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Evaluating safety experience in train stations by using an innovative feedback app and stereo sensors

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Abstract

An interdisciplinary team at the SBB wants to find answers to the questions 1) how customers experience safety and security in rail environments, 2) which factors influence risk taking behavior, 3) and which influence people density has on both, safety perception and risk taking behavior. To answer those questions, innovative research methodologies and instruments are applied in two studies. Study one focuses on safety perception and risk taking behavior (stepping into the danger zone) on train station platforms using stereo sensors. First results show that pedestrian density relates to the use of the danger zone and to subjective safety perception (Thurau, van den Heuvel, Ofwegen, Keusen, & Hoogendoom, 2017; Schneider, Thurau, Ehrat, Vollenwyder, & Krueger, 2017). The second study aims at investigating safety perception not only on train station platforms but in rail environments in general. Participants will report subjective safety perception and rate situations experienced concerning potential risks through an app during their journey with SBB. Findings could 1) help to find measures on how to improve rail infrastructure and environments and 2) give insights on how to solve crowding problems to further improve customer experiences with the Swiss Federal Railways.

Keywords

safety perception; customer experience; stereo sensors; train station; train station platform; research methodologies

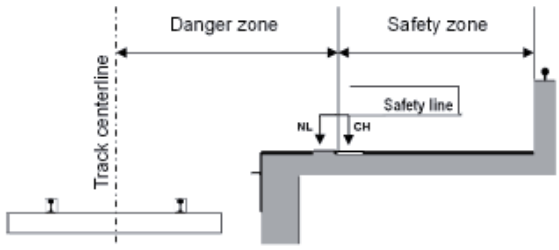
1. Heading

Monthly conducted customer surveys by the Swiss Federal Railways (SBB) show that security and safety perception are important predictors of customer satisfaction (KUZUBA, 2017). However, subjective and objective safety don't always correlate. Sørensen and Mosslemi (2009) describe objective safety as the actual number of accidents or incidents and subjective safety as a feeling or perception of safety, therefore the subjective experience of the risk of an accident or incident. Hence, the analysis of objective data does not necessarily indicate subjective perceived safety. In order to find corresponding measures to enhance perceived safety perception, more specific research in the field on the respective touchpoints is needed. A touchpoint is a point of interaction between company and customer (Lemon, & Verhoef, 2016). On the other hand, risk taking behavior in train station environments should be further explored, since risk taking and perceived safety showed to be related in other studies (e.g. Wilde 1976). Analog to subjective and objective safety, objective risk does not necessarily have to be congruent to the subjective perceived risk. Our brain applies heuristics and is subject of various biases that influence the judgment of risk. Therefore, risk assessment is not always accurate (Yates and Stone, 1992). In accordance with Trimpop (1994) risk taking behavior can be defined as any consciously, or non-consciously controlled behavior with a perceived uncertainty about its outcome, and/or about its possible benefits or costs for the physical, economic or psycho-social well-being of oneself or other. Thus, research questions about 1) how customers experience safety and security in rail environments, 2) which factors influence risk taking behavior, 3) and which influence people density has on both, safety perception and risk taking behavior are addressed. Safety perception or risk taking behavior are difficult to assess with subjective measurements only (e.g. questionnaires) due to the limitations that subjective measurements hold (Mayer, 2009; Raithel, 2008; Wohlrab, 2009). Therefore, we explore two innovative instruments (stereo sensors and app) to research safety perception and risk taking behavior. This should allow us to gather data in context and on a more qualitative level. Therefore, in this paper, the potential of sensor data analysis and an innovative feedback app should be explored. Study one focuses on how customers perceive their safety on platforms, which factors influence their safety perception and which factors lead to stepping into the danger zone. Study two focuses on safety perception in a wider train station environment.

1.1 Study 1 – Risk behaviour, safety perception and sensor data analysis

In study one we researched safety perception and risk taking behavior (stepping into the danger zones on a platform when no train is standing at the platform) applying a survey, observation and sensor data analysis. Focus on this study was to research reasons for stepping into the danger zone and subjective safety perception of passengers on the platform.

Figure1: Definition of safety line and areas on the platform



We expect that the number of persons using the danger zone rises with higher pedestrian densities on the platform. This hypothesis is based on the assumption that on a platform with more persons present, the probability of persons stepping into the danger zone increases. Also, we expect that the ratio of persons using the danger zone rises near obstacles. Furthermore, we expect that safety perception relates to people density. A relation between safety perception and people density was shown by Schlüter, Nicklas and Winzer (2016) in a similar context.

