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Abstract. Wearables are intimate solutions for a variety of purposes and could enhance safety on large passenger ships in cases of evacuations. Today's cruise ships offer capacities of up to 8000 passengers. From a technological point of view, wearables offer support for electronic mustering and more efficient possibilities to search for passengers. However, privacy and security perceptions of wearables have so far remained unclear for safety-critical areas. Moreover, the population on large passenger ships is characterized by a relatively high average age. Therefore, we investigated the results of a survey with 2085 passengers for the relationships between demographic data and privacy and security perceptions. Additionally, we explored potential influences of personal attitudes. Evidence was found that privacy concern and perceived security risk are influenced by age but not by gender. Interestingly, the effect of age on both variables is negative and stronger for security than for privacy perceptions. The individual need for safety contributes to explain both variables significantly. In conclusion, privacy concern and perceived security risk decrease with increasing age and need for safety.

Keywords: wearables · privacy · security · locating · age · safety

1 Motivation

1.1 Privacy and Security of Wearables

Wearable technology is an increasing trend. However, privacy and intimacy issues of these intimate devices have not yet been resolved. Wearables appear advantageous and scary at the same time. Support for various areas is available, for instance, for organizing everyday life, navigation, or fitness and health. Nevertheless, these systems need to collect data, such as the user's location, to function as helpful devices. Austen [2] most recently pointed out the challenges of security and the related concerns about privacy and security of wearables against the background of their benefits for everyday life, which is in accordance with previous literature, for instance Loebel [20], contrasting the risks of

location-based services and applications with their benefits for the user. Hence, wearables need to be viewed in light of their risks for privacy and security and, therefore, investigated for the perceptions by users.

1.2 The Research Gap of Privacy and Security Perceptions for Safety-Enhancing Wearables

Previous research has shown that privacy concerns and perceptions of security risks can hinder the usage of e-commerce systems (e.g. [21], [9]), online health information systems (e.g. [3]) and in particular of location-based services (LBS) of wearables (e.g. [37]). Raschke et al. [30] approached lowering of privacy concerns for LBS by a privacy-by-design paradigm, Barkhuus and Dey [4] suggested to let the user permit momentary locating, and Ahmed and Ho [1] proposed notifications for transparency of data collection for the user.

However, privacy perceptions towards wearables for safety-critical areas have not been investigated so far, although high potential can be seen in wearables for safety enhancement, for instance on passenger ships. Technical failures and events of disasters on passenger ships can never be completely excluded. Examples are the Star Princess in 2006, the Costa Concordia in 2012, and the Oriental Star in 2015. Nevertheless, the number of passengers is continuously increasing and modern cruises fit up to 8000 passengers. Hence, this trend invokes the need for new approaches for efficient mustering and passenger search in case of an evacuation. Wearables, such as locating bracelets, could enhance safety without video surveillance, which has become infamous for its exploitation on occasion.

In a large passenger survey, we revealed privacy concern and perceived security risk as predictors for the acceptance of safety-enhancing wearables on passenger ships for cases of evacuations [19]. Hence, we aimed at investigating the predictability of privacy concern and perceived security risk and their sensitivity for population characteristics such as demographics, which are obvious for shipping companies, and personal attitudes, which are indistinguishable for shipping companies. Therefore, we analysed the results of the survey with 2085 passengers from 16 to 81 years for influences of the demographic variables, age and gender, and personal attitudes, such as the individual need for safety, on the dependent variables privacy concern and perceived security risk regarding safety-enhancing wearables for locating.

2 Variables

2.1 Dependent Variables: Privacy and Security Perceptions

With emerging technologies, the term privacy has become fuzzy, with a dissent in science on the inclusion of security issues [35]. For a clear picture of the influences of independent variables on privacy and security perceptions, we separated these issues in the presented work.

Privacy Concern. With regard to Smith's et al. [36] dimension *collection*, privacy concern is therefore narrowly defined as the concern that is directly connected with the disclosure of location information for the intended purposes in an evacuation. This collection concern of privacy was shown to be a predictor of the usage intention for LBS [30]. Thus, two aspects are of interest for privacy concern in our context, i.e. the consent with location identification in an evacuation situation, and continuous, anonymous locating in case there is a sudden emergency, as even anonymous locating is likely to lead to privacy concerns [18].

Perceived Security Risk. The second dependent variable besides privacy concern is seen in the perceived security risk that location data is accessed without authorisation and/or misused, building on the more traditional term privacy risk that was introduced by Featherman and Pavlou [10] and Pavlou [27].

2.2 Demographic Variables

Age. The population on passenger ships and especially on cruise ships needs to be considered comparatively old, with 72% of the passengers older than 50 years [13]. Furthermore, low fertility rates and, especially, rapidly increasing life expectancies have led to a demographic change in Europe [5], suggesting even older passenger populations in the future. These data and trends raise the question of attitudes towards innovative wearable technology within an elderly population. Moreover, the age distribution is not constant over all travel locations but varies with the ship's route and type of travel, as there are, for example, theme cruises.

