft	Blind Violence	Sexual Assault	Harassment	Being too Late at Work	Sabotage	Terrorism
Private motorised travel modes (car)	3.80	2.97	1.92	3.02	5.28	2.26	1.82
Public travel modes	4.23	3.19	2.29	3.43	4.92	2.45	2.16
F-value	9.17 **	3.24 (NS)	7.68 **	7.20 **	12.33 ***	1.52 (NS)	9.37 **

Wilks' $\lambda = 0.95$, $p < 0.01$, ** = $p < 0.01$, *** = $p < 0.001$, NS = Non-Significant.

The respondents were also asked to assess the probability of "being too late at work" due to public travel mode delay. In this case the group difference was in the opposite direction. Those who most seldomly used public transportation assessed the probability of delay to be larger when using public travel modes compared to the cluster group of frequent users of such modes ($F = 12.33$, $p < 0.001$).

It could be argued that "being too late at work" is not a security problem in line with the other security problems in public transport. While the other items have to be conceived as the probability of outside inflicted damages, the probability of "being too late at work" is either caused by the traveller or by the operating travel company. In this case it is not a problem inflicted to a victim during the travel. Most often the consequences are more trivial compared to other security problems concerning public transportation. The internal consistency of the judgements of risk sensitivity measured on a single dimension was satisfactory ($\alpha = 0.839$). When excluding the item "being too late at work," the reliability improved marginally ($\alpha = 0.859$).

There were large and significant positive associations between the probability assessments of the security problems, that is, those who assessed one security problem to be large also tended to assess the other security problems in the same way and vice versa, indicating the presence of risk sensitivity (see Table 2). The coefficients varied between 0.15 and 0.65. “Being too late at work” is a triviality risk and not primarily a security problem. This risk was also only weakly associated to the other security hazards and hence, excluded from further analysis.

Table 2. Associations between probability assessments—security aspects (Pearson’s r correlation coefficients). (***) = $p < 0.001$)

	Theft	Blind Violence	Sexual Assault	Harassment	Being too Late at Work	Sabotage of Travel Mode
Blind violence	0.65 ***					
Sexual assault	0.41 ***	0.55 ***				
Harassment	0.55 ***	0.67 ***	0.57 ***			
Being too late at work	0.31 ***	0.27 ***	0.20 ***	0.29 ***		
Sabotage of travel mode	0.37 ***	0.47 ***	0.53 ***	0.48 ***	0.29 ***	
Terrorism	0.36 ***	0.50 ***	0.48 ***	0.42 ***	0.15 ***	0.60 ***

3.2. Previous Experiences with Security Risks

In addition to probability assessments the respondents were also asked whether or not they had been exposed to one or more security risks when using public transportation during the last five years. A total of 14.5 per cent reported that they had experienced themselves either “theft,” “sexual assault,” “harassment,” “terrorism” or “sabotage” during this time period. Thus, in addition to frequency of use of public travel modes, the respondents’ previous experiences of public travel mode security hazards have to be taken into consideration.

A MANCOVA was carried out to examine the differences in probability assessments of public travel security problems due to risk exposure (frequent users of public versus private transportation) and previous personal experience with security problems when using public transportation (see Table 3). As shown there were significant differences in the judgement of probability due to previous hazard experience (Wilks’ $\lambda = 0.87$, $p < 0.001$).

Table 3. Differences in probability assessment—security risks due to past risk exposure.

Effect	Wilks’ λ	F-values					
		Theft	Blind Violence	Sexual Assault	Harassment	Sabotage	Terrorism
Gender	0.845 ***	5.88 *	2.84	66.14 ***	22.49 ***	23.28 ***	9.60 **
Age group	0.945 ***	3.20	0.01	4.69	10.13 **	8.17 **	0.51
Level of education	0.967 *	1.46	13.33 ***	3.71	1.94	2.69	3.78
Security hazard exp.	0.872 ***	13.65 ***	26.10 ***	9.45 **	67.85 ***	7.51 **	3.48
Travel mode use: work	0.979	0.23	0.04	0.01	3.00	2.54	4.38 *
Travel mode use: leisure	0.960 *	0.04	2.47	5.97 *	0.96	0.44	0.02

*** = $p < 0.001$, ** = $p < 0.01$. * = $p < 0.05$, NS = non-significant. Integer 1 = low probability, integer 5 = high probability.

