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NOVEL MUSIC INTERACTIONS: THE SUBJECTIVE EXPERIENCE IN BEGINNER AND EXPERT MUSICIANS

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ABSTRACT

Lately, the music domain has been characterized by the appearance of innovative tools that are revolutionizing both the musicians' way of playing and the musical instruments themselves. For instance, the Internet of Musical Things comprises smart musical instruments and devices that can communicate and control each other wirelessly, changing the musicians-instruments interaction completely. The present experiment analyzes the subjective experience, i.e., usability, user experience, and acceptance, of beginners and expert guitar players, considering three multi-effect pedalboards. These last comprised two prototypes, designed and developed for the study, that were characterized by a high level of personalization. Findings showed that more positive evaluations were assigned to the prototypes than to the traditional multi-effect pedalboard in terms of perceived ease of use, enjoyment, and intention of use. Furthermore, the study underlined the relevance of high customization in affecting the self-reported metrics. Indeed, in some circumstances, the most innovative prototype, i.e., completely wireless, received more favorable evaluations than both other musical devices.

KEYWORDS

Prototyping, Human-Computer Interaction, Usability, User Experience, Acceptance

1. INTRODUCTION

Nowadays, new technologies are changing not only the way we interact with musical instruments and their hardware-related devices but also the actual physical features of the tools themselves (Saffer, 2008; Moggridge and Atkinson, 2007; Medeiros et al., 2014; Holland et al., 2013, 2016; Tanaka, 2019). Contemporary musical instruments are increasingly digitized, and they become closely linked to computers (Cook, 2017). Effects units, music software, digital audio workstations, pre-amplifiers are only a few of the tools that musicians have to learn and deeply understand, in terms of their functioning, both in a solo performance or while they are playing in a band (Wessel and Wright, 2002; Paine, 2013). Furthermore, a recent paper highlighted the vision and challenges related to the Internet of Musical Things (i.e., IoMusT; Turchet et al., 2018). This domain considers, for instance, smart instruments, wireless and wired networks, and service for controlling parameters of Musical Things. The aim is enriching the overall experience of concerts (i.e., augmented and immersive), increasing audience involvement, improving e-learning of music, and the quality of music studio production (Turchet et al., 2018; Turchet, 2018). This new perspective goes in the direction of design (Morreale, De Angeli, and O'Modhrain, 2014) and developing products that could be easier to use, accepted, and adaptable to the users' needs. In such circumstances, the musicians will consider these devices as tools that could enhance their performance skills, and as a consequence, their satisfaction within the performance and their actual intention to use. Fernandes and Holmes (Fernandes and Holmes, 2002) underlined how a musical device that does not match the requirements mentioned above hinders the user's creative process by increasing cognitive demands. In contrast, user interfaces that are intuitive and clear minimize interruptions to the spontaneity of performance or composition. According to Wanderley and Orio (2002), HCI methodology could be a suitable tool to evaluate the perceived usability and user experience of musical interfaces. In the following section, we will provide information regarding the concepts of usability, user experience, and system acceptance and their relevance for the human-machine interaction.

1.1 Usability, User Experience, and Acceptance

When designing interactive systems, one of the main goals is creating technological products that are usable, support positive user experience, and are accepted by users.

The usability assessment has to consider different aspects, such as the usage scenarios, the end-users, and the features of the systems themselves (Sharp, Preece, and Rogers, 2019). Usability is a multi-dimensional construct that allows investigating different aspects of the interaction with a specific tool (e.g., ease of use, safety, learnability). In literature, the most authoritative definition of usability is provided by the International Organization for Standardization (ISO, 2009): "The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments" (Boehm, Brown, and Lipow, 1976). The effectiveness is considered as the accuracy and completeness with which users can achieve specific goals in particular environments. The efficiency refers to the number of resources invested to reach the level optimal level of the accuracy and completeness of goals achievement. The comfort and acceptability of the working system might also be affected by its actual usage (Bevan, 2006). Higher usability increases the perceived efficiency of a system (Sharp, Preece, and Rogers, 2019).

