A Stress-Based Smart Retail Service in Shopping Environments: An Adoption Study

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Abstract. Since many years, retailers have tried to leverage the benefits of e-commerce by transferring concepts of online shops into retailing. However, shopping experience in physical stores is different from the one in online shops due to potential stress factors arising in-store. Two previous scientific works focused on unobtrusively detected customers' perceived stress in order to provide tailored mobile services in real-time. The purpose of this paper is to assess the adoption of the envisioned stress-based smart retail service amongst potential customers. The results show that tailored services are perceived positively and thus, have the potential to contribute to an enhanced shopping experience.

Keywords: retailing · stress-based services · technology adoption study

Introduction

For years, retailers have been driven by the trend towards digitization, especially since the growing omnipresence of mobile devices in our daily lives [1,2]. However, the shopping experience in physical stores differs from the one in online shops. This is due to the fact of arising stress factors such as long queues at the checkout, distances to walk to the products or limited time to shop [3]. Thus, customer's receptiveness for various services during shopping fluctuates. Additionally, studies have shown that perceived stress is one of the most influential factors in causing customers to abandon the purchasing process [4,5,6]. Nonetheless, to measure customers' stress during shopping in real-time and providing tailored mobile services is still an ongoing challenge. Previous work presents a potential methodological basis for a stress-based smart retail service (SBRS). The aforementioned basis shows that perceived stress during shopping can be identified in real-time through the combination of machine learning (ML) and neuroscientific methods [7]. The results revealed that ML is a valuable tool to predict perceived stress with an accuracy of 79.5 % by classifying customers' stress level, analyzing unobtrusively measured heart rate (commercially available health sensor) and movement data (smartphone sensor). Follow-up work introduced a prototype of the envisioned SBRS providing two different services based on the individual's stress level [8]. However, to provide more value to individual customers in retailing, we need to have a better understanding on how customer behavior is affected by such new digital technologies and how smart retail services need to be adapted in response. Prior to this, there is a need for analyzing how customers

would adopt such a service. This paper aims to do so by conducting a study to assess the adoption of the aforementioned SBRS amongst potential users. The paper addresses the following research question: *How would in-store customers adopt a smart retail service providing tailored mobile services in real-time based on individual stress level in shopping environments?*

State-of-the-art

Radhakrishnan et al. [9] emphasize that real-time mining methods using sensors from personal mobile and wearable devices for data analysis purposes can enhance in-store shopping experience. Sensor- and vision-based technologies such as camera and robots can be individually combined in order to personally identify individual customer characteristics (e.g. gestures, speech) [10,11,12]. Furthermore, sensor-equipped robots can interact with customers and adapt to their behavior such as providing assistance [10]. Kowatsch and Maass [3] have presented that mobile recommendation agents (MRAs) increase the value of product information in physical stores. There exist publications introducing recommendation systems for supermarkets, fashion and electronic stores [13, 14, 15]. Further technologies, such as store navigation and product locators add value in the context of retailing [16]. However, there are only few approaches making emotions a subject of discussion. A previous work of the authors presents a new and unique approach, i.e. a stress-based smart retail service (SBRS) focusing on customers' perceived stress level during shopping. Perceived stress is proven to have a negative effect on customer purchase behavior, perceived shopping experience, and consequently on customer satisfaction and the success of the store.

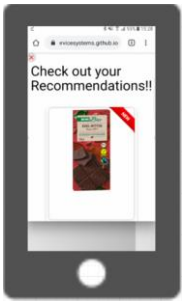
Stress-based Smart Retail Service

The introduced SBRS consists of a mobile app designed for collecting acceleration data from a mobile phone and unobtrusively measured heart rate data from a smartwatch during shopping [7]. The app recognizes when the customer enters the store (e.g. through visible light communication), the heart rate and acceleration data is constantly sent to the backend in an encrypted and anonymized format to guarantee an adequate level of privacy protection [7]. In the scope of the backend, the heart rate stream as well as acceleration data is analyzed with the help of ML to find patterns in the data and classify the customer into the two classes *stressed* and *relaxed* [7]. For the classification, the integrated ML model extracts mean acceleration and mean heart rate values of 60-seconds windows as well as significant time series characteristics from the heart rate curve to then analyses the data doing binary classification. Various ML models have been used for classification task to then focus on the best-performing model. Based on the results, the SBRS provides individually tailored services in real-time. If the customer is classified as *stressed*, additional help during shopping by finding products is provided. If the customer is classified as *relaxed*, the service introduces recommend products fitting to the customer's preferences and shopping list [8].