Table 4 shows the mean values separately for those who had themselves experienced a security problem on public transportation and those who had not experienced such a problem. Those who had experienced security problems perceived the security risks to be larger than the group who had not had such an experience. Thus, frequency of use as well as past personal experience of a security problem seemed to enhance the assessment of future probability of experiencing such an event.

Table 4. Differences in probability assessment due to past security risk experience.

	Hazard Experience	
	Yes	No
Theft	4.65	3.79
Blind violence	3.80	2.94
Sexual assault	2.61	1.91
Harassment	4.67	2.89
Sabotage	2.73	2.25
Terrorism	2.13	1.89

3.3. Risk Sensitivity and Risk Stability

A median split on risk sensitivity as well as risk stability was carried out and four groups emerged. The first group consisted of respondents who scored low on risk sensitivity as well as on risk consistency ($n = 342$). In addition to rating the probability as low they were characterised by a low Sd, indicating that they judge the overall probability to be low, that is, consistent low score. This group could be defined as consisting of risk ignorant respondents. The next group consisted of respondents who rated some of the risks to be large and at the same time their evaluations were characterised by a low Sd ($n = 152$). This group was characterised of risk instability and consisted of risk steady respondents. The third group of people who rated most of the probabilities to be low, however, was characterised by a high Sd, indicating a variety in judgements ($n = 188$). This group was entitled risk fluctuating respondents. Finally, there were respondents who rated the probability of all risks to be high and consequently the group was characterised by a low Sd ($n = 351$). This group was entitled risk sensitive respondents. A total of 52.2 per cent of the respondents scored high on risk stability and 48.7 per cent on risk sensitivity (see Table 5).

Table 5. Number of respondents due to risk sensitivity and risk stability.

		Risk sensitivity		n
		Low	High	
Risk stability	Low	342 (33.1%)	152 (14.7%)	494 (47.8%)
	High	188 (18.2%)	351 (33.0%)	539 (52.2%)
n		530 (51.3%)	503 (48.7%)	1033

The number of risk sensitive female respondents were larger than expected by statistical inference compared to male respondents $\chi^2 = 30.06$, $p < 0.001$. There were also more risk sensitive respondents than expected among those who had a vocational practical education and a university education less than 3 years. The number of risk insensitive respondents were larger than expected by statistical inference among those who had a university education lasting for more than three years compared to the other groups, $\chi^2 = 23.71$, $p < 0.05$. The age groups were also compared and risk sensitivity decreased by age, $\chi^2 = 28.71$, $p < 0.01$.

3.4. Risk Sensitivity, Risk Stability and Priority of Security

The respondents were also asked to rate how they prioritized security in transport, that is, how important it was for themselves. This evaluation included the importance of implementing countermeasures to prevent theft, harassment and terror. Table 6 shows the differences between the four groups of respondents in risk sensitivity, that is, how probable it is to experience a set of security risks and risk consistency, that is, how consistent the judgements are across the risk sources. In addition to the risk sensitivity and risk consistency groups past security risk experience was entered as a fixed factor. Gender, education and age group were entered as covariates. The results showed a significant overall difference in priority of security due to risk sensitivity, Wilks' $\lambda = 0.96$, $p < 0.001$, gender, Wilks' $\lambda = 0.7$, $p < 0.001$, educational level, Wilks' $\lambda = 0.97$, $p < 0.001$ and age group, Wilks' $\lambda = 0.97$,

$p < 0.01$. However, there were no significant differences in priority of security due to past security risk experience, Wilks' $\lambda = 0.99$, NS. The F-values in column four in Table 6 show the differences between the four risk sensitivity and risk consistency groups. The higher the mean values in column four, the higher is the priority given to security measures and vice versa for low values. As can be seen, risk ignorant and risk steady respondents prioritised security measures to a lower extent compared with risk fluctuating and risk sensitive respondents.