Furthermore, usable systems positively affect the safety of the HCI interaction, decreasing the chance of errors, reducing the time of training, and the support needed by the users. The usability also has a relevant impact on the success of a product on the market. When two systems present the same functionality and comparable prices, the users will choose the one that better supports the interaction.

While in the evaluation of usability, the primary focus is on the performance and fluid interaction, the user experience (UX) takes in consideration desirable (e.g., satisfaction, engagement, enjoyment) and undesirable (e.g., unpleasantness, frustration, boredom) aspects of the interaction (Sharp, Preece, and Rogers, 2019). The term "User Experience" was coined to describe what a person feels when interacting or imagining to interact with a prototype, a final product, a system, or a service. The International Organization of Standardization defined UX as: "a person's perceptions and responses that result from the use or anticipated use of a product, system or service" ISO (2009). As already mentioned, the previous experiences of use are part of the UX, and they are relevant to consider when the designer aims to develop a new product or to improve a product that is already on the market. The various dimensions of UX can be evaluated during the entire lifecycle of a product (i.e., early prototypes, launch into the market, and product abandonment).

Finally, when introducing a new technological device, it is fundamental to assess its level of acceptance. Indeed, low acceptance severely affects the actual usage of a system. The best-known framework is the Technology Acceptance Model (TAM, Davis, 1989; TAM3, Venkatesh and Bala, 2008). The TAM considers as crucial dimensions related to the technology acceptance, the Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) insofar as they can affect the Intention of Usage (IU), which in turn influences the Use Behavior. Besides, the attitude towards technologies may impact on the perceived UX and usability, and this may hamper the potential adoption and continuous utilization of technologies. However, individual differences (e.g., age, expertise) and the technology characteristics play a role in affecting the PEOU and the PU (Venkatesh and Bala, 2008). In the present experiment, the level of musical experience (beginners vs. experts), and different features of three musical devices, were considered to evaluate their effects on the subjective experience of users.

The most commonly adopted tool to assess the complexity of the above mentioned subjective experience is the survey. For this reason, an ad hoc questionnaire has been realized to thoroughly analyze aspects of usability, UX, and acceptance (see Section 2.3 *Experimental equipment and materials*).

1.2 Evaluation of Prototypes

It is clear that the methods adopted to evaluate usability, UX, and acceptance strongly depend on the stage of the product lifecycle in which the assessment takes place. When the product is still an idea, the subjective experience could be analyzed through prototypes, drawings, sketches, narratives, using well-known methods for the elicitation and organization of ideas (e.g., brainstorming, focus group, affinity diagram). Afterward, it is possible to consider virtual simulations of the products. The preferred assessment approach, which involved the users directly, is the *User-Centered Design*. Target users can be involved in laboratory experiments or field trials wherein their interaction with a product could be investigated employing questionnaires, interviews, and video-analysis, and specific tasks. The continuous evaluation of a product/system at the different stages of its lifecycle also aims to prevent errors and unnecessary costs of further modifying a final prototype (Faulkner, 2003). It is possible to define two main phases of evaluating a product: the *formative evaluation* phase, pertains to the design loop; the *summative evaluation* phase, considers the quality of the advance prototype and identifies new requirements for future developments of the systems. This research study fits inside the *formative evaluation* phase, where the authors aimed to investigate how different multi-effect units, as well as the musical experience and the Personal Innovativeness of participants, can affect users' evaluations of perceived usability and the user experience. Obtain this data will be useful to improve the final prototype.

1.3 Peculiar Aspects of Musical Interfaces

A literature review by Medeiros and collaborators (Medeiros et al., 2014) identified some critical points that all designers and developers linked to the musical domain should consider when they realize New Interfaces for Musical Expression (NIME). Indeed, musicians utilize different evaluation parameters to decide whether to adopt a novel musical interface. The authors have taken into consideration these guidelines while designing the prototypes.