Method

The experiment consists of two parts: (1) playing through pre-defined shopping scenarios (equipped with an unobtrusive heart rate sensor and mobile phone), and (2) two paper-and-pencil questionnaires regarding the perception of the shopping scenario and the adoption of the additionally presented SBRS. The SBRS that is tailored to the pre-defined shopping scenarios is described in form of short stories as part of conceptual models. The study consisted of 100 participants in total aged between 18 and 30 years (female = 63, male = 37). Both groups received a short description about the envisioned situation-specific smart retail service and its functionalities that is mapped to the shopping situation they just played through. Furthermore, the participants have been informed that using the service would involve having to wear a sensor (such as smartwatch).

Tab. 1. To-be Narratives for Group 1 (N = 50) and Group 2 (N = 50)

To-Be Narrative Group 1: Relaxed shopping scenario	
	It is Friday afternoon and you want to enjoy your evening by having a dinner. You decide to go to the supermarket to buy some food. You have a shopping list for your purchase. After arriving at the supermarket, you put all the products on your list into the shopping cart and look for additional products that might attract your attention. While strolling through the store, the situation-specific smart retail service on your mobile phone analyses your stress level and recognizes that you are relaxed and strolling around. The situation-specific smart retail service on your mobile phone gives you a notification: "Check your recommendations". Based on your shopping list and your preferences, the service recommends you a bar of chocolate "fine dark".
To-Be Narrative Group 2: Stressed sopping scenario	
	It is Friday evening. Some friends are going to visit you at 8 pm and you totally forgot to prepare something. You do not have anything to eat at home. You decide to go to the supermarket to buy some food. You prepared a shopping list before going to the store. When you arrive at the supermarket, you see that you have only 3 minutes left to make your purchase before the supermarket closes. You run into the supermarket and start putting the products from your shopping list into the shopping cart. You try to find canned food from the brand "Sonnen Bassermann", but you are not able to find it. The situation-specific smart retail service analysis your stress level and recognizes that you are stressed. It sends a notification to your smartphone: "Do you need help?". You checkmark "Sonnen Bassermann" on the list and the service provides the information on where to find the product.

Conceptual models are means by which a designer expresses his or her own understanding of an envisioned information system such as the SBRS [17]. Studies have shown that the more structured a conceptual language is, the better the mental representations are [18]. For evaluation of the shopping scenarios, the subjects played through the pre-defined as-is narratives in a laboratory supermarket setting to then

answer questions about the perceived stress, and confusion caused by the store layout. The difference between the relaxed shopping situation (group 1) and the stressful shopping situation (group 2) is that in group 2, participants were given two shopping stressors which were identified by [19], namely a product from the list not available on the shelves and a time restriction. To assess the participants' perceived stress during the played-through shopping scenarios, we designed the first survey adopting constructs from shopping stress [20,21,22], shopping excitement [23], and confusion about the store layout [24]. In a second part, we aimed to assess individuals' perceptions of the envisioned SBRS with respect to its potential adoption into their shopping routines. For this, each participant received a to-be narrative describing the SBRS service tailored to their shopping scenario they played through based on the group they belong to (*relaxed* or *stressed*, see table 1). For the second survey, we adopted constructs from situation-service-fit (SSF) [26], behavior-service-fit (BSF) [25], perceived usefulness (PU) [26], flexibility of the service (FoS) [27], intention to use (ItU) [27], attitude towards usage (AtU) [27], as well as general technological affinity of the user [28]. All responses were measured on 7-point Likert scales (1 = strongly disagree, 7 = strongly agree).

Results

The results show that group 1 significantly perceived the shopping situation less stressful than group 2. Furthermore, the groups did not differ concerning shopping excitement with group 2 having a higher (but still insignificant) rating value than group 1. Moreover, the groups differed concerning confusion about the store layout with group 1 having a lower rating value than group 2.