Table 6. Differences in priority of security due to risk sensitivity and risk consistency.

Priority of Security	Secure d-Variables Sensitivity 4 Groups	Mean	F-Value	Bonferroni's Post Hoc		
				Risk Fluctuating	Risk Stable	Risk Sensitive
Theft	Risk ignorant respondents (Lmean Lsd)	4.89	10.34 ***	<0.001	NS	<0.001
	Risk steady respondents (Hmean Lsd)	5.89				
	Risk fluctuating respondents (Lmean Hsd)	4.90				
	Risk sensitive respondents (Hmean Hsd)	5.55				
Harassment	Risk ignorant respondents (Lmean Lsd)	4.87	9.62 ***	<0.001	NS	<0.001
	Risk steady respondents (Hmean Lsd)	5.93				
	Risk fluctuating respondents (Lmean Hsd)	5.03				
	Risk sensitive respondents (Hmean Hsd)	5.65				
Acts of terror	Risk ignorant respondents (Lmean Lsd)	4.81	8.75 ***	<0.001	NS	<0.001
	Risk steady respondents (Hmean Lsd)	5.99				
	Risk fluctuating respondents (Lmean Hsd)	4.75				
	Risk sensitive respondents (Hmean Hsd)	5.35				

Wilks' $\lambda = 0.96$, $p < 0.001$, *** = $p < 0.001$.

The Post Hoc tests showed that there were no statistically significant differences between the security priorities of the groups of risk insensitive and risk stable respondents. The tests showed an identical pattern of differences for all the three assessed factors. The priority of security measures in the risk sensitive group differed significantly from all the other three groups. However, both the two last groups (the groups of risk steady and risk sensitive respondents) differed significantly from risk fluctuating and risk sensitive respondents, $p < 0.001$. This was the case for priority of countermeasures to reduce the risk of theft, harassment as well as terror. Of note, there were no significant differences between the security priorities of the risk fluctuating and risk sensitive respondents. The pattern was the same for all the three prioritised areas. Thus, risk fluctuation and risk sensitivity seem to enhance the priority of security measures to reduce the risk of theft, harassment as well as terror. Risk perception varied due to previous risk security experience. However, there were no significant differences in priority of risk reduction measures due to past experience of security problems in public transport.

3.5. Priority of Security, Risk Sensitivity and Travel Mode Use

The next step was to examine how priority of security and risk sensitivity predicted travel mode use. Hierarchical and k -means cluster analysis was carried out separately for leisure and work travels to identify mode user groups. The first group consisted of those who most frequently used public transport and the second group consisted of respondents who mainly used car. The same cluster groups emerged for leisure as well as work travels (Table 7).

The first analysis in Table 8 concerned leisure travelling (columns 2–6). As expected, the first block consisting of demographic variables, distance from home to the nearest public transport point and car access significantly predicted leisure travel mode use ($\chi^2 = 213.74$, $p < 0.001$). Adding priority of security significantly improved the model ($\chi^2 = 16.05$, $p < 0.05$) and adding risk sensitivity as the final block added further to the explained variance ($\chi^2 = 4.03$, $p < 0.05$). When all the blocks were adjusted for in the model, level of education (OR = 1.36, $p < 0.001$), annual income (OR = 0.67, $p < 0.01$) and car access (OR = 0.02, $p < 0.001$) significantly predicted travel mode use. Annual income and access to car were negatively associated with use of public transportation. Gender, minutes to walk from home to the nearest public transport point and previous personal experience with security hazards

were non-significant predictor variables. In the second block the significant predictor variables were priority of security against theft (OR = 1.80, $p < 0.05$) and harassment (OR = 1.41, $p < 0.001$). Priority of countermeasures to reduce theft was largest among frequent car users and countermeasures for reducing harassment was prioritised among public travel mode users. Finally, the probability of belonging to the group of frequent public travel mode users was larger when risk sensitivity increased (OR = 1.24, $p < 0.05$).