Demographic and social data have been collected in privacy research but often only used for the sample description but not investigated for predicting privacy perceptions (e.g. [34], [6]). Morris and Venkatesh [23] have found that the salience of technology acceptance factors varies and the initial intention to use technologies decreases with increasing age. These findings have been supported by succeeding research [22], [31].

Gender. The gender ratio is to be assumed balanced for passenger ships [13]. However, like the age distribution, it might vary with regard to travel destinations and types. Effects of gender on privacy perceptions were obtained in previous research. Nosko et al. [25], for instance, found that females are more careful about disclosing sensitive information.

2.3 Personal Attitudes

Personal attitudes such as personality traits and general attitudes are investigated for their additional explanatory power on the privacy and security perceptions. Three personal attitudes of interest were identified in the literature review and the prior interviews with passengers.

Technical Enthusiasm. Wearables for safety-enhancement in evacuations are a new technology. Hence, general technological attitudes might influence privacy and security perceptions. Technical enthusiasm was defined by Karrer et al. [16] as one dimension of technical affinity meaning the perceived enthusiasm for new electronic devices. Other measures, such as technology readiness (TRI, [26]) or computer literacy [33], often presuppose direct interaction over an interface.

Neuroticism. Uncertainty is of high relevance in the investigated research topic. The personality trait neuroticism, as one of the five personality traits in the Big Five Inventory [14], was defined as the opposite of emotional stability [15]. Its influence might be ambiguous. On the one hand, there is potential for uncertainty regarding the privacy and security of wearables. On the other hand, this might be outbalanced by the uncertainty and even fear of an emergency.

Need for Safety. Closely related to neuroticism, we suggest a third personal attitude for the investigation for effects on privacy and security perceptions in safety-critical contexts, the need for safety. We defined need for safety as the attitude towards and the weighting of safety. Regarding the safety-critical context of emergencies at sea, need for safety is of particular interest as the investigated wearables aim at enhancing safety at expense of uncertainty for privacy and security risks.

3 Method

3.1 Participants

Passengers of a cruise company were invited to participate in the online survey via mail and a cruise club website. There was no payment or other incentives. 2100 passengers completed the online survey, from which 15 were excluded from this investigation due to obvious misuse of the survey or missing age. The gender ratio was balanced and similar to the recommended IMO [13] population statistics with 49.6% females and 50.4% males, i.e. 1035 female and 1050 male participants. The mean age was $M = 49.22$ years ($SD = 12.59$). Even more importantly, the age ranged from 16 to 81 years (see Fig. 1), also representing people with 50 years and older (51.3%).

3.2 Questionnaire

Each variable, introduced in Sec. 2, was mapped in the survey by several items (see Table 1). The items were based on the discussed research for this variable as far as possible and, if necessary, translated to German for target group adequacy. Participants rated their degree of consent with the items on a 5-point Likert-scale (from 1 = disagree to 5 = agree).

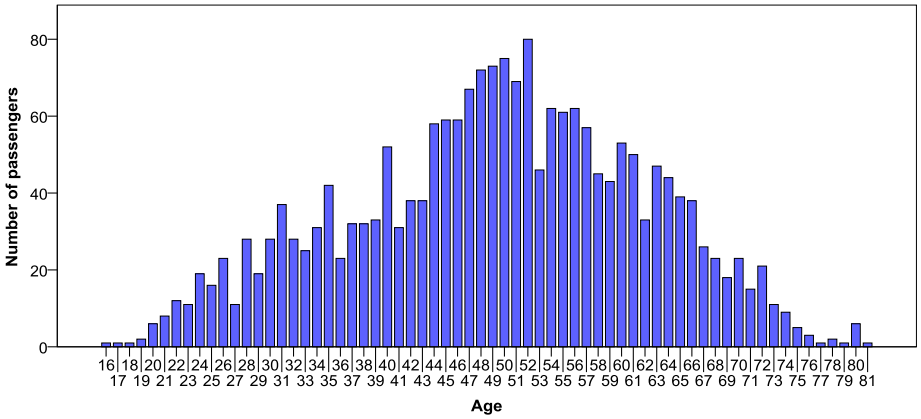

Fig. 1. Age distribution of the participating passengers ranging from 16 to 81 years with a mean age of 49.22 years

Table 1. Items

Variable	Items
Privacy concern	I would not want anyone to be able to locate me, even not for purposes of rescue.
	I would not want my bracelet to be tracked, even anonymously.
Perceived security risk	I would be worried that someone would track my location for other purposes than rescue.
	I think that someone would use my location data without authorization.
Technical enthusiasm	I inform myself about electronic devices, even if I do not have the intention to purchase.
	I love owning new electronic devices.
	I am enthusiastic when a new electronic device is launched.
	I like going to specialized trade stores for electronic devices.
	I have fun trying a new electronic device.
Neuroticism	I am relaxed, handle stress well. (R)
	I get nervous easily.
Need for Safety	Safety is important to me.
	Safety always comes first.

