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Applying Persona method for describing users of escape routes

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Abstract

Subways are an important means of transport and stations can be filled with thousands of passengers at a time and have limited space for movement. In emergencies such as fire, the life of passengers is at high risk. But not only spatial restrictions of escape routes, also passenger characteristics are important. Subway passengers differ widely in their motivation and individual behavior. In this paper, we present a method offering a more elaborate approach for including characteristics, the Persona method. In this case the results of field studies, passenger counts, interviews and literature review led to the description of different Personas.

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1. Designing escape routes for subway passengers

A broad cross-section of the population uses the subway as transport medium but the design of escape routes is conducted due to established rules and norms (e.g. NFPA 130) and has to satisfy the requirements of all passengers likewise. In this context the VDV (Verband Deutscher Verkehrsunternehmen (2010)) divides the users of the subway into the following categories: business and commuter traffic, education traffic, recreational and handling traffic, as well as holiday traffic. Even within this grouping a strong deviation between the passengers is to be expected since motivation, ability and needs differ widely. It makes a difference whether a mother goes shopping with a child or a student does the same. Also the fact whether someone on the way to work needs crutches to walk or if this person has no physical restrictions can influence the choice of escape route. Guidelines for the quality of

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escape routes have to consider those human factors because in case of danger an appropriate escape route is essential for saving lives. The design of safe escape routes has been recognized as an important task for a long time. This includes the question of how an escape route can be optimally marked. It might not be sufficient to just follow regulatory demands with respect to the dimensional properties of an escape route. If you do not consider the actual user when choosing e.g. signage (cf. Nilsson (2009)), user expectations with respect to color, pictograms or writing including character font and size might fail to be useful for the passengers trying to leave the station. To give an example, in a German subway system, signs with a yellow background displayed black arrows together with the road name would lead you to an exit. However, people unable to read the text when asked for the escape route were looking for a green running men pointing to the closest exit. In the meantime the running man is added to every station of that subway system. Thus, for the design of safe escape routes, not only spatial restrictions, but also passenger characteristics have to be considered. At the same time subway passengers differ widely in their physical and cognitive abilities, emotional condition, motivation and individual needs and behavior (Hofinger et al. (2014)). A way of taking into account this variety of passenger characteristics is in the focus of this paper. This raises the question: who are the actual passengers and what do they expect from their escape route? Answering these questions the authors used the approach of the Persona method, in order to include a broader range of possible passenger expectations and their respective requirements for safe escape routes.

2. The Persona method

Especially software development often needs the adaptation to a respective user to create a comfortable use of a product. A too long learning curve for understanding the use of an application as well as mental underload represents central problems. For this purpose a comprehensive knowledge about the user is required. Know your user is the backbone for the development of useful products and therefore several methods exist for analyzing the user. The Persona method is one powerful example. Personas are a user-centered design method and furthermore are “fictional characters, based on actual data, that depict target user population” (Pruitt and Grudin (2003)). It is important that Personas are based on facts, ethnological research or interviews to conceive a useful product. In the end the method provides a close narrative description of real-world user or a cluster of users based on valid observations and interviews to build one special kind of user model. In general models are “powerful tools for representing complex structures and relationships for the purpose of better understanding” (Cooper et al. (2007)) and in this case enable drawing inferences about motivation, behavior and goals of the target group. Personas are one module of a full range of quantitative and qualitative methods regarding usability. Cooper notes that designers often neglect the actual user and choose scenarios on people similar to themselves (Cooper et al. (2007)). Hence by creating a characteristic persona with a fictional name and background a higher empathy with the user could be reached and help designers to get in touch with the user. Comparing to other methods the benefit of using Personas is the closer relationship between designer and user. In this case the Persona method is used to analyze and understand passengers of a subway in an evacuation situation during their escape. In the words of a designer, the escape route is the product to be optimally designed according to the users´ needs. Given the variety of users pointed out in the introductory paragraphs above, consequently Personas for various types of passengers have to be defined.

