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Measuring Musician's Playing Experience: Development of a questionnaire for the evaluation of musical interaction

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ABSTRACT

In the context of new interfaces for musical expression, no systematic studies can be found dealing with the evaluation of musician's playing experience. A validated tool to measure this unique experience would be beneficial for the design process of new digital musical instruments. Experimental applications could also reveal a deeper understanding of musical interaction itself. By embracing an exploratory approach, this research aims to find the relevant dimensions of this construct and to validate them by using established statistical methods. With completion of the planned work, the contribution to the NIME-community will be a questionnaire to investigate the musician's playing experience in musical interaction. This short paper gives a brief overview of the relevant dimensions by looking at user experience research and previous domain specific studies. The planned procedure towards the development of measuring musician's playing experience is briefly described.

Keywords

Evaluation, musician's playing experience, musical practice and interaction, HCI, user experience, measurements, audio-haptic modalities, digital musical instrument

1. INTRODUCTION

Musical interaction is a unique experience for the performer. User experience (UX) in HCI is understood to generally involve emotions, enjoyment and aesthetics [1]. These dimensions are also of potential interest in musical interaction. Measuring musician's playing experience (MPX) within the context of NIME would help to acquire a deeper understanding of musician's needs. Johnston [7] reported that contributions to NIME are merely introducing musical instruments that present technical or artistic novelty. By developing a questionnaire that measures the subjective experience of musicians, the aim of this research is to provide a useful tool to find and evaluate the relevant dimensions of MPX suitable for investigations in NIME. As a result, the iterative design processes could benefit from incorporating such a tool as a resource for guidance in important design decisions.

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Only a limited number of studies can be found that deal with evaluation of digital musical instruments (DMIs) [16]. Since the beginning of NIME in 2001 a commonly used approach for evaluation was to borrow established methods from HCI. The chosen evaluation methods were often similar to simultaneous trends in HCI research. According to that, Wanderley and Orio [18] adapted usability testing to evaluate input devices for musical expression. Kiefer and colleagues [8] reflected usability testing for DMIs and noticed that this method lacks in providing any measure of the participants' experience during musical interaction. By building up on this insight, it is highlighted that the acknowledgment of ergonomics and efficiency as non primary dimensions for the quality of a musical interface is similar to the recognition in HCI that task-based evaluation is often inadequate, especially within creative domains [7]. Also, Swift [17] asked for broader investigations of musical interaction, which in his case was a scientific study of 'jamming'. Swift argued that using the concept of UX offers new possibilities for the design of DMIs if jamming is in focus. Furthermore, O'Modhrain [14] demanded a broader definition of the term evaluation itself within DMI-design. To generate sensibility for her concern, O'Modhrain distinguished different stakeholders (audience, performer, designer and manufacturer) within the field. Each of them would have a different usage and understanding of the term.

Evaluation appears to be a delicate issue in NIME. This is not surprising because it is stated that the evaluation in this domain would be a novel field of research [19]. Stowell et al. [16] observed that only a limited amount of research concerning the development or application of evaluation methods within NIME exists. Furthermore, it is mentioned that HCI methods have only been scarcely used for evaluation in NIME-publications. Many published papers would not include evaluation, or only contain it informally. Johnston [7] stated that the question of how evaluation within NIME should be done has been a recurring issue. Apparently, there is no well established and robust measurement tool available to evaluate MPX. Evaluation of new interfaces is often done by using self-created measures of UX, only including small sample sizes and without providing a detailed description of the methodological procedure. Hence, the measurements of the different concepts are neither validated nor reliable and these studies are therefore difficult to replicate and compare. As a consequence, Stowell et al. argued that further development of related methodologies would be beneficial for the field [16].

With the intention to contribute to the further development of evaluative approaches within NIME, the purpose of this research is to develop a measurement tool to evaluate MPX. This will be achieved by designing a questionnaire based on relevant dimensions suitable for musical interaction and previous work in UX-research. The resulting MPX measurement will then allow for evaluation of a specific device in different stages of the design process. In addition, similar or different DMIs can be compared on MPX-dimensions. Since this research will be done within the framework of the SNSF[1]-funded research project AHMI (audio-haptic modalities in digital musical interfaces) another application of MPX might involve the comparison of devices with and without haptic feedback. MPX evaluation can therefore also contribute to the explanation of benefits from implementing haptic feedback in DMIs.