3.3 Statistical Analyses

First, multiple regressions and (M)ANOVAS were conducted to identify the relevant predictors for privacy concern and perceived security risk. Analysis of variance was used for independent nominal variables, i.e. only gender in this case, whereas regression analysis was used for ratio or interval scaled variables, i.e. every other variable in this investigation. The alpha-level was set to $\alpha = .01$. Based on Cohen [7], we defined the effect size regarding measures of association

power as small, when explaining 1% of the variance, as medium, when explaining 6%, and as large, when explaining 14%. For inclusion of independent variables in the final model, we therefore further defined the effect size explaining at least 1% of the variance in at least one of the target variable as prerequisite, i.e. independent variables that explained less than 1% of the variance in privacy concern and/or perceived security risk were excluded from further investigation. Second, we were interested in the sensitivity of privacy concern and perceived security risk by changes in the population. Hence, in accordance with Schwieger [32], multiple stepwise regressions were conducted with the identified relevant predictors of the target variables, forcing objective factors into the first step to increase the overall model validity.

4 Results

4.1 Descriptive Statistics

Table 2 presents the descriptive statistics of the target variables and the personal attitudes as demographic descriptives were presented in Sec. 3.1. Construct reliability was assessed by Cronbach's alpha α and the item-total correlation r_{it}. Kline [17] and Field [11] recommend thresholds of $\alpha > .70$ and $r_{it} > .30$. While all constructs met the latter requirement, neuroticism's and need for safety's Cronbach's alphas were not excellent but satisfactory for exploratory analyses [12],[8]. In addition, the neuroticism scale had been validated in the short version BFI-10 [28,29].

Table 2. Descriptive statistics for dependent variables and personal attitudes

	Mean	SE	Cronbach's α	Item-total correlation r_{it}
Privacy Concern	2.24	0.027	.847	.739
Perceived Security Risk	2.84	0.030	.933	.875
Technical Enthusiasm	3.11	0.022	.902	$.673 - .828^*$
Neuroticism	2.28	0.019	.669	.504
Need for Safety	4.80	0.009	.586	.447

*range because of the number of items

4.2 Statistical Selection of Independent Variables for the Final Model

The independent variables were investigated for their explanatory power on privacy concern and perceived security risks. Linear regression results with age as the only predictor for privacy concern showed a significant effect of age on the target variable, $F(2082) = 37.381$, $p < .001$, $R^2 = .018$, fulfilling both criteria for inclusion in the final model, i.e. significance at $p < .01$ and an explanatory power of more than or equal to 1%. The impact of age on security risk was higher, $F(2083) = 93.960$, $p < .001$, $R^2 = .043$, again fulfilling both criteria for inclusion in the final model.

Gender had a significant effect on privacy concern, investigated by MANOVA, $F(1, 2084) = 11.381$, $p < .001$. However, the explanatory power was very small, $\eta_p^2 = .005$. No significant effect of gender on perceived security risk was found, $F(1, 2084) = .004$, $p = .951$. Thus, gender was rejected as predictor for both target variables.

The influences of the personal attitudes technical enthusiasm, neuroticism, and need for safety were assessed by regression analyses. There was no significant effects of technical enthusiasm on privacy concern, $F(1, 2083) = .016$, $p = .899$, and on perceived security risk, $F(1, 2083) = 2494$, $p < .114$. Neuroticism had a significant effect on privacy concern, $F(1, 2083) = 12.407$, $p < .001$, but with a very small effect size of $R^2 = 0.6\%$, and no significant relation with perceived security risk, $F(1, 2083) = .119$, $p = .730$. Need for safety significantly affected privacy concern, $F(1, 2083) = 222.771$, $p < .001$, $R^2 = .097$, and perceived security risk, $F(1, 2083) = 107.361$, $p < .001$, $R^2 = .049$. Hence, the only personal attitude, included in the final model, is need for safety.

4.3 Final Multiple Regression Models

For the final multiple regression models, age and need for safety were considered as independent variables and privacy concern and perceived security risk as dependent variables. The dependence of need for safety on age was checked by regression analysis, showing a small significant effect of age on need for safety, $F(1, 2083) = 48.427$, $p < .001$, $R^2 = .023$. As our primary focus is the explanatory power of objective factors, such as demographics, we applied multiple stepwise regression analysis, forcing age into the model first and need for safety second, investigating need for safety only for additional explanation of the variance in the target variables that is not explained by age.