Table 7. Travel group cluster groups for leisure and work travels (z-scores).

Travel Mode	Leisure Travels		Work Travels	
	Cluster 1	Cluster 2	Cluster 1	Cluster 2
Train	0.19625	−0.09802	0.23330	−0.21187
Bus	0.41539	−0.59862	0.60473	−0.98769
Car	−0.43332	1.27713	−0.08741	1.06000
Tram	0.38604	−0.57576	0.35102	−0.55945
Subway	0.39267	−0.48791	0.41762	−0.61160

Table 8. Indicators of mode use on leisure and work travels. (* = $p < .05$, ** = $p < .01$, *** = $p < 0.001$)

Indicators	Leisure Travels					Work Travels				
	B	SE	Wald	OR	CI 95%	B	SE	Wald	OR	CI 95%
Block 1:										
Gender (Ref. male)	−0.20	0.25	0.61	0.82	0.50–1.35	0.31	0.29	1.18	1.36	0.78–2.28
Age	0.04	0.01	11.28 **	1.05	1.02–1.07	0.01	0.02	0.48	1.01	0.98–1.04
Level of education (Ref. basic)	0.27	0.12	5.41 *	1.32	1.04–1.67	0.21	0.12	2.77	1.23	0.96–1.57
Annual income	0.35	0.13	6.92 *	0.7	0.55–0.92	−0.32	0.14	4.86 *	0.73	0.55–0.96
Previous experience	0.55	0.30	3.31 *	1.73	0.96–3.13	0.51	0.32	2.57	1.66	0.89–3.07
Minutes to walk from residence to publ. transp.	0.00	0.01	0.32	1.01	0.99–1.01	−0.01	0.02	0.13	0.99	0.95–1.03
Car access (Ref. no)	−3.65	0.494	54.54 **	0.03	0.01–0.69	−1.40	0.31	20.65 ***	0.25	0.14–0.45
Cox & Snell’s R ²									0.10	
Negelkerke’s R ²									0.18	
Block 2:										
Gender (Ref. male)	−0.31	0.26	1.40	0.73	0.44–1.23	0.29	0.29	1.03	1.34	0.76–2.37
Age	0.05	0.01	13.14 ***	1.05	1.02–1.08	0.01	0.02	0.43	1.01	0.98–1.04
Level of education (Ref. basic)	0.28	0.12	5.25 *	1.32	1.04–1.68	0.21	0.17	2.64	1.23	0.96–1.57
Annual income	−0.37	0.13	7.81 **	0.68	0.53–0.90	−0.31	0.14	4.68 *	0.73	0.55–0.97
Security risk experience	0.52	0.31	2.85	1.68	0.92–3.05	0.53	0.32	2.77	1.70	0.91–3.16
Minutes to walk from residence to publ. transp.	0.00	0.01	0.16	1.00	0.99–1.01	−0.01	0.02	0.19	0.99	0.99–0.95
Car access (Ref. no)	−3.65	0.50	52.42 ***	0.03	0.01–0.07	−1.39	0.31	19.91 ***	0.25	0.14–0.46
Priority of security-heft	−0.22	0.11	3.69 *	0.80	0.64–1.01	−0.11	0.12	0.90	0.90	0.71–1.13
Priority of security-harassment	0.37	0.12	10.12 ***	1.44	1.15–1.81	0.02	0.11	0.04	1.02	0.82–1.28
Priority of security—terror	−0.09	0.07	1.61	0.91	0.79–1.05	0.09	0.08	1.05	1.09	0.93–1.28
Cox & Snell’s R ²									0.10	
Negelkerke’s R ²									0.19	
Block 3:										
Gender (Ref. male)	−0.37	0.27	1.94	0.69	0.41–1.16	0.21	0.29	0.51	1.23	0.69–2.19
Age	0.405	0.01	10.59 ***	1.05	1.01–1.08	0.00	0.02	0.04	1.00	0.97–1.03
Level of education (Ref. basic)	0.31	0.12	6.17 *	1.36	1.07–1.73	0.23	0.13	3.15	1.25	0.98–1.61
Annual income	−0.41	0.14	9.03 **	0.67	0.51–0.87	−0.36	0.15	5.93 *	0.69	0.52–0.93
Security risk experience	0.40	0.31	1.62	1.49	0.81–2.74	0.40	0.32	1.56	1.50	0.80–2.82
Minutes to walk from residence to publ. transp.	0.00	0.01	0.10	1.00	0.99–1.01	−0.01	0.02	0.23	0.99	0.94–1.04
Car access (Ref. no)	−3.72	0.51	52.36 ***	0.02	0.01–0.07	−1.42	0.32	20.32 ***	0.24	0.13–0.45
Priority of security-theft	−0.22	0.11	3.74 *	0.80	0.64–1.00	−0.13	0.12	1.22	0.87	0.69–1.11
Priority of security-harassment	0.35	0.12	8.78 **	1.41	1.12–1.77	0.01	0.11	0.02	1.01	0.81–1.37
Priority of security—terror	−0.09	0.07	1.50	0.91	0.79–1.06	0.09	0.08	1.14	1.09	0.93–1.29
Risk sensitivity	0.21	0.11	3.95 *	1.24	1.00–1.52	0.24	0.12	4.24 *	1.28	1.01–1.61
Cox & Snell’s R ²									0.11	
Negelkerke’s R ²									0.20	