2. RESEARCH CONTEXT

The planned research will be realised within the HCI research group at the Department of Cognitive Psychology and Methodology of the University of Basel[2]. Given the opportunity to contribute to the interdisciplinary research project AHMI, the development of the MPX-measurement and its application will provide deeper understanding of DMIs offering haptic feedback. The AHMI-project aims to recover lost physicality in DMIs, which currently do not provide active haptic feedback to the performer. This lack of feedback, when compared to traditional instruments might weaken the action-perception loop and therefore prevent engagement and embodiment of the player with the instrument. The planned research will assess these issues. Moreover, the development of new experimental devices, perceptual investigations on the role of audio-haptic cues in musical practice, performance assessment and evaluation methodologies in musical interaction are planned. In the end, the projects aims to find general results that can guide the design of future haptic DMIs.

3. DEVELOPMENT AND VALIDATION

The development process will be done in dependence of established approaches as in previous UX-research (e.g., [10]). By using an exploratory approach, the core dimensions of MPX will be identified. In order to do so, it is crucial to establish a clear definition of MPX. This definition will be based on general findings of UX-research and the specific context of research in NIME. In a second phase the validation of the construct will be assessed.

3.1 Dimensions of UX in general

User experience (UX) is defined as "a person's perceptions and responses that result from the use or anticipated use of a product, system or service" (ISO, [5]). According to Law and colleagues [11], this definition is in good accordance with the answers from 275 respondents out of both academia and industry. Hassenzahl and Tractinsky [4] introduced three main perspectives of UX: (1) Importance of non-instrumental aspects (i.e. aesthetics), (2) Affective and emotional aspects and (3) an Experiential perspective. Lim [12] concluded that UX focuses on the feel of interaction with a particular product, and can change over time. Also, it is closely related to emotional responses. Bargas-Avila and Hornbæk [1] conducted a meta-analysis on how UX is measured. In comparison to usability, which operates mainly in a task-oriented way by focusing on efficiency, effectiveness or satisfaction, UX incorporates hedonic qualities like aesthetics or self-actualization. Further, Bargas-Avila and Hornbæk found *emotions and affect* (24%), *enjoyment* (17%) and *aesthetics* (15%) to be the three main dimensions examined in their reviewed research. They also found that UX is heavily used on art products (21%) and stated that new dimensions such as enchantment, engagement, tangible magic, aesthetics of interaction and relevance were employed.

3.2 Dimensions of MPX

By giving a short review over previous evaluative studies in this particular area, useful concepts for MPX can be drawn.

Wanderley and Orio [18] claim that the factors learnability, explorability and controllability of features as well as timing are, among other aspects, especially relevant for the usability of digital musical DMI manipulation. By using these factors as guidelines, a number of potential musical tasks were proposed: pitch control, dynamics, musical phrases, rhythm control and others. Birnbaum [2] did qualitative investigations on the touch flute, which is based on an acoustic woodwind instrument reacting to breath pressure. Finger-controlled keys enable the user to change the output frequency. With haptic feedback, the musicians felt more connected to the music and reported that the natural behaviour of the instrument improved.

Johnston [7] focused on practice-based research in new musical instrument design and proposed a method on how to map UX to design criteria. Identified design criteria from theory can be assessed by examination of performer's experiences. Johnston's grounded approach resulted in a classification of three different 'modes of interaction': (1) *Instrumental*, where musicians strive to acquire detailed control over the behaviour of the instrument. (2) *Ornamental*, where control is not essential, rather it is expected that the instrument itself brings out some form of augmentation. Finally in (3) *Conversational mode*, the musician sees the instrument as a responding partner who influences the development of play.

Marshall and Wanderley [13] investigated effects of integrated vibrotactile feedback on the "feel" of a digital musical instrument called 'Viblotar'. They let five subjects rate five characteristics of "feel" on a 5-point Likert scale: ease of use, controllability, engagement, entertainment and potential for further performance. The results suggest an improvement in engagement and slight improvement in entertainment. Controllability was slightly lower with haptic feedback, which was discussed as an artefact of having additional information with the haptic channel. In [9] an experiment with the Falcon haptic device was conducted. Subjects had to manipulate musical parameters. The authors measured UX by collecting ratings on ease of use, pleasantness, accuracy and musical expressibility. They interpreted their results as an evident change of UX due to the haptic modality.

