Tool acceptance and acceptability: insights from a real tool use activity

Boris Alexandre, François Osiurak, Jordan Navarro, Emanuelle Reynaud

TOOL ACCEPTANCE AND ACCEPTABILITY: INSIGHTS FROM A REAL TOOL USE ACTIVITY

Boris Alexandre[1], François Osiurak[1,2], Jordan Navarro[1,2] & Emanuelle Reynaud[1]

[1]Laboratoire d'Etude des Mécanismes Cognitifs (EA 3082), Université de Lyon, France

[2]Institut Universitaire de France, Paris, France

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Abstract

The issue of tool adoption has been the subject of many investigations, which focus either on acceptability (evaluating intention to use, a priori) or acceptance (evaluating real tool use, a posteriori). There are many criteria in the literature explaining why a tool is accepted or rejected by users, but behavioral observations are rare. This work aims to study the relationship between acceptability and acceptance, and to find out if there is a hierarchy between the criteria that lead a user to use a particular tool. We exposed participants to eight xylophones varying according to three criteria: Ease of use, Utility and Aesthetics. We assessed acceptability and judgment of participants about xylophones with questionnaires, based on tool use observation in a video session, and after a short-term use (Experiment 1); we also measured acceptance after a long-term use of five sessions during which participants learned to play xylophone (Experiment 2). The results suggested that previous exposure to the tool influenced the judgment of the user, indicating a difference between acceptability and acceptance and between observation and use of a tool. The results also indicate differences in the hierarchy of criteria. In the acceptability phase, user judgments are guided by Ease of use. However, during the acceptance phase, the Utility criterion has the greatest influence, whether in terms of tool preference, or time spent using tools.

Keywords: Acceptability; Acceptance; Technology; Tool Behavior

Declarations

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Introduction

In our societies, humans are constantly surrounded by tools and technologies. Some tools are accepted, and replace the old ones, while others are rejected, raising the critical issue of the reasons why a tool is adopted or rejected by users. Our work aims to study the question of the existence of criteria for the acceptability and the acceptance of the tool. The notion of "tool" refers to an object that is manipulated by the user to make changes in the environment over generations (Osiurak, Jarry and Le Gall 2010). Tool adoption process can be subdivided into two sub-processes based on the interaction between the user and the technology (Barcenilla and Bastien 2009, Lee et al., 2003): acceptability and acceptance. Acceptability is an *a priori* phenomenon, and represents the judgment by the user before its use (Barcenilla and Bastien 2009; Fevrier 2011). Conversely, acceptance is an *a posteriori* judgment, that is to say an evaluation made after an experiential phase of actual use of the tool (Tricot et al. 2003, Février 2011). Experiments available in the literature often have a methodological approach exclusively based on questionnaires, mainly focusing on acceptability rather than acceptance (Brangier, Dufresne and Hammes-Adelé 2009; Subramanian, 1994). There are only scarce behavioral observations of the real use of tools (Hornbæk 2006), and especially with a relatively short exposure to the tool, the temporality being almost never taken into account (Karapanos et al., 2009). Our first objective is therefore to study the potential gap between acceptance and acceptability measures, by evaluating users' judgment on acceptability (i.e. before tool use and after a short use) and acceptance (after a long-term use).

The issue of tool acceptance and acceptability has been addressed by several approaches and perspectives, including ergonomics, sociology, cognitive science and psychology (Dubois & Bobillier-Chaumon 2009; Venkatesh, Morris & Ackerman 2004; Yousafzai, Foxall & Pallister 2010) offering in this context a broad variety of concepts and a large number of criteria (e.g. usability, attitude, usefulness, beliefs, subjective norm, aesthetics, satisfaction, experience, trust, ease of use, accessibility). For the sake of feasibility, we focused on 3 criteria: Ease of use, Utility and Aesthetics. The three criteria were chosen based on a previous work, a review of the literature (Alexandre, Navarro, Reynaud, & Osiurak, 2018) that lists 142 criteria of acceptance and acceptability, and shows that all of these criteria can be classified into four main categories: Ease of use, Utility, Aesthetics and Contextual/Social differences. We focused on the first three criteria, because our previous work showed that Ease of use, Utility and Aesthetics can explain the majority (70%) of criteria of acceptance and acceptability according to the literature, and moreover the last category were more difficult to manipulate experimentally. The three criteria were defined as follows: (1) Ease of use expresses the means of reaching the goal and the difficulty of using the tool (Davis 1989; Sun & Zhang 2006) (2) Utility is focused on production, and expresses the purpose of the tool and its function. (Nielsen 1994) (3) Aesthetic is a