The peculiar aspects of the above-mentioned musical interfaces will be explained in further details:

- *Mapping*. It does not pose physical constraints to interfaces design and fabrication regarding the direct link between input (e.g., gestures) and output (e.g., sounds), so it is needed to define effective and usable mapping strategies in the design process;

- *Transparency and Engagement.* It is "the psychophysiological distance, in the player and the audience minds, between the input and output of a mapping device" (Murray- Browne, Mainstone, Bryan-Kinns, & Plumbley, 2011). For instance, the audience should feel more engaged when they understand the gestures-sounds connection of a cutting-edge gesture-based instrument. Visual feedbacks are needed to make such a relationship more transparent;

- *Limitations of sensor and actuators*. It is needed to consider the information richness of sensors (this last could not gather some essential data) and their ability to produce precise and real-time sound (i.e., latency, jitter) and visual outputs (i.e., feedbacks);

- *Embodied relationship*. Payne describes the relation between performers and musical tools as an "embodied relationship" (Paine, 2013). Regarding an acoustic instrument, the actions of playing a note (e.g., pinch a guitar string) and the sound generated are inherently associated. Insofar as in NIME these two components are dissociated, the performer can explore unlimited possibilities (e.g., hand gestures in mid-air). Nevertheless, NIME designers have to consider how to provide other types of feedback (e.g., vibrotactile through smart gloves) to reinstate the association present in acoustic instruments.

- *Virtuosity factor*. Contrary to conventional acoustic instruments, there is no virtuous demonstration of how far one can go while playing these novel instruments. Thus, it would be challenging to understand if a musician is playing a difficult song or not, and if he/she is an expert or an inexpert. It will be necessary to establish new standards for evaluating musical performances.

- *Context of Use*. A performer can play in a group or solo, improvising, accompanying others, etc. These different scenarios of use may demand different properties from the instrument. Designers of NIME have to take into account these aspects in the design process.

2. METHOD

2.1 Participants

Forty-two students from University of XX took part in the main study (F = 2, M = 40, mean age = 27.73, SD = 2.36). Twenty-one participants were experienced guitar players (i.e., nine years of active study of guitar and/or graduated at the conservatory). Besides, they were frequent users of multi-effects pedalboards. Twenty-one participants were considered beginners guitar players. Among all the participants, twenty-one usually use a pedalboard, thirteen rarely, and eight have never used it. A total of eleven participants have positioned the second prototype (wireless) on the ground, thirteen on the guitar, and eighteen chose mixed positions (i.e., ground, guitar, and/or body parts; see 3.2.3).

2.2 Experimental Design

Two factors were independently manipulated within the current study (3 X 2 mixed-design). The within-participants factor was the type of multi-effect device (three levels: *fixed-pedals* on the ground vs. *movable-pedals* on the ground vs. *movable* and *wireless pedals*; see Fig. 1, 2, 3) utilized in the three musical sessions. The between-participants factor was the musical experience of participants (two levels: beginners vs. experts). The order of presentation of the multi-effect units was counterbalanced across participants. The between-participants factor was the musical experience of participants (two levels: beginners vs. experts). Following the literature, we defined the cut-off for considering an expert musician as the active study of an instrument for at least nine years or the attendance/graduation from a conservatory (Gaser and Schlaug, 2003; Hanna-Pladdy and MacKay, 2011), and the frequent use of multi-effect pedalboards.

Figure 1. Traditional Pedalboard (BOSS GT-10; i.e., *fixed-pedals* on the ground).

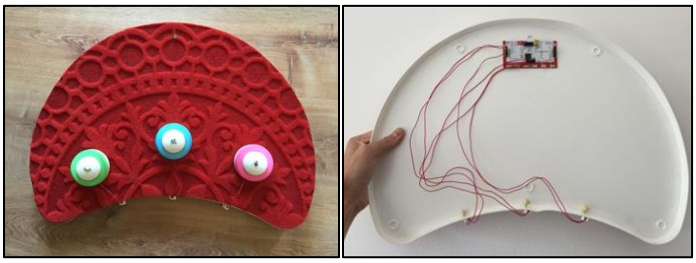

Figure 2. First Prototype (MakeyMakey based; i.e., *movable-pedals* on the ground)