Method

A survey link was distributed on three different train station platforms – Bern, Lenzburg and Visp in April and May 2017. Bern was chosen because the described sensors are installed at this station. Lenzburg is a station with a lot of drive-through train trains and with high pedestrian densities. Visp is a tourist station. The links were handed out during the

observation which took place during peak hours. However, we created two different access links to two different surveys. This allowed us to distribute one link to passengers which overstepped the safety line, (group A) and one link to passengers which weren't observed overstepping the safety line (group B). The surveys were identical, the sub-division helped us to identify if the survey was actually filled out by a person, which was overstepping or not. 179 participants answered the survey. 9 participants were excluded due to invalid data. Hence, the answers of 170 participants (64 = female, 102 = male, 4 = no answer) were analyzed, whereof 32 (13 = female, 16 = male, 4 = no answer) belonged to group A and 143 (51 = female, 86 = male) to group B. There were no significant differences respective gender ($F(1,164) = .823$, $p = .33$) and age ($F(1,164) = .16$, $p = .68$) between group A and B. In the survey we conducted subjective safety feeling and subjective perceived passenger density at the train station platform. During the observation we protocolled point of time of oversteps. Data from stereo sensors installed at a platform in Bern (track 3 and 4) is used. The sensors were installed to track people (movement) on platforms. Accuracy was tested at the point of interest (van den Heuvel, Thurau, Schakenbos, van Ofwegen, Hoogendoorn, 2017). Data was conducted between April and May 2017. Analysis focused on weekdays and peak hours.

Data Analysis

In order to differentiate between areas with and without obstacles, the platforms were divided in five zones. The average number of uses of the danger zone per meter platform length and second was calculated. The results were compared against each pedestrian density within the zone, for each second divided by the surface available for passengers in the safety zone. The data was only analyzed when no train was waiting on the platform because in this scenario overstepping the safety line is allowed and doesn't imply risk taking behavior. For more information about sensor data analysis see Thurau, van den Heuvel, Ofwegen, Keusen, & Hoogendoom (2017).

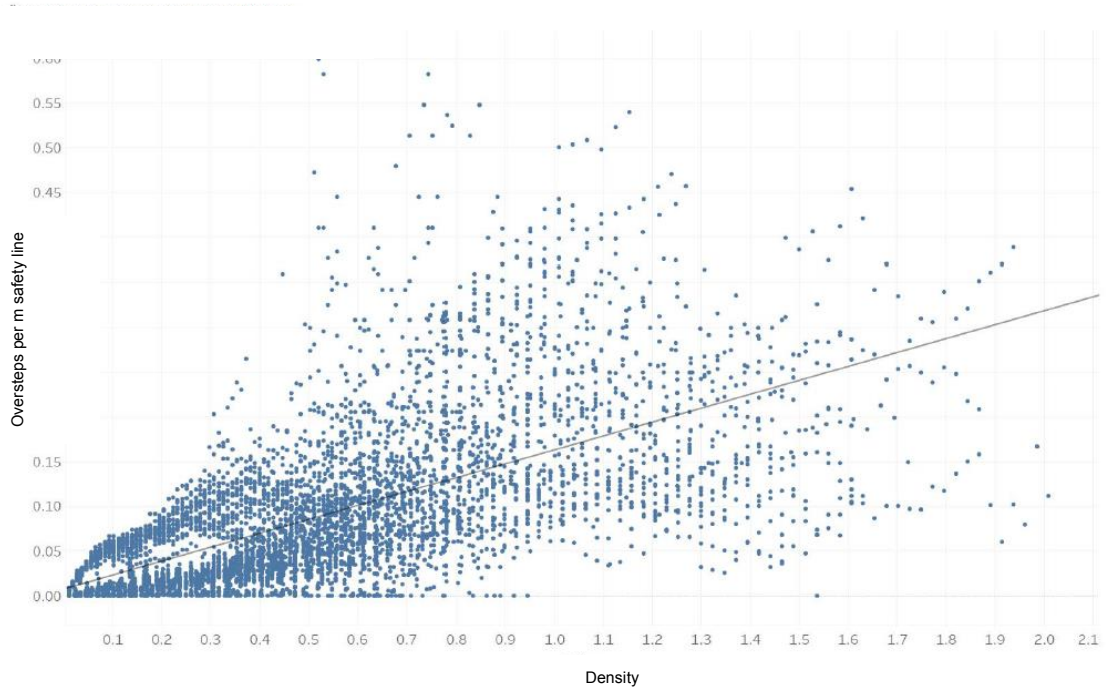
Results

With regards to subjective perceived safety/security feeling, a Pearson correlation test showed a highly significant correlation between safety/security perception and estimated passenger density ($r = -0.45$, $p < .002$, $n = 170$). The higher the passenger density on the platform is estimated, the lower is the perceived safety/security on the platform The estimated passenger