Multiple Regression with Privacy Concern as Dependent Variable. The regression model with age and need for safety, stepwise entered into the analysis, can explain 10.5% of the variance in privacy concern, $F(2, 2082) = 121.538$, $p < .001$ (see Table 3). Age accounts for 1.8% of the variance, $F(1, 2083) = 37.381$, $p < .001$, but need for safety can explain another 8.7%, $F(1, 282) = 202.087$, $p < .001$, $\Delta R^2 = 0.087$. The relation between age and privacy concern is negative, i.e. the older people are, the lower their privacy concern is,

$\beta = -0.88$, $t(2082) = -4.186$, $p < .001$. Need for safety also negatively relates to privacy concern, $\beta = -.298$, $t(2082) = -14.216$, $p < .001$.

Table 3. Multiple regression results for privacy concern as dependent variable

		B	$SE\ B$	β
STEP 1				
	Constant	2.884	0.109	
	Age	−0.013	0.002	-0.133^{**}
STEP 2				
	Constant	7.178	0.320	
	Age	−0.009	0.002	-0.088^{**}
	Need for Safety	−0.940	0.066	-0.298^{**}

$R^2 = .018$ for Step 1, $\Delta R^2 = .087$ for Step 2, $p < .01^{*}, p < .001^{**}$

In other words, there is a significant negative effect of age on privacy concern but the negative effect of the individual need for safety, for which age only partly accounts for, is larger. For a better understanding, we depicted these effects in a diagramm in Fig. 2 by recoding need for safety into only two categories, i.e. highest value in need for safety (high NfS: NfS = 5) and rest of the population (low NfS: NfS $\leq$ 4.5).

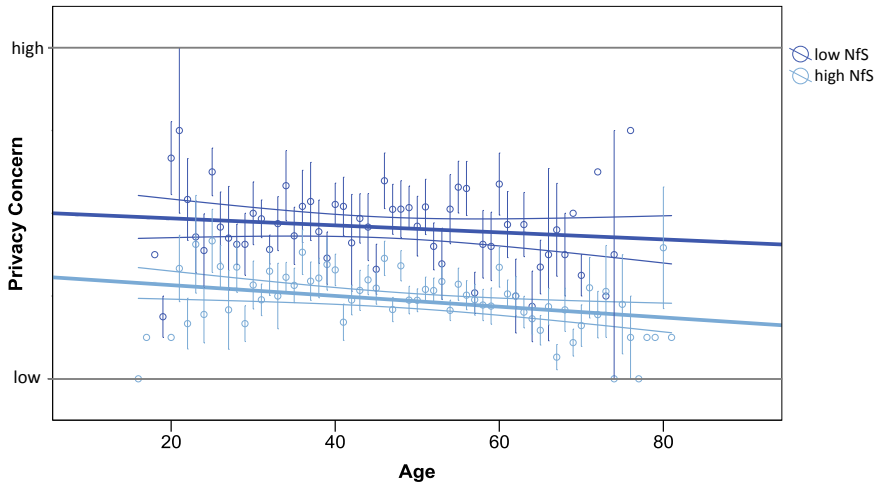

Fig. 2. Means of privacy concern with SEs in dependence on age, with regression lines (=thick lines) with 95% CI (=thin lines); dark blue depicts the group with a low safety need, light blue depicts the group with a high safety need

Multiple Regression with Perceived Security Risk as Dependent Variable. The regression model for perceived security risk can explain 8.0% of the variance in this target variable, $F(2, 2082) = 90.840$, $p < .001$. Age accounts for 4.3%, $F(1, 2083) = 93.960, p < .001$, and need for safety for another 3.7%, $F(1, 2082) = 83.978, p > .001$. Both independent variables are again negatively related to the target variable, i.e. perceived security risk decreases with increasing age of passengers, $\beta = -.208$, $t(2082) = -8.390$, $p < .001$, and with increasing need for safety, $\beta = -.195$, $t(2082) = 9.164$, $p < .001$.

Table 4. Multiple regression results for perceived security risk as dependent variable

		B	$SE\ B$	β
STEP 1				
	Constant	3.959	0.120	
	Age	−0.023	0.002	-0.208^{**}
STEP 2				
	Constant	7.070	0.359	
	Age	−0.020	0.002	-0.178^{**}
	Need for Safety	−0.681	0.074	-0.195^{**}

$R^2 = .043$ for Step 1, $\Delta R^2 = .037$ for Step 2, $p < .01^{*}, p < .001^{**}$