Tab. 2. Item Analysis of the Questionnaire Survey of Group 1 and Group 2 (Welch's t-test).

CONSTRUCT		*# OF ITEMS*	*INTERNAL CONSISTENCY*		*MEAN*		*ST.DEV (SD)*		*SKEW*	
			G1	*G2*	*G1*	*G2*	*G1*	*G2*	*G1*	*G2*
Part 1	Shopping Stress	6	.88	.86	2.52	4.42	1.07	1.20	.83	-.82
	Shopping Excitement	3	.77	.78	4.44	4.59	1.18	1.10	-.57	-.73
	Confusion in store layout	2	.81	.96	2.84	3.93	1.47	1.77	1.09	-.14
Part 2	Situation-Service Fit	1	-	-	4.70	4.96	1.46	1.37	-.56	-1.32
	Behavior-Service Fit	1	-	-	4.98	4.92	1.56	1.60	-.17	-.14
	Perceived Usefulness	2	.81	.81	4.64	4.66	1.29	1.15	-.87	-.57
	Flexibility of Service	1	-	-	4.86	4.86	1.03	.95	-.41	-.76
	Intention to Use	3	.93	.96	4.35	4.05	1.60	1.59	-.51	-.02
	Attitude towards Usage	3	.95	.90	4.63	4.48	1.43	1.22	-.74	-.51
	Technical enthusiasm	2	.87	.83	5.06	5.00	1.33	1.26	-.42	-.45

Second, each subject had to assess the envisioned SBRS. All constructs for the two groups were rated with mean values ≥ 4 and negative skew values, which both are indicators for an overall positive rating of the SBRS. In group 1, participants rated BSF the highest with a mean of 4.98. Furthermore, SSF, PU, FoS, ItU, and AtU are rated positively with ItU rated the lowest with a mean of 4.35. For group 2, a similar picture emerges with highest mean for SSF (4.96) and BSF (4.92) and slightly lower mean values for BSF and ItU compared to group 1. The mean values for SSF, PU, and AtU are slightly higher compared to group 2.

Discussion and Implications

The goal of this paper was to analyze how users adopt the envisioned stress-based smart retail service (SBRS) tailored to the user's stress level while shopping in-store (RQ). We first applied a laboratory experiment where we designed two shopping scenarios – relaxed and stressful – to simulate pre-defined as-is situations based on literature in the scope of in-store shopping. Then, the participants of the laboratory experiment had to complete two paper-and-pencil questionnaires so that a) the perceived stress level of the participants during the shopping scenarios and b) the adoption of an envisioned SBRS providing tailored services in real-time. The analysis results of the study and the questionnaire have shown the success of the intention of creating relaxed and stressful shopping scenarios. Regarding the questions for adoption of the SBRS, we see that both groups answered all questions with a mean value >4, indicating that the SBRS was assessed positively and that customers would welcome different services tailored to different shopping situations. This is supported by the fact that SSF, BSF and FoS were rated the highest. Even though the participants of the *relaxed* group rated the service more positive than the *stressed* one, the difference is not significant. Thus, we can assume that customers being stressed might need services specifically tailored to their sopping situation. The analysis results also show that the SBRS reacting to the stress level of customers in real-time is a hot topic in the NeuroIS community [29,30,31,32,33]. By classifying customers with respect to their stress levels, retailers have the potential to create an interactive shopping experience and improve customer loyalty by providing suitable services. The envisioned SBRS could enable applications such as: (a) targeted and customized advertisement: e.g. new product launch; (b) proactive retail help: a shop assistant to help customers finding products or recommendations for additional products suitable for purchases in the shopping list. However, it has to be mention that the use of information and communication technologies itself can constitute a source of stress, namely digital stress. Thus, it is possible that the SBRS might cause stress [33,35,36].