Fontana and colleagues [3] carried out an exploratory study with a digital piano provided with haptic feedback. Their results suggest that vibrotactile feedback improved the perceived sound quality while playing. Järveläinen and colleagues [6] studied the effect of auditory and vibrotactile cues in a finger-pressing task. Subjects had to learn and perform three target pressing forces of different intensity. The dependent measurement was accuracy. The manipulation consisted of four conditions: no feedback, auditory feedback only, auditory and vibrotactile feedback and vibrotactile feedback only. Results showed that the audio-tactile condition made it easier to reach the learned target force in comparison to the other conditions. There were no direct UX measurements raised, which would anyway be very

[1]Swiss National Science Foundation
[2]`http://www.mmi-basel.ch`

difficult, due to the rather basic nature of the device.

In summary, there is only a small amount of literature about the effects of haptic feedback on possible MPX-dimensions in DMI-research. Empirical studies often lack a reasonable number of experimental subjects. In fact, recruiting musicians is mentioned to be a problem in a large number of experimental studies [6]. However, the already used dimensions have to be carefully considered in order to develop a rather holistic MPX-construct.

3.3 Methodological procedure

Following a similar approach used by Lavie and Tractinsky [10] who developed a questionnaire to measure perceived web site aesthetics, a brief description of the planned procedure is given.

In an initial phase, Lavie and Tractinsky worked in an exploratory manner. They generated items by reviewing literature regarding aesthetics in general, and asked experts to produce lists of adjectives representing aesthetics. In the case of MPX, this step will be done qualitatively by screening relevant literature and collecting data from expert interviews. In a second step, Lavie and Tractinsky conducted two studies where subjects had to fill out questionnaires after comparing two websites. The aim was to reduce the number of items and to identify the number of factors by calculating and analysing an exploratory factor analysis (EFA). Items with low factor loadings were dropped. The adequacy of questionnaires for evaluation within NIME is questioned because they only supply reflective data. Johnston [7] therefore tested an adapted version of the think-aloud method because wind and brass players are not able to speak and play at the same time. However, even adapted versions with including breaks interrupt the interaction and lead to artificial results, limiting external validity [14]. Therefore, data collection of reflective user data from questionnaires combined with real-time sensor data is an often-used approach. However, this incorporates that data are not elicited at the same time [14]. Although the moment of data collection is very crucial for the results of an experiment, questionnaires are frequently used in psychology, and due to their simplicity in application they are a very useful and cheap way for data collection. In order to validate their questionnaire, Lavie and Tractinsky conducted a third study including additional constructs in the questionnaire to assess the concurrent validity. Finally, construct validity was investigated by calculating confirmatory factor analysis (CFA).

Within the planned research for the development and validation of MPX, different populations of subjects are conceivable. In general, subjects should be musicians but may range from hobbyists to professionals. Also, different experimental settings (practice, live or an artificial laboratory studies) are possible but, they have not been designed yet.

3.4 Possible applications of MPX

Within the framework of the research project AHMI, the role of haptic feedback in DMIs to the MPX will be investigated. Experiments could reveal deeper insight into the influence of haptic feedback on the experience of musicians. Interfaces providing haptic feedback are often mentioned to enhance UX [3]. Also, questions of coherences between experience variables, quality ratings and performance represent an interesting topic. The measurement of MPX in general would offer a great resource for the evaluation of DMIs in order to guide through important design decisions. In addition, different musical interfaces can be compared according to MPX-dimensions with the objective of gaining deeper understanding of musicians' needs and wishes.

4. CONCLUSIONS

Poupyrev and colleagues described that one main issue within NIME is to foster a dialogue about how to design good musical interfaces [15]. Poupyrev et al. further stated that this dialogue should discuss the role of cognitive psychology for musical interface design with the aim to identify factors that determine whether an interface is suitable for creative expression of complex ideas and emotional patterns. Until today evaluation of MPX-dimensions in NIME was only done partially. Evaluation is even often omitted or only conducted informally. Apparently, the MPX-dimensions can be measured in various ways. However, this leads to the impossibility of comparing musical interfaces properly. Moreover, only a small amount of studies strive for the rigorous development of experience measurements within NIME.

Due to the fact that evaluation is a recurring issue within NIME, there appears to be a need for a continuous development of evaluative approaches. An accessible and easy to use questionnaire to measure MPX could meet this need. The development and validation of the MPX-questionnaire aims to extend the previous evaluation methodologies within NIME by focusing on the musician's perspective in musical interaction. This measuring tool can be applied for different purposes: Having guidance in important design decisions by the MPX-evaluation of prototypes, comparing different or advanced interfaces on MPX-dimensions or in order to gain a deeper understanding of how the musician's playing experience is shaped.