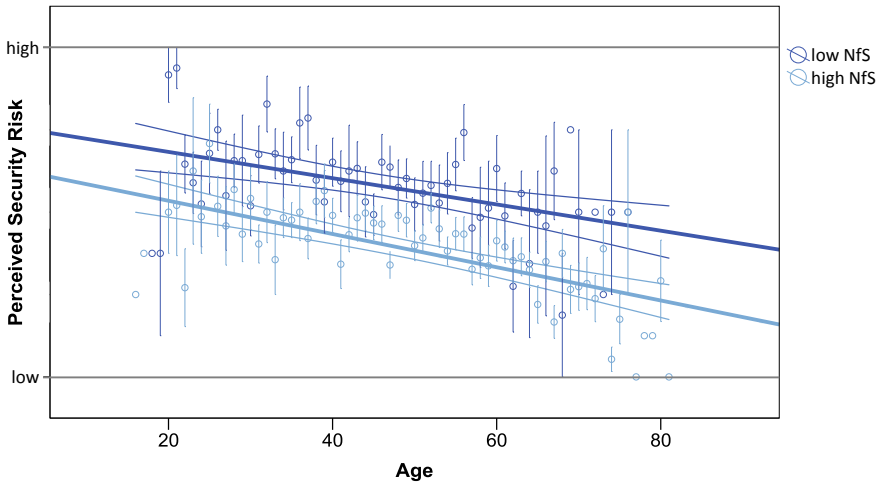

Fig. 3. Means of perceived security risk with SEs in dependence on age, with regression lines (= thick lines) with 95% CI (= thin lines); dark blue depicts the group with a low safety need, light blue depicts the group with a high safety need

In contrast to the small explanatory power of age on privacy concern, age as objective demographic factor explains almost as much variance in perceived security risk as need for safety, reflected by the obviously higher gradient in Fig. 3 than in Fig. 2 using the same scaling for the axes.

4.4 Summary of Results

The effects of age and need for safety on privacy concern and perceived security are depicted in Fig. 4. The black arrows reflect the explanatory power of the objective demographic variable age on the two target variables. Moreover, we found significant influences of need for safety on privacy concern and perceived security risk, additionally contributing to explain variance in the target variables. Taken together, age and need for safety account for 10.5% of the variance in privacy concern and 8.0% in perceived security risk, with a stronger influence of age on the latter variable.

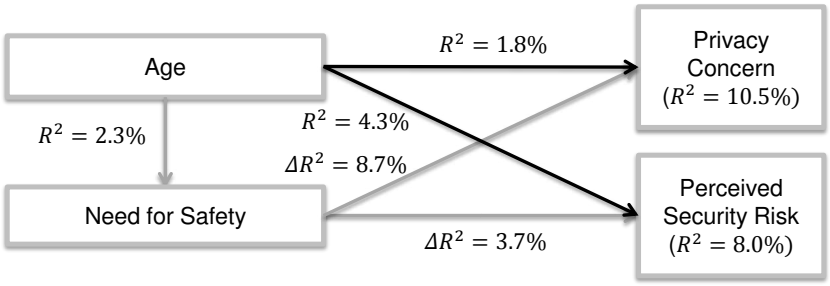

Fig. 4. Model with explanatory powers R^2 of the objective demographic variable age on privacy concern and perceived security risk (black arrows) and the change in the explanatory powers ΔR^2 integrating the need for safety into the model (grey arrows)

4.5 Limitations

The selection of independent variables was based on a comprehensive literature review and interviews with passengers aged between 32 and 70 years old. However, the unexplained variances in the perceptions of privacy and security suggest that there might be more, not yet identified factors of influence. Only as many items as constructs' dimensions were used in order to avoid boredom and fatigue by seemingly redundant questions. To ensure reliability though, the survey was iteratively tested with about twenty persons including passengers and experts from psychology and communication sciences. After each test we enhanced the items for clarification and representativeness of the underlying dimensions. In order to collect data from as many passengers as possible, we decided for an online survey, implying a potential bias by technical affinity. Lastly, a bracelet is obviously not the only possible form for safety-enhancing wearables.

5 Discussion and Future Work

The demographic variable age and the individual need for safety have been revealed to have significantly negative effects on privacy and security perceptions by a survey with 2085 passengers. A model based on multiple regressions has been developed explaining 10.5% of the variance in privacy concern and 8.0% of the variance in perceived security risk. Age was shown to be a stronger predictor for perceived security risk than for privacy concern.

For assessing sensitivity of the privacy and security perceptions due to varying population characteristics, we present the multiple regression results in Fig. 5 and 6.