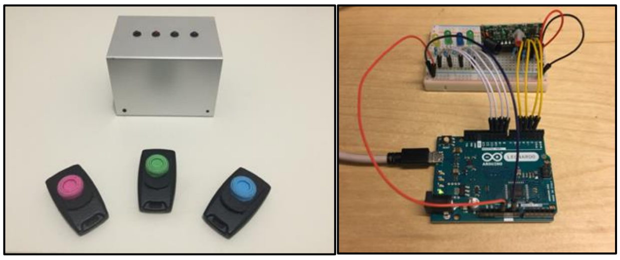

Figure 3. Second Prototype (Arduino Leonardo Based; i.e., *movable* and *wireless pedals*).

2.3 Research Questions and Hypotheses

1. Is the subjective experience of participants modulated by the type of multi-effect pedalboard? The author expected less positive evaluations of usability, UX, and acceptance for a traditional multi-effect pedalboard than the two innovative prototypes which present a higher level of customization.

2. Does the level of expertise (beginners vs. experts) influence the overall experience? The author predicted that musical expertise could modulate the evaluations. For instance, the perceived ease of use should receive a higher evaluation in the group of experts for their familiarity with these multi-effect pedalboards.

3. Does the personal innovativeness of participants affect the subjective experience? The author speculated that higher personal innovativeness could result in more positive evaluations of the two prototypes for their novelty and higher personalization than the traditional multi-effect pedalboard.

4. Does the opportunity of customizing the relative positions of the multi-effects pedals influence the general experience? The author envisaged that the chance of placing the pedals in different positions could result in more favorable evaluations given to the two prototypes compared to the traditional device.

2.4 Experimental Equipment and Materials

The following equipment and materials were utilized in the study.

An MSI Notebook GE72 6QD was used to run the software Ableton 9 Live and power the M-Audio Fast Track Pro Audio/MIDI interface. Participants wore a pair of Sony MDR-XB200 headphones to listen to the sounds output. A Samsung Notebook NP300E5C was employed to allow participants to fill out the questionnaires (using Google Modules).

BOSS GT-10 (i.e., *fixed-pedals* device). A traditional pedalboard already on the market (see Figure 1).

First prototype (i.e., *movable-pedals* device). A pedalboard realized utilizing the MakeyMakey board with wired but movable controllers (see Figure 2). Participants were allowed to customize the positions of the controllers on the external surface (i.e., red in Figure 2) of the device. The controllers could be attached with Velcro on chosen positions of the device surface.

Second prototype. A pedalboard realized utilizing the Arduino Leonardo microcontroller board (i.e., *movable* and *wireless pedals* device). The device comprises four parts: the main box containing the Arduino, three completely wireless controllers (see Fig. 3). The absence of wires allowed participants to choose where to place the three controllers freely. The controllers were attached with Velcro on the desired positions.

Pre-Test questionnaire. This tool contained different items regarding general information (e.g., demographic, musical experience) and three items that evaluated the Personal Innovativeness of users. The gathered data allowed us to divide the participants' sample into beginners and expert musicians. Instead, the Personal Innovativeness dimension was considered to subsequently investigate if the judgments given to the items presented in the post-test questionnaires were influenced by participants' attitude towards the novel information technology (Agarwal and Prasad, 1998).

Post-test questionnaire. An ad hoc questionnaire was administered to collect information about the participants' perceived usability, user experience, and acceptance of the various multi-effect devices. The tool comprises a total of nineteen items. The following seven constructs extracted from the Technology Acceptance Model 3 (Venkatesh & Bata, 2008) were evaluated: Perceived Ease of Use (PEOU), Perceived External Control (PEC; i.e., the degree to which a user believes that there are external resources, e.g., technical, to support the technology utilization), Enjoyment (ENJ; i.e., the activity of using a device is perceived as enjoyable by itself), Sound Output Quality (SOUT), Interface Output Quality (IOUT), Lights Output Quality (LOUT; i.e., for all the quality constructs the user' belief that the system is performing well) and Intent of Use (INT). The questionnaire aimed at assessing how perceived usability and UX were related to the intention of adopting a technology. Indeed, while the PEOU, PEC, Lights, and Interface Output are associated with the usability of a system, the enjoyment and more qualitative and aesthetical features of a technology (i.e., Sound quality, pleasantness) are linked to the UX. Scores were provided on a 7-point Likert scale (i.e., from 1, strongly disagree, to 7, strongly agree). The presentation of the items was randomized. The questionnaire was administered three times during the experiment, i.e., after each session.