density on the different platforms differs significantly in relation to the train station ($F(2,165) = 3.296$, $p = .04$, $n = 170$). People density is perceived the highest in Lenzburg ($M = 3.28$, $SD = 0.76$) and the lowest in Visp ($M = 2.66$, $SD = 0.65$). Likewise, perceived safety/security perception differs significantly in relation to the platform ($F(2,165) = 6.469$, $p = .002$, $n = 170$). Participant feel the safest in Visp ($M = 2.42$, $SD = 1.44$) and the least safe in Lenzburg ($M = 3.26$, $SD = 1.70$). Therefore, the significant differences of safety feeling in the different train station can be explained with perceived passenger density in the different train stations. More than 60% of the participants (group A = 50%, group B = 66%) named a crowded platform as a reason for feeling unsafe. In the qualitative statements, participants added that they would feel afraid of being pushed on the rail by someone when the platform is crowded. Over 82% of the survey participants identified the safety line correctly. Concerning the question "were there already situations in which you had to overstep the safety line (despite when entering or leaving the train)" in group A 40% answered with no and only 60% with yes. From group B, 70% said yes, only 30% said no. Group A and B did not differ respective perceived safety.

Sensor data analysis showed a general rise of people stepping into the danger zone with rising pedestrian densities. Therefore, the probability of a person using the danger zone rises with the number of persons present. Further analysis suggest that there are other factors influencing the oversteps which should be further explored. Analysis showed that some zones seem to reach a point when the number of overstepping personas starts rising exponentially (Thurau, van den Heuvel, Ofwegen, Keusen, & Hoogendoom, 2017).

Figure 2: Oversteps in relation to people density



Study 1 - Conclusion

Our research shows that the number of passengers overstepping the safety line relates to higher passenger density. Also, the oversteps varies between zones and between days. This suggests that pedestrian density is not the only factor influencing oversteps. This assumption is also supported by our survey results, which show that more than 60% of respondents did not respect the safety line by admitting that there were already situations in which they overstepped the safety line. In addition, one out of three respondents from group a said that there was never a situation in which he/she had to overstep the safety line. This leads to the conclusion that inattention could be one other factor leading to oversteps. However, more evidence is needed to support this conclusion because it is also possible that the answer wasn't answered honestly due to e.g. social desirability.

As a result of the survey, the necessity of a campaign explaining the possible risks of overstepping the safety line was made clear. A media campaign to raise awareness was launched. In addition, the results could be the base for nudging projects aiming at a better distribution of passengers on the platform. Further analysis and equipping other station could help to generate a data pool to identify the moment of risk. This idea is further explained by Thurau, van den Heuvel, Ofwegen, Keusen, & Hoogendoom (2017).

1.2 Study 2 – Using the SBBgo App to explore safety perception

In study two, we want to research safety perception in a wider rail environment. Therefore, we want to investigate in which situations during their journey with the SBB, passengers don't feel safe or secure. This research should help to understand KUZUBA results on a deeper and more qualitative level. The KUZUBA results show e.g. that customers feel especially unsafe/insecure at night, when encountering particular group of people, during big events or when there are only few people at the train station. (The described situations are among the 10 most named situations). Also, as a result of the KUZUBA survey we see that safety perception levels at certain train stations are particularly low. But we don't have any specific data that gives us more information about the specific context and situation in which passengers feel unsafe. Therefore, we started a study with the SBBgo app – an app that was especially developed to research customer journeys and analyzed touchpoints (Schneider, Muggli & Krueger, in preparation).

Method

With the SBBgo app, study participants will documents situations in which they feel unsafe during their journey with the SBB. It is planned that 30 participants from Yverdon and 30 participants form Bern document their journey during two weeks with the app. The will get a step by step instruction on how to use the app and get the instruction to document situations in which they don't feel safe or secure. In the app they will document the name of the journey (e.g. journey from Bern to Olten). They can take a picture of the situation, rate the situation with a smiley and write a comment. Furthermore, they can tag the situation (e.g. night, alone/in group, stressed, safety staff on location), rate how dangers the perceive the situation and how the evaluate their own risk behavior.

1.3 Discussion

This paper shows that new technologies open new opportunities to research customer behavior and customer experience. This is important to get a holistic view about the customer in context. This data basis can then be used to find measures, which help to enhance customer experience. Stereo sensor data can help to learn more about customer behavior and in the future can be used to create crowd management concepts (Thurau, van den Heuvel, Ofwegen, Keusen, & Hoogendoom, 2017). Exploring safety experience in context will help to find specific measures which can be applied in the field.

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