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6. REFERENCES

[1] J. A. Bargas-Avila and K. Hornbæk. Old wine in new bottles or novel challenges: A critical analysis of empirical studies of user experience. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pages 2689–2698, New York, NY, USA, 2011. ACM.

[2] D. Birnbaum. The touch flute: Exploring roles of vibrotactile feedback in music performance. *Project Report*, pages 1–4, 2004.

[3] F. Fontana, M. Civolani, S. Papetti, V. del Bello, and B. Bank. An exploration on the influence of vibrotactile cues during digital piano playing. *Proc. 8th Sound and Music Computing Conference (SMC2011),(Padua, Italy)*, pages 273–278, 2011.

[4] M. Hassenzahl and N. Tractinsky. User experience-a research agenda. *Behaviour & Information Technology*, 25(2):91–97, 2006.

[5] International Organization for Standardization. ISO DIS 9241-210:2010. Ergonomics of human system interaction - Part 210: Human-centred design for interactive systems, Switzerland, 2010.

[6] H. Järveläinen, S. Papetti, S. Schiesser, and T. Grosshauser. Audio-tactile feedback in musical gesture primitives: Finger pressing. In *Proceedings of the Sound and Music Computing Conference*, pages

[3] `http://p3.snf.ch/project-150107`

109–114, Stockholm, Sweden, 2013. Logos Verlag Berlin.

[7] A. Johnston. Beyond Evaluation: Linking Practice and Theory in New Musical Interface Design. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 280–283, 2011.

[8] C. Kiefer, N. Collins, and G. Fitzpatrick. HCI Methodology For Evaluating Musical Controllers: A Case Study. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 87–90, 2008.

[9] A. Kontogeorgakopoulos and G. Kouroupetroglou. Low cost force-feedback interaction with haptic digital audio effects. In E. Efthimiou, G. Kouroupetroglou, and S.-E. Fotinea, editors, *Gesture and Sign Language in Human-Computer Interaction and Embodied Communication*, volume 7206 of *Lecture Notes in Computer Science*, pages 48–56. Springer Berlin Heidelberg, 2012.

[10] T. Lavie and N. Tractinsky. Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human-Computer Studies*, 60(3):269–298, 2004.

[11] E. Law, V. Roto, M. Hassenzahl, A. Vermeeren, and J. Kort. Understanding, scoping and defining user experience: A survey approach. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pages 719–728, New York, NY, USA, 2009. ACM.

[12] T. Y. Lim. User experience evaluation methods for mobile devices. In *Third International Conference on Innovative Computing Technology (INTECH)*, pages 281–286, Aug 2013.

[13] M. T. Marshall and M. M. Wanderley. Examining the Effects of Embedded Vibrotactile Feedback on the Feel of a Digital Musical Instrument. In *Proceedings of the International Conference on New Interfaces for Musical Expression*, pages 399–404, 2011.

[14] S. O'Modhrain. A framework for the evaluation of digital musical instruments. *Computer Music Journal*, 35(1):28–42, 2011.

[15] I. Poupyrev, M. J. Lyons, S. Fels, and T. Blaine (Bean). New interfaces for musical expression. In *CHI '01 Extended Abstracts on Human Factors in Computing Systems*, CHI EA '01, pages 491–492, New York, NY, USA, 2001. ACM.

[16] D. Stowell, M. D. Plumbley, and N. Bryan-Kinns. Discourse analysis evaluation method for expressive musical interfaces. In *Proceedings of the Conference on New Interfaces for Musical Expression*, 2008.

[17] B. Swift. Chasing a feeling: Experience in computer supported jamming. In S. Holland, K. Wilkie, P. Mulholland, and A. Seago, editors, *Music and Human-Computer Interaction*, Springer Series on Cultural Computing, pages 85–99. Springer London, 2013.

[18] M. M. Wanderley and N. Orio. Evaluation of input devices for musical expression: Borrowing tools from hci. *Computer Music Journal*, 26(3):62–76, 2002.

[19] A. Xambó, R. Laney, C. Dobbyn, and S. Jordà. Video analysis for evaluating music interaction: Musical tabletops. In S. Holland, K. Wilkie, P. Mulholland, and A. Seago, editors, *Music and Human-Computer Interaction*, Springer Series on Cultural Computing, pages 241–258. Springer London, 2013.