2.5 Procedure

Upon arrival, at one of the laboratories of the Department XX of the University of XX, participants were welcomed and asked to read carefully a document containing general information about the study. Then, they were administered with an informed consent. Afterward, participants filled out the Pre-Test questionnaire. Based on a literature review (Barbosa et al., 2011), participants performed three sessions of practice to familiarize with the controllers of each multi-effect device, respectively, before each of the three performance sessions (i.e., one for each pedalboard; see Fig. 4 for details). They were asked to play a song at leisure with the guitar. Besides, they had to interact at least once with each of the three controllers available on the multi-effects devices. Note that the *fixed-pedals* device presents six controllers, but participants could utilize only four of them. Concerning the two prototypes, participants had an additional temporal interval that allowed them to place the controllers. For the whole duration of the experiment, the researcher remained inside the experimental room, although out of participants' sight. A complete experiment lasted about one hour.

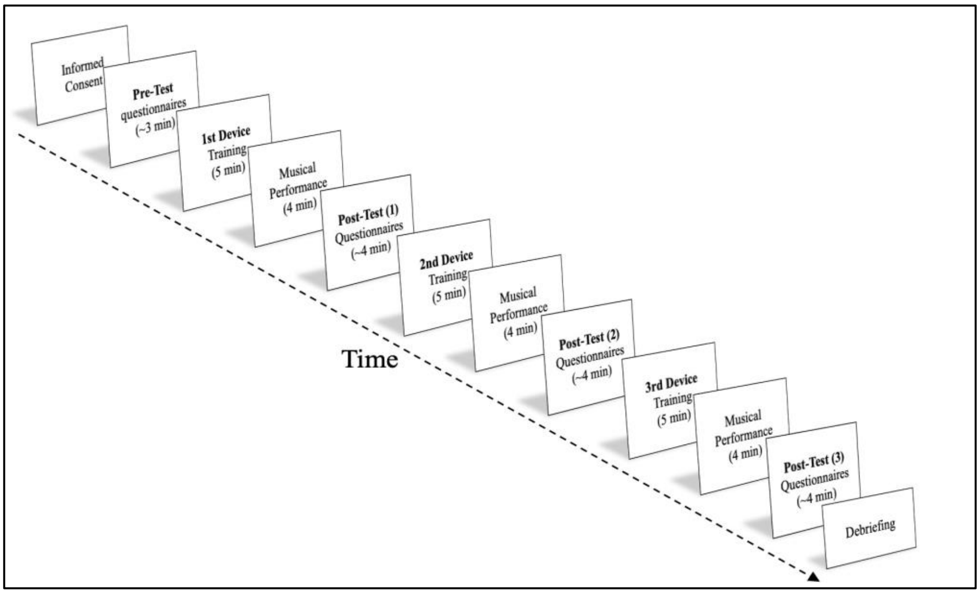

Figure 4. Experimental Procedure

3. DATA ANALYSIS AND RESULTS

All the statistical analyses were performed utilizing the R Studio software (Core Team, 2019). Non-parametric tests were used insofar as the considered dependent variables were ordinals (i.e., Likert scale scores).

3.1 Pre-Test (Personal Innovativeness and Expertise Level)

A series of Mann-Whitney *U* tests was performed to analyze potential differences in the participants' attitude towards information technology due to their musical experience. No main effects due to the musical experience emerged ($p > .05$). Beginners and experts showed similar mean scores to the personal innovativeness construct.