Conclusion and Future Work

Despite the fact that the stress-based smart retail service (SBRS) was rated positively and thus, provides multiple advantages not only for retailers but also for customers, they need to be motivated to use the SBRS, i.e. download the app and use it. For instance, retailers have the option to provide incentives (discounts or vouchers) for the

initial sign-in. Moreover, the fact that the SBRS is supposed to be privacy-friendly can attract users. In this context, taking adequate measures to ensure data security as well as privacy is crucial. This paper serves as a first evaluation of the SBRS. Due to the exploratory nature of this work, several limitations need to be overcome by future research. We used narratives to present the envisioned SBRS. In a next step, the service is planned to be assessed in practice to compare the results to the ones presented in this paper. For this, we plan to conduct a laboratory study where the ML-based service will be integrated into a mobile phone. The recruited subjects wearing unobtrusive heart rate sensors and carrying the mobile phone will be able to use the installed service in the pre-defined shopping scenarios to then evaluate the service. Thus, additional constructs such as perceived ease of use [27] can be assessed too. Furthermore, focusing on additional shopping scenarios and generating new services based on perceived stress is also a topic of future work. In addition, it should not be neglected that the SBRS itself might be a source of stress (technostress) and thus, constitutes a potential limitation and deserves future investigation.

References

1. Li, Y. M., Lin, L. F., Ho, C. C.: A social route recommender mechanism for store shopping support. Decision Support Systems. 94, 97-108 (2007)
2. Liang, T. P., Lai, H. J., Ku, Y. C.: Personalized content recommendation and user satisfaction: Theoretical synthesis and empirical findings. Journal of Management Information Systems, (23:3), 45-70 (2006)
3. Kowatsch, T., Maass, W.: In-store consumer behavior: How mobile recommendation agents influence usage intentions, product purchases, and store preferences. Computers in Human Behavior, 26:4, 697-704 (2010)
4. Albrecht, C. M., Hattula, S., Lehmann, D. R.: The Relationship Between Consumer Shopping Stress And Purchase Abandonment In Task-Oriented And Recreation-Oriented Consumers. Journal of the Academy of Marketing Science. 4:5, 720–740 (2017)
5. Baker, J., Wakefield, K. L.: How Consumer Shopping Orientation Influences Perceived Crowding, Excitement, And Stress At The Mall. Journal of the Academy of Marketing Science. 5:40, 791–806 (2012)
6. Zhu, W., Timmermans, H.: Cut-Off Models For The 'Go-Home'decision Of Pedestrians In: Shopping Streets. Environment and Planning B: Planning and Design, 35:2, 248–260 (2008).
7. Öksüz, N., Maass, W.: A Situation-specific Smart Retail Service Based On Vital Signs. In Internation Conference on Information Systems (ICIS) (2020).
8. Öksüz, N., Manzoor, H.M., Harig, A., Maaß, W.: A ML-based Smart Retail Service Prototype using Biosignals. In Workshop on Information Technology and Systems. Workshop on Information Technology and Systems (WITS) (2020)
9. Radhakrishnan, M. Misra, A.: Can Earables Support Effective User Engagement During Weight-Based Gym Exercises?. Proceedings of the 1st International Workshop on Earable Computing, 42–47 (2019)
10. Bertacchini, F., Bilotta, E., Pantano, P.: Shopping With A Robotic Companion. Comput. Human Behav. 77, 382–395 (2017)
11. Chu, T. H. S., Hui, F.C.P., Chan H. C. B.: Smart Shopping System Using Social Vectors and RFID. Int. Multiconference Eng. Comput. Sci. 1, 239–244 (2013)