The results of the analysis of work travels are shown in columns 7–11 (Table 8). As expected, the predictor variables of the first block also significantly predicted work travel mode use ($\chi^2 = 57.62$, $p < 0.001$). This was also the case for the third block ($\chi^2 = 4.37$, $p < 0.05$). However, the predictors of the second block seemed not to be equally important for mode use on work travels ($\chi^2 = 1.53$, NS) compared to leisure travels. The significant predictor variables in the final analysis were annual income (OR = 0.69, $p < 0.05$) and access to car (OR = 0.25, $p < 0.001$) from the first block. Risk sensitivity also significantly predicted mode use (OR = 1.28, $p < 0.05$). The prediction of leisure travel mode use

(Cox & Snell's $R^2 = 0.35$, Nagelkerke's $R^2 = 0.49$) was more successful than predicting mode use on work travels (Cox & Snell's $R^2 = 0.11$, Nagelkerke's $R^2 = 0.20$).

4. Discussion

The current study showed that priority of security and risk sensitivity were significant predictors of travel mode use among an urban public when demographic factors were controlled for. In studies carried out previously [16,17] risk sensitivity was conceived to be a predictor of "risk perception." However, risk sensitivity is the tendency to perceive all risks to be high and risk insensitivity the opposite. Explaining a large percentage of the variance in "perceived risk" [16,17] 2004) could partly have been caused by the use of risk sensitivity as a predictor variable which is coincident with the criterion variable. Rundmo and Nordfjærn [9] found no support for a model where risk perception was conceived to be a formative construct of subjective assessments of probability and judgement of the severity of consequences. Subjective judgements of risk should be conceptualised as perceived risk assessments when the judgements are not considered to be a formative construct.