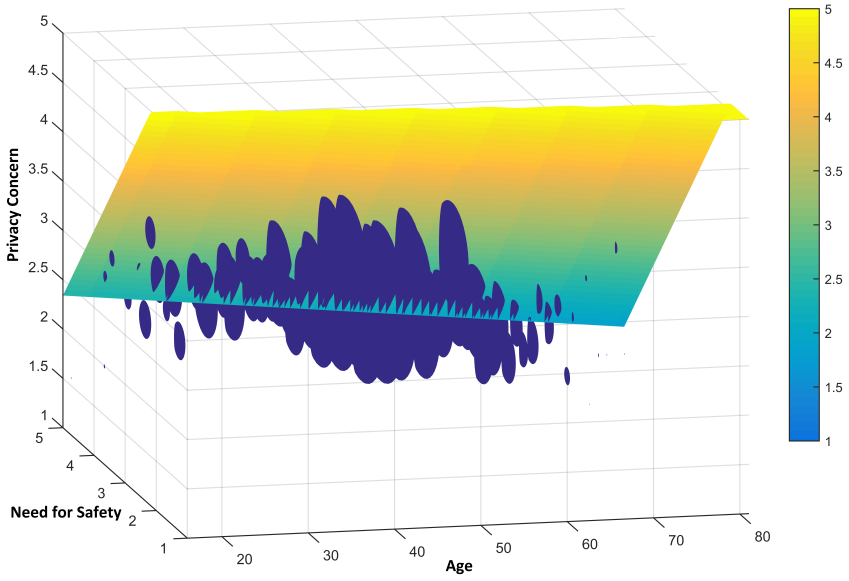

Fig. 5. Privacy concern as dependent variable of age and need for safety according to the multiple regression simulation; ellipses depict the survey data with sizes representing the frequency of answers

Fig. 5 shows the simulated ratings for privacy concern in dependence on age and need for safety. The data is derived from the survey and covers an age range from 16 to 81 years. The regression plane shows how privacy concern decreases with increasing age and need for safety. However, need for safety increases with age enhancing the revealed effects on the target variables. Additionally, the actual average values for privacy concern in dependence on age and need for safety are mapped by ellipses, with the ellipse sizes representing the number of answers.

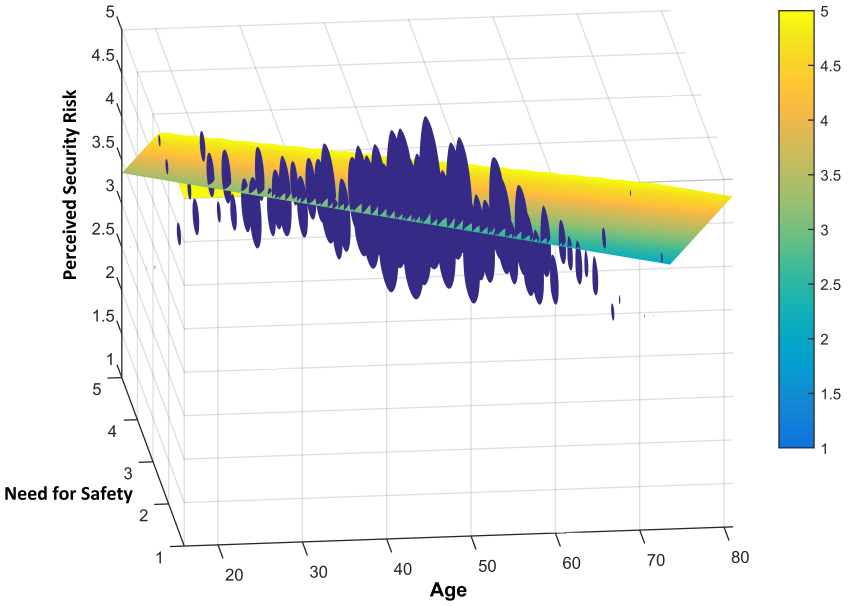

Fig. 6. Perceived security risk as dependent variable of age and need for safety according to the multiple regression simulation; ellipses depict the survey data with sizes representing the frequency of answers

Fig. 6 presents the ratings for perceived security risk in dependence on age and need for safety and depicts the multiple regression model as a surface plot. The regression plane shows how perceived security risk decreases with increasing age and need for safety. Again, the actual observations from the survey are mapped by ellipses in the figure.

The findings indicate that privacy concern and perceived security risk depend on the population characteristics age and need for safety. While need for safety of passengers is not directly visible to shipping companies, age is easy to retrieve. In general, privacy concern ratings beyond the threshold of 3.5 suggest a negative perception of the presented technology. According to the regression model, persons with a low need for safety are likely to show such a perception. The multiple regression simulation for the variable privacy concern in dependence on age and need for safety shows high values in privacy concern for low values in need for safety over the entire range of age. Thus, for a scale value for need for safety of less than 3.49, the simulated rating for privacy concern is above the threshold value for the entire range of age. This effect becomes even stronger for younger passengers than for older passengers. For passengers younger than 30 years, forming the youngest age group according to the IMO [12] recommendations for population characteristics, privacy concern only exceeds the threshold for the variable need for safety being 3.35 or lower. However, in our tested pop-

ulation we found a large majority of persons that showed a high need for safety, which indicates a correlation with low ratings for privacy concern.