3. Defining Personas

A precondition to define Personas is the comprehensive knowledge about the user. For that purpose the rough estimation of the overall number of passengers available from the subway services are insufficient. Additional and more specific data had to be collected. Starting out with a literature review relevant factors in evacuation were collected. In the literature different parameters affecting the time needed for evacuation are elaborated on. These include the influence of infrastructural elements, e.g. obstacles, narrow passages or staircases (Jiang et al. (2009), Schreyer (2003)), (Fujiyama and Tyler (2010)), more general phenomena of pedestrian-flow in crowds under normal and emergency conditions (e.g. Moussaid et al. (2011), Helbing (2002)) and the influence of individual-centered parameters of subway passengers, e.g. winter- or summer clothes or heavy luggage (Predtetschenski and Milinsky (1971), Sime (1995)). These physical characteristics are relevant for the requirements for escape routes and the actual choice to use an escape route in case of an emergency.

A next step in collecting data was a number of passenger counts in subway stations. From the list of relevant characteristics mentioned in the literature the following were picked out to be counted: passengers with impairments in walking and in seeing, the number of passengers in company, e.g. families, and the number of passengers carrying heavy luggage such as a suitcase or a stroller. By means of these passenger counts in a station, the frequency and distribution of passengers with these characteristics were determined.

Additionally more than 200 interviews were conducted with passengers. The questions aimed at the passengers´ knowledge of pictograms relevant for evacuation, on local knowledge of the infrastructure and on aspects of expected or self-observed own behavior in evacuations.

A final step of collecting data was a number of evacuation experiments. These aimed at determining the actual behavior of people (passengers) during an evacuation from a subway station. Results allowed for conclusions on the influence of local knowledge, group membership and physical impairments. Passengers needed assistance, due to physical impairments or a lack of local knowledge. Some passengers helped each other, e.g. moving slowly as a group. Others focus on their own well-being, e.g. pushing others aside when leaving the station. To sum up the results, the reactions to an evacuation request and the behavior displayed during the evacuation differed in parts significantly. The same holds true with the time needed for evacuation. A more detailed description of the design and results of the methods used to collect empirical data can be found in a prior publication (cf. Zinke et al. (2014)). Also psychological aspects - human factors - influenced the observable behavior. These emotional, cognitive and motivational aspects of the participants were included in the later determination of Persona. Based on the gathered data main features regarding the expected behavior was determined. For the enrichment of behavioral data additional motivational aspects resulting in a behavior displayed by persons were identified.

Within this paper the authors use the approach of Cooper et al. (2007) for creating Personas. The approach includes seven steps starting with step one, the **identification of behavioral variables** followed by step two, the **mapping of the interview subjects** with the behavioral variables.

An important aspect identified in the behavior displayed during escape, is the variable of local knowledge (Schäfer et al. (2013)). This is a key factor in the initial reaction upon realizing a threat or hearing an alarm. In Fig. 1 below, passenger type 1 represents the total lack of local knowledge – they might be a tourist who exits a specific station for the first time. Passenger type 2 has been there before; they might remember the route they chose the last time when exiting the station. Yet, they have no differentiated mental map of the station´s structure and they will not immediately find their way out a different exit. Passenger type 3 on the right hand side is a frequent user of a specific station and will know how to get outside from any starting point within the station.

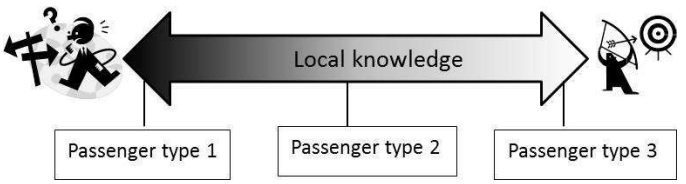

Fig. 1. Variable local knowledge.

Even though a person may know a specific station very well that does not guarantee for the right choice of the escape route. In the trials of the authors passengers followed a leading person from their group, even though this person chose a dead-end staircase.

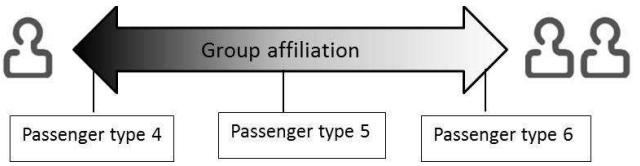

Fig. 2. Variable group affiliation.