The current study was restricted to examining the probability component of the perceived risk evaluations. In future research the role of severity of consequences should also be included. This could add to explaining the variance in predictions of travel mode use. Sjøberg [30], as well as Rundmo and Moen [7], showed that the subjective judgement of severity of consequences if a negative event should occur was a more significant predictor of demand for risk mitigation compared to the probability assessment. Studies carried out previously have shown that subjective assessments of risk and judgement of severity of consequences may predict worry, and worry has been found to be associated with demand for risk mitigation in transport [7] as well as mode use preferences [14,15]. Probability assessment was found to be rather insignificant for such demands. The current research did not aim to re-examine the role of worry in travel mode use. It is interesting to note that the assessment of the probability-component of risk sensitivity alone contributed significantly to prediction of travel mode use (public transportation versus use of car).

The results of the current study showed that the same set of predictor variables explained a significantly larger proportion of explained variance in leisure travel mode use compared to work travel mode use. There could be several explanations for this. Most obvious is that the freedom to choose travel modes could be different on the two types of travels. It may be that the freedom of choice is larger for leisure travels compared to work travels. As expected, access of private travel modes was an important predictor of travel mode use. In addition, the power of this predictor variable was significantly larger for travel mode use on work travels compared to leisure travels, indicating that it may be easier to choose other travel modes for leisure travels. Further, demographic factors seemed to be of less importance for travel mode use in leisure time than for work travels. Other possible explanations, which could be further investigated, include possible differences in the role of habits. Because work travels can have a more repetitive nature than many travels conducted during leisure time, habits could play a larger role in mode use on these travels [31].

In this study, perceived risk evaluations and risk sensitivity have been considered to contain the same data of evaluations of probability assessments and judgement of severity of consequences. Consequently, the concepts of perceived risk evaluations and risk sensitivity are unquestionably woven together. They are two parts of the same intuitive evaluation of risk; a direct assessment of probability of an event with negative consequences and the stability or consistency in the evaluation of various risk sources. The first element may vary because it relates closely to the hazard or object of evaluation. The second element is not primarily related to the object, but is a general tendency influencing on the direct evaluation of risk. This element consists of two elements. The first is risk sensitivity, that is, judging a set of hazards or risk sources on a continuum varying from high (indicating risk sensitivity) to low (indicating risk ignorance). The second element is risk stability, which varies from high (indicating risk stability) to low (indicating risk flexibility). Perceived risk evaluation is only the "basic material" for calculating risk sensitivity. Therefore, risk sensitivity is the main concept, covering the perceived

risk evaluations, including intuitive judgments of probability as well as severity of consequences across a set of risk sources.

Further research should examine predictors of risk sensitivity as well as risk stability in further detail. It could be interesting to investigate how aspects of subjective risk judgements not directly associated with characteristics of the risk source influence judgement. Therefore, research on risk sensitivity should be given priority, not the mere analysis of single hazard or risk source evaluation. Further investigations could focus on associations between personality variables and risk sensitivity, which in previous research have been found to be associated with risk perception as well as risk-taking behaviour. Such behaviour has been connected to personality factors for example, sensation seeking. Another hypothesis is that attitudinal factors, for example, attitudes towards risk-taking and risky behaviour, may stabilise risk sensitivity on a high or low level, working more or less independently in the judgement of single hazards or risks. The current study showed that priority of security also was associated with travel mode use. The relations between priority of security, personality factors and risk sensitivity should be investigated more thoroughly in future research.

5. Conclusions

The results of the current study showed that priority of security, as well as risk sensitivity, were significant predictors of travel mode use among an urban public when demographic factors were control variables. In previous studies risk sensitivity was conceived to be a predictor of risk perception. The large proportion of explained variance in perceived risk reported in these studies could partly be due to the use of risk sensitivity as a predictor variable which is coincident with the criterion variable. It may be appropriate to replace the risk perception concept with perceived risk evaluations, which cover the intuitive cognitive judgements of probability of an event with negative consequences as well as the severity of consequences if such an event takes place. The paper proposes that risk sensitivity should be a main concept, covering the perceived risk evaluations, including intuitive judgments of probability as well as severity of consequences across a set of risk sources.

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