Especially the perceived security risk is sensitive to age, i.e. younger populations, for instance due to theme cruises, perceive higher security risks than older ones. For young passengers (<30 years), the threshold value of perceived security risk is lower than 3.5 only if need for safety is rated at 4.85 or higher according to our regression model. Especially older passengers (>50 years, oldest age group assumed in IMO [13]), even with a low need for safety, are likely to perceive a low security risk when confronted with the proposed technology (threshold value of 3.5). This means that according to the model, corresponding attitudes can be assumed to prevail among certain groups. The group of elderly people with a positive need for safety and the group of younger people with a very high need for safety are likely to show a rating above the threshold.

There is an implicit contradiction to prior research as we found that elderly are more open to safety-enhancing technologies than younger people, although, for more traditional technologies, Morris and Venkatesh [23], McCloskey [22] and Rogers and Fisk [31] found a decreasing initial intention to use these technologies. Our research findings suggest an opposing relation of age with privacy and security perceptions for wearables to usage intentions for more traditional technologies.

Motti and Caine [24] found that users are unaware of the details of data collection by wearables and our research has shown that elderly people are not as critical about privacy and security of wearables suggesting that privacy and security perceptions would not hinder the deployment of wearables for safety-enhancement in elderly populations that much. In contrast, these findings are alerting for consumer-oriented wearables for the elderly as especially elderly persons have to be informed more about potential privacy and security risks. Hence, future work on privacy and security design including information policy for wearables that support elderly in everyday life is desirable.

Acknowledgements. The study was conducted within a project funded by the German Federal Ministry of Education and Research (BMBF) in the context of the national program *Research for Civil Security* and the call *Maritime Security* (FKZ: 13N12954).

References

1. Ahmed, R., Ho, S.Y.: Privacy Concerns of Users for Location-Based Mobile Personalization. In: CONF-IRM Proceedings Paper 10. Curran Associates, Seoul, South Korea (2011)
2. Austen, K.: The Trouble with Wearables. Electronic Gadgets on and in Our Bodies Are Multiplying Fast, but Transmitting All Their Data Safely Will Be a Challenge. Nature 525, 22-24 (2015)
3. Bansal, G., Zahedi F., Gefen, D.: The Impact of Personal Dispositions on Information Sensitivity, Privacy Concern and Trust in Disclosing Health Information Online. Decision Support Systems 49 (2), 138-150 (2010)

4. Barkhuus, L., Dey, A.K.: Location-Based Services for Mobile Telephony: a Study of Users' Privacy Concerns. In: Rauterberg, G.W.M., Menozzi, M., Wesson, J. (eds.) Proceedings of the IFIP International Conference on Human Computer Interaction, INTERACT '03, pp. 702-712. Zurich, Switzerland (2003)
5. bpb (Federal Agency for Civic Education): Demographic Change and Migration in Europe. Policy Brief 24. Institute for Migration Research and Intercultural Studies (IMIS) of the University of Osnabrueck, Osnabrueck, Germany (2013)
6. Buchanan, T., Paine, C., Joinson, A.N., Reips, U.D.: Development of Measures of Online Privacy Concern and Protection for Use on the Internet. Journal of the American Society for Information Science and Technology 58 (2), 157-165 (2007)
7. Cohen, J.: Statistical Power Analysis of the Behavioral Sciences. 2nd ed. Academic Press, New York (1988)
8. Cortina, J.M.: What Is Coefficient Alpha? An Examination of Theory and Applications. Journal of Applied Psychology 78 (1), 98-104 (1993)
9. Eastlick, M.A., Lotz S.L., Warrington, P.: Understanding Online B-to-C Relationships: An Integrated Model of Privacy Concerns, Trust, and Commitment. Journal of Business Research 59 (8), 877-886 (2006)
10. Featherman, M.S., Pavlou, P.A.: Predicting E-Services Adoption: a Perceived Risk Facets Perspective. International Journal of Human-Computer Studies 59 (4), 451-474 (2003)
11. Field, A.: Discovering Statistics Using IBM SPSS Statistics. Sage, London (2009)
12. George, D., Mallery, P.: IBM SPSS Statistics 21. Step by Step: a Simple Guide and Reference. 13th ed. Pearson Education, Boston (2014)
13. IMO (International Maritime Organization): Guidelines for Evacuation Analysis for New and Existing Passenger Ships. MSC Circular n. MSC/Circ.1238. 30th October 2007
14. John, O.P., Donahue, E.M., Kentle, R.L.: The Big Five Inventory Versions 4a and 5. University of California, Institute of Personality and Social Research, Berkeley (1991)
15. John, O.P., Srivastava, S.: The Big Five Trait Taxonomy: History, Measurement, and Theoretical Perspectives. In: Pervin, L.A., John, O.P. (eds.) Handbook of Personality Theory and Research, pp. 102-138. Guilford Press, New York (1999)
16. Karrer, K., Glaser, C., Clemens, C., Bruder, C.: Technikaffinitaet erfassen der Fragebogen TA-EG. In: Der Mensch im Mittelpunkt technischer Systeme, 8. Berliner Werkstatt Mensch-Maschine-Systeme, pp. 196-201. VDI Verlag GmbH, Duesseldorf (2009)
17. Kline, P.: The Handbook of Psychological Testing. 2nd ed. Routledge, London (2000)
18. Kobsa, A.: User Acceptance of Footfall Analytics with Aggregated and Anonymized Mobile Phone Data. In: Eckert, C., Katsikas, S.K., Pernul, G. (eds.) Trust, Privacy, and Security in Digital Business. LNCS, vol. 8647, pp. 168-179. Springer, Heidelberg (2014)