12. Kamei, K., Ikeda, T., Shiomi, M.: Cooperative Customer Navigation Between Robots Out-Side And Inside A Retail Shop—An Implementation On The Ubiquitous Market Platform. Ann. Telecommunication. 7:8, 329–340 (2012)
13. Christidis, K., & Mentzas, G.: A Topic-Based Recommender System For Electronic Marketplace Platforms. Expert Systems with Applications. 40:11, 4370–4379 (2013)
14. Hwangbo, H., Kim, Y. S., Cha, K. J.: Recommendation System Development For Fashion Retail Ecommerce. Electronic Commerce Research and Applications. 28, 94–101 (2018)
15. Keller, T., & Raffelsieper, M.: An E-Commerce Like Platform Enabling Bricks-And-Mortar Stores To Use Sophisticated Product Recommender Systems. Proceedings of the 8th ACM Conference on Recommender system, 367–368 (2014)
16. Linzbach, P., Inman, J. J., & Nikolova, H.: E-Commerce in a Physical Store: Which Retailing Technologies Add Real Value?. NIM Marketing Intelligence Review. (11:1), 42–47 (2019)
17. Kuechler, W. L., Vaishnavi, V.: So, talk to me: The effect of explicit goals on the comprehension of business process narratives. Mis Quarterly. (30), 961-979 (2016)
18. Maaß, W., Storey, V. C.: Logical design patterns for information system development problems. In Johannesson, P., Lee, M.-L., Liddle, S.W., Opdahl, A.L., López, O.P., (eds.) Conceptual Modeling - 34th International Conference, ER 2015, Lecture Notes in Computer Science, vol. 9381, pp. 134-147, Springer (2015)
19. Aylott, R., Mitchell, V. W.: An Exploratory Study Of Grocery Shopping Stresors. International Journal of Retail & Distribution Management. 26:9, 362–373 (1998)
20. Baker, J., Wakefield, K. L.: How Consumer Shopping Orientation Influences Perceived Crowding, Excitement, And Stress At The Mall. Journal of the Academy of Marketing Science. 5:40, 791–806 (2012)
21. Miller, E. G., Kahn, B. E., Luce, M. F.: Consumer Wait Management Strategies For Negative Service Events: A Coping Approach. Journal of Consumer Research. 34, 635–648 (2008)
22. Russell, J. A., Pratt, G.: A description of the affective quality attributed to environments. Journal of Personality and Social Psychology. 38:2, 311–322 (1980)
23. Wakefield, K. L., Baker, J.: Excitement At The Mall: Determinants And Effects On Shopping Response. Journal of Retailing. 74, 515–539 (1998)
24. Garaus, M., Wagner, U.: Retail shopper confusion: An explanation of avoidance behavior at the point-of-sale. ACR North American Advances. (2013)
25. Maass, W., Kowatsch, T., Janzen, S., & Filler, A: Applying Situation-Service Fit to Physical Environments Enhanced by Ubiquitous Information Systems. 20th European Conference on Information Systems (ECIS). 221, 1–12 (2012)
26. Venkatesh, V., Davis, F. D.: A theoretical extension of the technology acceptance model: Four longitudinal field studies. Management Science. 46:2, 186–204 (2000)
27. Wixom, BH., Todd, PA.: A Theoretical Integration of User Satisfaction and Technology Acceptance. Information Systems Research. 16:1, 85–102 (2005)
28. Edison, S. W., Geissler, G. L.: Measuring attitudes towards general technology: Antecedents, hypotheses and scale development. Journal of targeting, Measurement and Analysis for Marketing. *12*:2, 137-156 (2003)
29. Riedl, R.; Kindermann, H.; Auinger, A.; Javor, A.: Technostress from a neurobiological perspective: System breakdown increases the stress hormone cortisol in computer users. Business & Information Systems Engineering, 4/2, 61-69 (2012)
30. Adam, M. et al.: Design blueprint for stress-sensitive adaptive enterprise systems. Business & Information Systems Engineering, 59, 277-291 (2017)
31. Riedl, R.; Léger, P.-M.: Fundamentals of NeuroIS – Information Systems and the Brain. Springer (2016)

32. Vom Brocke, J.; Hevner, A.; Léger, P.-M.; Walla, P.; Riedl, R.: Advancing a NeuroIS Research Agenda with Four Areas of Society Contributions. European Journal of Information Systems, 29/1, 9-24 (2020)
33. Riedl, R.: On the biology of technostress: Literature review and research agenda. DATA BASE for Advances in Information Systems, 44:1, 18-55 (2013)
34. Fischer, T.; Riedl, R.: Lifelogging for Organizational Stress Measurement: Theory and Applications. SpringerBriefs in Information Systems. Springer, (2019)
35. Fischer, T.; Riedl, R.: Technostress research: A nurturing ground for measurement pluralism? Communications of the Association for Information Systems, 40, 375-401, (2019)
36. Fischer, T.; Riedl, R. (2020): On the stress potential of an organizational climate of innovation: A survey study in Germany. Behaviour & Information Technology, Published online: 10 Nov 2020.