A further example for the range of possible actions is the strength of individual group affiliation (see Fig. 2). If a person identifies himself very closely with a group, e.g. his family, he will try to stay with that group (cf. passenger type 6, below), while on the other hand a person on his own will not at all feel affiliated with another group of passengers. He will not pay attention to them and will not try to stay close to them. Somewhere in between the passenger-type 5 is a member of a loose group of passengers, e.g. soccer fans of the same team, who will not at all cost try to stay together with that group.

Step three in creating a Persona is the **identification of significant behavior patterns**. All in all eight different basic patterns of behavior were identified in our field research. These ranged from waiting, to walking without a specific destination to targeted escape using the shortest escape route. Furthermore the realizing of danger and respective requests for action, the readiness to offer support, the desire to maintain a group affiliated with, reaching a final destination and seeking for information are additional factors that determine the action.

In step 4 **characteristics and goals** of a persona are synthesize. Here the different attributes were combined to furthermore specify and detail the different Personas from the gathered data. Sticking to the attributes mentioned above a Persona is described through a combination of attributes of passenger type 1 to 3 and 4 to 6.

In step five, after having identified the relevant combinations of attributes, the grouping of attributes is checked for **redundancy and completeness**. At this time, the above mentioned passenger types were looked at again. Given that in the course of evacuation individual characteristics could change, e.g. a group could fall apart or be separated, the individual may now be regarded as a different Persona with other attributes. By looking at the phases following the initial request to leave the station, further attributes and possible combinations of them were added creating additional Persona. Consequently, in step six according to Cooper, an expanded **description of attributes and behaviors** was formulated. Per definition the identified groups are thus clearly separated from one another as Personas. In the seventh and final step the **persona types are designated** and now receive a name (cf. Persona profiles in the illustrations below).

4. Introducing a Persona

Based upon the conducted field trials and observations of the authors, 16 personas were identified and elaborated. Each of these personas describes a typical user of subways by focusing on four characteristics of each user-type: 1) Acting and moving as an individual or belonging to a group, 2) extent of local knowledge, 3) emotional restrictions and 4) physical restrictions. For each Persona basic behavior patterns are described at an abstract level for their course of escape, e.g. if they are likely to start running immediately or if they would adopt a wait-and see attitude out of curiosity instead.

After the seven steps described above, a more detailed description of the reactions after the sounding of an alarm could be given for each Persona. The following example focuses on the differences of two Personas that both could be part of the category “vacation traffic” from the introductory example. That category could contain different Personas. E.g. there could be a backpacker traveling as a single person, while another one might be a mother traveling with her child, who took half the day off from work. Both of them are participating in a sightseeing tour of the city. However, the respective characteristics of these two Personas are quite different. They are given concerning the four dimensions differentiated above: group affiliation, local knowledge, physical impairments, and emotional impairments. Also their expectations regarding escape routes are listed. Both of these Personas belong to a group, only the affiliation of a mother to her child is stronger (cf. passenger type 6, above) than the one of the tourist to his group (cf. passenger type 5). As the tourist is at a station for the first time, his local knowledge is very limited (cf. passenger type 1, above). Since the mother drops off her child regularly at the kindergarten just outside that subway station, her local knowledge is excellent (cf. passenger type 3, above). None of them has a physical impairment. Yet, if you think of a fire that scares her child, the mother´s emotional state is very worried about her daughter´s well-being. The tourist has experienced a fire alarm before and is thus emotionally unaffected by the present threat. Instead, he is rather curious to find out what exactly is the cause of the evacuation request.

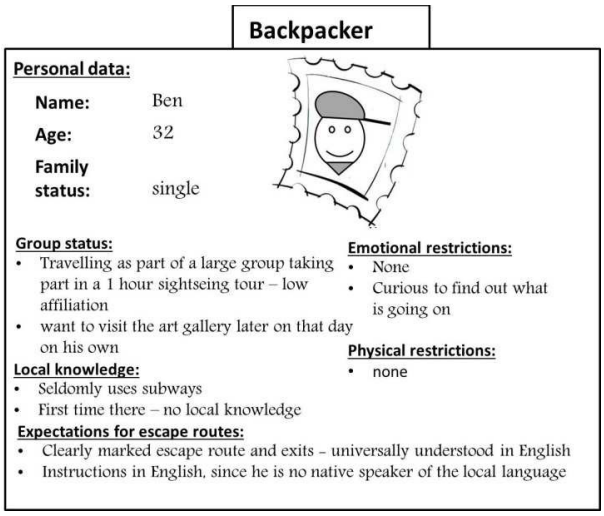

Fig. 3. Persona Ben.