3.2 Post-Test

3.2.1 Usability, UX, and Acceptance as a Function of Device

A series of Friedman tests was performed in order to analyze potential differences due to the three different multi-effect devices. An effect emerged considering each of the following dimensions: Perceived Ease of Use (PEOU; $X^2(2) = 12.24$, $p < .01$), Perceived External Control (PEC; $X^2(2) = 18.85$, $p < .001$), Enjoyment (ENJ; $X^2(2) = 30.75$, $p < .001$), Sound Output Quality (SOUT; $X^2(2) = 20.28$, $p < .001$), Interface Output Quality (IOUT; $X^2(2) = 12.25$, $p < .001$), Lights Output Quality (LOUT; $X^2(2) = 9.72$, $p < .001$), and Intent of Use (INT; $X^2(2) = 36.20$, $p < .001$). Pairwise comparisons using Wilcoxon tests were performed to compare the median scores given to the different devices (see Tab. 1, 2). The *p*–values were adjusted using the Bonferroni correction.

Table 1. Pairwise comparisons' *p*-values (Usability, UX, and Acceptance dimensions) as a function of the device.

Constructs	1 Vs 2	1 Vs 3	2 Vs 3
PEOU	$p < .05$*	$p < .001$***	$p > .05$
PEC	$p < .05$*	$p < .01$**	$p > .05$
ENJ	$p < .01$**	$p < .001$***	$p > .05$
SOUT	$p < .05$*	$p < .05$*	$p > .05$
IOUT	$p > .05$	$p < .05$*	$p > .05$
LOUT	$p > .05$	$p < .001$***	$p < .01$**
INT	$p < .01$**	$p < .001$***	$p > .05$

Note. 1 = traditional pedalboard, 2 = first prototype, 3 = second prototype.

Table 2. Median scores (Usability, UX, Acceptance dimensions) as a function of the device.

Constructs	1	2	3
PEOU	*Mdn* = 4.75	*Mdn* = 5.50	*Mdn* = 6
PEC	*Mdn* = 5.33	*Mdn* = 5.83	*Mdn* = 6
ENJ	*Mdn* = 5	*Mdn* = 6	*Mdn* = 6.33
SOUT	*Mdn* = 4.33	*Mdn* = 5.66	*Mdn* = 5.66
IOUT	*Mdn* = 4.50	*Mdn* = 5.16	*Mdn* = 5.50
LOUT	*Mdn* = 4.66	*Mdn* = 4.66	*Mdn* = 5.33
INT	*Mdn* = 3	*Mdn* = 4.66	*Mdn* = 5.33

Note. 1 = traditional pedalboard, 2 = first prototype, 3 = second prototype.

3.2.2 Usability, UX, and Acceptance as a Function of Expertise Level

A series of Mann-Whitney *U* tests was carried out to evaluate the perceived usability, UX, and system acceptance dimensions (PEOU, PEC, ENJ, SOUT, IOUT, LOUT, INT) as a function of the expertise level. A difference emerged considering respectively the Perceived Enjoyment ($W = 2502.5$, $p < .05$) and the Sound Output Quality ($W = 2614$, $p < .01$). These *p*–values were adjusted for multiple comparisons utilizing the BH method (Benjamini & Hochberg, 1995).

3.2.3 Usability, UX, and Acceptance as a Function of Devices and Placement

A series of Friedman tests was conducted to evaluate the perceived usability, user experience, and acceptance as a function of the placement of the controllers. Three groups of participants were identified based on where they placed the *movable* and *wireless pedals* (i.e., on the ground, on the guitar, or in a mixed position). Significant differences emerged only in the group of *mixed positions* (i.e., *movable* and *wireless pedals*) compared to the first prototype (i.e., *movable pedals*) and the traditional pedalboard (i.e., *fixed-pedals*). In particular, the differences were shown with the PEOU (X^2 (2) = 9.48, $p < .01$; see Figure 5), ENJ ($X^2(2) = 18$, $p < .001$; see Figure 6), SOUT ($X^2(2) = 18.5$, $p < .001$; see Figure 7) and INT ($X^2(2) = 23.85$, $p < .001$, see Figure 8) dimensions. The subsequent Wilcoxon tests showed that the PEOU scores were higher for the second prototype than the traditional device ($p < .05$). The ENJ scores were higher for both the first ($p < .01$) and the second prototype ($p < .001$) in comparison to the traditional device. Higher scores in terms of SOUT were assigned to both the first ($p < .001$) and the second prototype ($p < .05$) compared to the ones of the traditional device. Finally, considering the INT dimension, higher scores were associated with both the first ($p < .05$) and the second prototype ($p < .05$) compared to the ones of the traditional device.

