attitude towards the system is greatly affected by the level of explanations provided. Concretely, concerning H1 we found that argumentative explanations performed better in terms of system acceptance. We assume that one critical reason for argumentative explanations being preferred is that they provide a well formulated rationale behind recommendations which the other two variants lack. Beyond that, the explanation gets an even more solid fundament by listing possible positive and negative consequences of a particular decision as shown by area (A) mentioned in the red circle, in Fig.2. Such polarized enumerative depictions can easily be grasped by people making complex decision domains more accessible and therefore increasing the system's trustworthiness [2].

Out of the 12 dependent variables that contribute to overall system acceptance, four came out to be statistically significant, i.e. Explanation Quality, Information Sufficiency, Use Intentions, and Overall Satisfaction. Our results are in accordance to existing research stating that argumentative explanations are designed to yield higher results in, for instance, explanation quality, information sufficiency, and overall satisfaction. However, receiving increased levels of Use Intention is surprising, especially when considering that interaction was merely performed on a design mockup. One possible reason might be that argumentative explanations offer direct textual assurance that a recommended camera is adequate for the intended use case, e.g. *"Nikon D750 is perfect for your sport photography needs"*.

Non-significant differences regarding the remaining eight dependent variables maybe also due to the system being only a mockup and due to a somewhat reduced statistical power as well as relatively small sample size.

Beyond the influence of systematically varying the level of explanations, H2 was concerning with the degree to which one relying on an explanation is also moderated by individual decision-making strategies. People with intuitive or experiential thinking styles showed more dependency on explanations to make advantageous decisions in a risk-involved situation. By contrast, those with rational or logical thinking styles seem to make their decisions independent of whether or not they are provided with explanations for their choices. We take this as evidence that the benefit of argumentative system feedback in the form of explanations is, in fact, moderated by participants' cognitive functions. Users with experiential thinking style deserve more guidance by the system, e.g. in the form of explanations, when they are about to make risk-involved decisions. These findings validate hypotheses H2.1 and H2.2 and are in line with research in psychology and cognitive sciences [4, 10].

6 CONCLUSION AND FUTURE WORK

The current work has made several contributions. First, we proposed a conceptual framework that extended the conventional explanation approaches to a more argumentative manner following the basic structure of Toulmin's model of argumentation. We presented an initial UI design mockup to show that how these argumentative explanations may be provided to users in complex decision situations. As a main contribution, we conducted a user study to investigate the impact of varying levels of explanations including the proposed argumentative explanation, on overall system acceptance. The study results validated our conceptual framework, where the argumentative explanations outperformed the other two variants of the explanations in terms of better system acceptance by users. Our result findings further showed that the acceptance of system in the presence of varying levels of explanations is moderated by decision styles of the user i.e., rational and experiential. The results indicated that the users with experiential thinking style showed more dependency on the levels of explanations provided to them as compared to the rational decision makers.

The future work will focus more on methods to develop a real recommender system based on our proposed framework. Furthermore, we will focus more on developing and demonstrating the explanation algorithms, i.e., methods for selecting, structuring and evaluating the arguments to be included in an explanation. Additionally, we tend to explore methods to present these textual argumentations in a more interactive and visual manner without overwhelming the user with information overload.

REFERENCES

[1] Bader, R., Woerndl, W., Karitnig, A. and Leitner, G. 2011. Designing an explanation interface for proactive recommendations in automotive scenarios. *International Conference on User Modeling, Adaptiation, and personalization (UMAP)* (2011), 92–104.

[2] Bedi, P. and Vashisht, P. 2014. Empowering recommender systems using trust and argumentation. *Information Sciences*. 279, (2014), 569–586. DOI:https://doi.org/10.1016/j.ins.2014.04.012.

[3] Bedi, P. and Vashisth, P. 2011. Interest based recommendations with argumentation. *Journal of Artificial Intelligence*. 4, 2 (2011), 119–142. DOI:https://doi.org/10.3923/jai.2011.119.142.

[4] Brand, M., Fujiwara, E., Borsutzky, S., Kalbe, E., Kessler, J. and Markowitsch, H.J. 2005. Decision-Making Deficits of Korsakoff Patients in a New Gambling Task With Explicit Rules: Associations With Executive Functions. *Neuropsychology*. 19, 3 (2005), 267–277. DOI:https://doi.org/10.1037/0894-4105.19.3.267.

[5] Brand, M., Laier, C., Pawlikowski, M. and Markowitsch, H.J. 2009. Decision making with and without feedback: The role of intelligence, strategies, executive functions, and cognitive styles. *Journal of Clinical and Experimental Neuropsychology*. 31, 8 (2009), 984–998. DOI:https://doi.org/10.1080/13803390902776860.

[6] Briguez, C.E., Budán, M.C.D., Deagustini, C.A.D., Maguitman, A.G., Capobianco, M. and Simari, G.R. 2012. Towards an argument-based music recommender system. *COMMA. Frontiers in Artificial Intelligence and Applications*. 245, 1 (2012), 83–90. DOI:https://doi.org/10.3233/978-1-61499-111-3-83.

[7] Van Eemeren, F., Garssen, B., Krabbe, E.W., Snoeck Henkemans, a F., Verheij, B. and Wagemans, J.M. 2014. Toulmin's Model of Argumentation. *Handbook of Argumentation Theory*. Springer, Dordrecht. 203–256.

[8] Epstein, S. 1973. The Self-Concept Revisited: Or a Theory of a Theory. *American Psychologist*. 28, 5 (1973), 404–416. DOI:https://doi.org/http://dx.doi.org/10.1037/h0034679.

[9] Heras, S., Navarro, M., Botti, V. and Julain, V. 2009. Applying dialogue games to manage recommendation in social networks. *International Workshop on Argumentation in Multi-Agent Systems* (2009), 256–272.

[10] Kahneman, D. 2011. *Thinking, Fast and Slow*. Macmillan.

[11] Lamche, B., Adigüzel, U. and Wörndl, W. 2014. Interactive explanations in mobile shopping recommender systems. *In Joint Workshop on Interfaces and Human Decision Making in Recommender Systems* (2014), 14–21.

[12] Nunes, I. and Jannach, D. 2017. A systematic review and taxonomy of explanations in decision support and recommender systems. *User Modeling and User-Adapted Interaction*. 27, 3–5 (2017), 393–444. DOI:https://doi.org/10.1007/s11257-017-9195-0.

[13] Pu, P. and Chen, L. 2011. A user-centric evaluation framework of recommender systems. *Fifth ACM conference on Recommender systems* (2011), 157–164. DOI:http://doi.org/10.1145/2043932.2043962