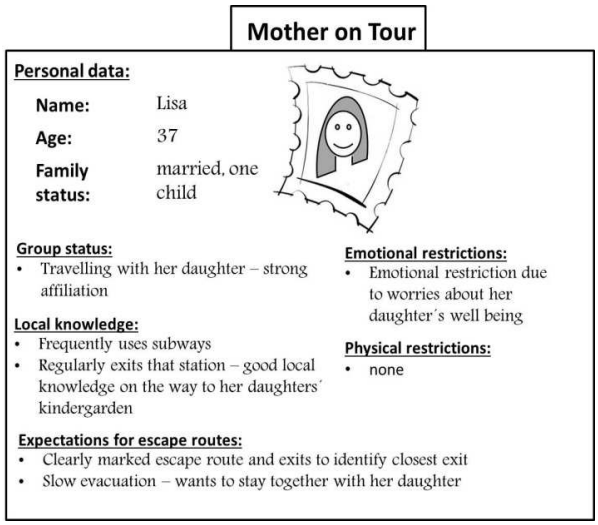

Fig. 4. Persona Lisa.

These distinct attributes of the Personas have an effect on the duration of the evacuation. The two Personas will display a different sequence of action. The Persona "Ben" will hear the alarm, immediately understanding its meaning, and will wait to seek more information about the threat and the environment. He might look for others moving into a certain direction or he might walk into an unspecific direction looking for a plan of the station or an exit sign pointing out the escape route. This will cause a detour on his way out, before he finally reaches the stairs to the safe surface. The Persona Lisa will first make sure that her child is O.K. and that she will keep up with her. She will then start to exit the station using the shortest way possible. In result, both Personas will most likely reach a safe area with the difference in the chosen exit and in the duration of the escape. The time needed for evacuation thus depends not solely on the characteristics of the escape route (dimensions, blockages) or the number of passengers evacuating. Equally important the time needed for evacuation is determined also by the individual Persona´s attributes and requirements with respect to the escape route. Changes to any of these aspects will have an effect on the evacuation time, e.g. if heavy smoke would arise (cf. Oswald et al. (2005), Noren and Winer (2003)). Now the

Persona would have a “physical impairment”, and most likely an “emotional impairment” as well, changing their sequence of action during evacuation.

5. Conclusion and further steps

For the design of safe escape routes, the variety of users has to be integrated into the design process. Since it is hardly possible to pay attention to every single user and the possible range of variations in their expectations and behavior, a systematic reduction has to be conducted. The Persona method appears to be a promising approach when trying to include the most prominent characteristics of passengers. Further validation is needed, e.g. with respect to the Personas identified as well as their overall distribution. A next step is the integration of the defined Personas into a simulation of a subway station in order to predict the optimal escape routes in a given threat (e.g. a fire or an explosion). By doing so, even a dynamic distribution of escape routes with respect to individual human factors is possible. If a specific escape route is designed properly, the different Persona could be individually guided on an escape route that meets their individual expectations and needs (e.g. to a barrier free exit). Adjustments might be necessary when trying to apply the Personas identified to subway-passengers in a different country. In principle this transfer onto a different subway system is possible. Furthermore, the Persona approach could be used to define a set of objectively most likely users of any infrastructure, e.g. buildings like hospitals, vehicles like buses or closed systems like cruise liners. The defined Personas could also be integrated into simulations of the respective infrastructures. This would allow determining the optimal escape routes for Personas in reaction to an incident. Furthermore simulating evacuations including Personas could offer useful data for defining novel guidelines for infrastructure-specific building codes or guidelines on the design of escape routes.

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