19. Kwee-Meier, S.T., Buetzler, J.E., Schlick, C.: Development and Validation of a Technology Acceptance Model for Safety-Enhancing, Wearable Locating Systems. Behaviour & Information Technology. Accepted, DOI: 10.1080/0144929X.2016.1141986. (2016)
20. Loebel, J.-M.: Is Privacy Dead? An Inquiry into GPS-Based Geolocation and Facial Recognition Systems. In: ICT Critical Infrastructures and Society: 10th IFIP TC 9 International Conference on Human Choice and Computers, HCC10 2012, IFIP AICT 386, pp. 338-348. Springer, Berlin (2012)
21. Malhotra, N., Kim, S., Agarwal, J.: Internet Users' Information Privacy Concerns (IUIPC): The Construct, The Scale, and a Causal Model. Information Systems Research 15 (4), 336-355 (2004)
22. McCloskey, D.W.: The Importance of Ease of Use, Usefulness, and Trust to Online Consumers: an Examination of the Technology Acceptance Model with Older Customers. Journal of Organizational and End User Computing (JOEUC) 18 (3), 47-65 (2006)
23. Morris, M.G., Venkatesh, V.: Age Differences in Technology Adoption Decisions: Implications for a Changing Work Force. Personnel Psychology 53 (2), 375-403 (2000)
24. Motti, V.G., Caine, K.: Users Privacy Concerns About Wearables. In: Financial Cryptography and Data Security, pp. 231-244. Springer, Berlin Heidelberg (2015)
25. Nosko, A., Wood, E., Kenney, M., Archer, K., De Pasquale, D., Molema, S., Zivcakova, L.: Examining Priming and Gender as a Means to Reduce Risk in a Social Networking Context: Can Stories Change Disclosure and Privacy Setting Use when Personal Profiles Are Constructed?. Computers in Human Behavior 28 (6), 2067-2074 (2012)
26. Parasuraman, A.: Technology Readiness Index (TRI): a Multiple-Item Scale to Measure Readiness to Embrace New Technologies. Journal of Service Research 2 (4), 307-320 (2000)
27. Pavlou, P.A.: Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model. International Journal of Electronic Commerce 7 (3), 101-134 (2003)
28. Rammstedt, B., John, O.P.: Kurzversion des Big Five Inventory (BFI-K). Diagnostica 51 (4), 195-206 (2005)
29. Rammstedt, B., John, O.P.: Measuring Personality in One Minute or Less: a 10-Item Short Version of the Big Five Inventory in English and German. Journal of Research in Personality 41 (1), 203-212 (2007)
30. Raschke, R., Krishen, A.S., Kachroo, P.: Understanding the Components of Information Privacy Threats for Location-Based Services. Journal of Information Systems 28 (1), 227-242 (2014)
31. Rogers, W.A., Fisk, A.D.: Toward a Psychological Science of Advanced Technology Design for Older Adults. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences 65 (6), 645-653 (2010)
32. Schwieger, V.: Nicht-lineare Sensitivitatsanalyse gezeigt an Beispielen zu bewegten Objekten. Bayerische Akademie der Wissenschaften, Mnchen (2005)

33. Sengpiel, M., Dittberner, D.: The Computer Literacy Scale (CLS) for Older Adults Development and Validation. In: Mensch & Computer 2008: Viel Mehr Interaktion, pp. 7-16. Oldenbourg Verlag, Muenchen (2008)
34. Sheehan, K.B., Hoy, M.G.: Dimensions of Privacy Concern among Online Consumers. Journal of Public Policy & Marketing 19 (1), 62-73 (2000)
35. Smith, H.J., Dinev, T., Xu, H.: Information privacy research: an interdisciplinary review. MIS Quarterly 35 (4), 989-1016 (2011)
36. Smith, H.J., Milberg, S.J., Burke, S.J.: Information Privacy: Measuring Individuals' Concerns about Organizational Practices. MIS Quarterly 20 (2), 167-196 (1996)
37. Zhou, T.: Examining Location-Based Services Usage from the Perspectives of Unified Theory of Acceptance and Use of Technology and Privacy Risk. Journal of Electronic Commerce Research 13 (2), 135-144 (2012)