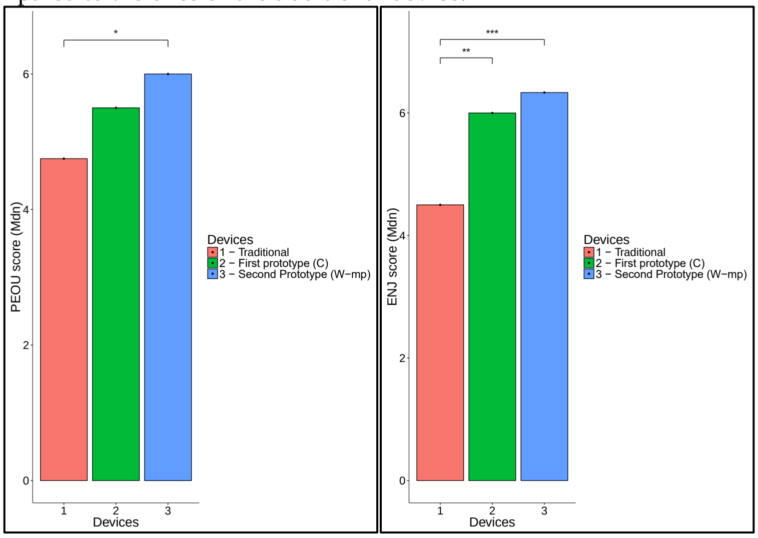

Figure 5 and 6. 5 (left) Median scores of Perceived Ease of Use (PEOU) as a function of devices in the mixed position group. C = customized; W-mp = Wireless mixed-position. 6 (right) Median scores of Perceived Enjoyment (ENJ) as a function of devices in the mixed position group. C = customized; W-mp = Wireless mixed-position. *Note*: $*p < .05$ $**\ p < .01$ $***\ p < .001$

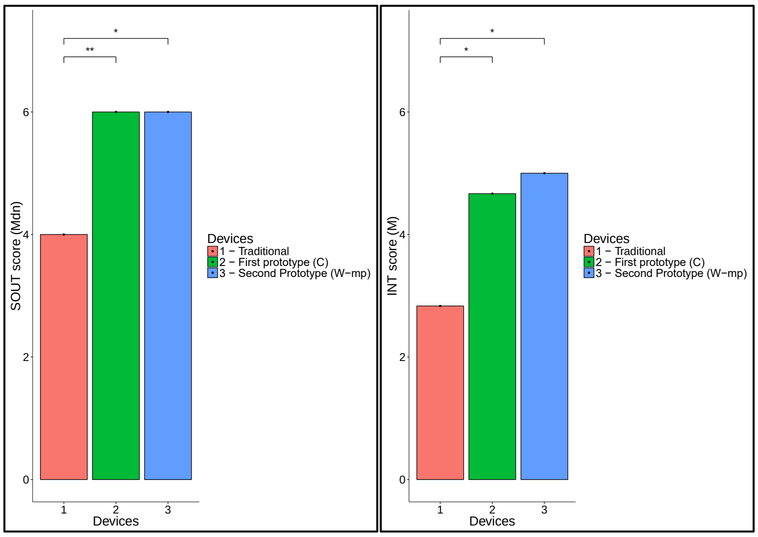

Figure 7 and 8. 7 (left) Median scores of Sound Output Quality (SOUT) as a function of devices in the mixed position group. C = customized; W-mp = Wireless mixed-position. 8 (right) Median scores of Intent of Use (INT) as a function of devices in the mixed position group. C = customized; W-mp = Wireless mixed-position. *Note*: $*p < .05$ $** p < .01$

3.2.4 Usability, UX, and Acceptance as a Function of Personal Innovativeness

A median split method was utilized to investigate whether the level of personal innovativeness could affect usability, UX, and acceptance. We obtained two groups of participants: high vs. low level of personal innovativeness (i.e., *Mdn* = 4). A series of Wilcoxon tests was performed, and a significant effect emerged considering only with the Perceived of External Control construct ($W = 2341$, $p < .001$).

4. CONCLUSION

The present study aimed to investigate how the features of three different multi-effects pedalboards for guitar affected the subjective experience of musicians in terms of perceived usability, UX, and acceptance. Furthermore, also the musical expertise (i.e., beginners vs. experts) and Personal Innovativeness were considered. Concerning to the usability, user experience, and acceptance, as a function of the device, overall higher scores were assigned to the first (i.e., *movable pedals*) and the second prototype (i.e., *movable* and *wireless pedals*) compared to the traditional pedalboard (i.e., *fixed-pedals*). Findings showed that both prototypes appeared as more ease of use, more controllable, and enjoyable compared to the traditional device. Insofar as higher scores of Perceived Ease of Use and the Intention of Use, according to the TAM model, if available for participants, both prototypes would be likely adopted over time (i.e., Use Behavior; Venkatesh and Bala, 2008). Besides, considering more in detail the outcomes, the quality of visual feedback showed a difference. The second prototype received a better evaluation than the first one. This occurrence could be due to the presence of led lights with different colors for every pedal (i.e., dedicated to each sound-effect). This feature helped participants to promptly and effectively recognize which effect they had currently selected.

Furthermore, although both beginners and experts evaluated the prototypes as more enjoyable than the traditional device (i.e., *fixed-pedals*), a difference emerged as a function of musical experience. The beginner's group only evaluated the Sound Output Quality (SOUT) better while considering the second prototype (i.e., *movable* and *wireless pedals*) compared to the traditional pedalboard. An explanation can be that the experts are familiar with the small distortions in the sounds that characterize an analogic pedalboard (i.e., the traditional one) in contrast to the clean sound produced by digital pedalboards (i.e., first and second prototypes). Thus, experts seemed to be able to recognize that the variation in sound quality was due to a different physical architecture of the pedalboard (i.e., analogic vs. digital) and not to the quality of the sound output itself.

Considering the wireless prototype as the most advanced one, due to its customizable architecture, the authors deeply investigate the effect of the placement of the wireless pedals (i.e., on the ground, on the guitar, or in mixed positions, namely on the guitar, ground and/or musician's body). The emerged differences supported the assumption that the opportunity to explore a novel mixed- and free-placement of pedals positively affected the perceived UX (SOUT) and acceptance (INT). Besides, the attitude towards information technology was impacting the perceived usability. Indeed, a higher predisposition to information technology (i.e., high Personal Innovativeness) resulted in higher scores on the Perceived of External Control (PEC) construct. This result suggests that people who consider themselves as more attracted by novel technologies perceived the presented prototypes more controllable. This research study underlined that there are no limitations to where a musician can place the controllers of multi-effect devices. For instance, the mixed-positions group of participants found new ways of interaction because of the freedom in controllers' placement (e.g., guitar neck, between the knees and under the armpits).

Furthermore, the possibility of a high personalization led to more positive evaluations and entirely new interaction experience with musical devices, compared to a situation in which the multi-effect devices cannot be customized (i.e., traditional pedalboard with *fixed-pedals*). In general, making devices more usable for novices is crucial to reduce the traditional barriers that may hamper the initial phases of learning how to play a musical instrument (McPherson, Morreale, and Harrison, 2019). However, some limitations of the study have to be pointed out. It should be crucial to increase the numerosity of the sample in the investigation of the wireless prototype, especially regarding the positions chosen by participants for the placement of the pedals. A second limitation pertains to the sample composition (i.e., gender). Herein the females involved were only two in the face of forty males, limiting the generalizability of the results. Finally, a potential development should be the further personalization of the prototypes adding new pedals of different sizes and/or other functions.

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