judgment of the agreeability of the tool and refers to the aesthetic features. (Norman, 2004; Van der Heijden 2003). Our second objective is to study the relationship between these criteria, how they influence users over time and whether there is a hierarchy or an interaction between them.

In order to experimentally investigate a real tool use activity, we set up two experiments in which the participants were confronted with the same following tools: eight xylophones that varied according to the three criteria (Ease of use, Utility and Aesthetics), each xylophone may rate high or low on each criteria. To study the issue of acceptability in tool use, we proposed a first experiment (Experiment 1) involving sixty participants. Fifty of them were asked to rate on a 5-degree Likert scale each xylophone, evaluating their Ease of use, Utility and their Aesthetics based on videos of xylophones being played. The other ten participants had to do the same thing, but tried each xylophone before rating it. In the results, we evaluated how did participants rate each xylophone. Moreover, when participants evaluate tools on their Ease-of-use, Utility and Aesthetics, we looked if some criteria had influence on the rating of other criteria or are the criteria independent? In a second step, to study the issue of acceptance in tool use, we proposed a second experiment (Experiment 2) involving thirty participants. The task was to learn to play xylophones, during five different sessions with two-days breaks between every session. The participants were free to explore a room containing the eight xylophones. As the sessions progressed, they established an order of xylophone preferences. In the results, we evaluated what were the characteristics of the preferred xylophone, and how did participants rate each xylophone.

Experiment 1: Acceptability

Method

Participants

Sixty participants (thirty-nine women) took part in experiment 1. They were all undergraduate students in cognitive science at the University of Lyon (M_{Exp1} = 21 ± 1.5). Each participant gave informed consent to the study.

Materials

Eight xylophones were used in Experiment 1. Each xylophone was built according to the same model (a 12-keys wooden xylophone), but varied according to three different criteria, Ease of use, Utility and Aesthetics. Each xylophone may rate high or low on each criterion. **Table 1** summarizes the different tools that participants had at their disposal. The physical differences between the xylophones were as follows: (1) concerning the Ease of use criterion (i.e.

the difficulty of using the tool.), the four easy-to-use xylophones were provided with normal (rigid) rods, and the four non-easy-to-use xylophones were provided with modified rods (soft rods, thus making the action of striking on the keys of the xylophone more difficult) (2) Concerning the Utility criterion (i.e. the purpose of the tool), the four useful xylophones had keys (wooden slats) that produced a normal sound, and the four useless had some slats blocked and therefore non-functional (screwed hard enough so that the note does not resonate). (3) Concerning the Aesthetic criterion (i.e. visual agreeability of the tool), the four aesthetic xylophones were made of unvarying and dark colors, recalling the exotic wood colors, while the non-aesthetic xylophones were scribbled and bore various traces.

< INSERT TABLE 1 ABOUT HERE >

Procedure

Among the sixty participants, fifty of them participated in two video sessions, and ten of them participated in a xylophone playing session. We conducted questionnaires in which participants were asked to rate on a 5-degree Likert scale each xylophone, presented randomly. The questionnaire was in French, and items were formed on the following model example: "*How would you describe this instrument, from useless to useful* ", with 6 item in all, each criterion (Ease of use, Utility and Aesthetics) being represented by 2 items. During video session, participants (n = 50) answered the questionnaire based on videos of xylophones being played, twice (video session 1, video session 2). In each video, participants could see a xylophone being played on each key, from the left to the right. During playing session, participants (n = 10) responded after actually using each xylophone. Participants had to play each xylophone by trying each of the 12 keys from left to right, then answered the questionnaire.

Results

Xylophone evaluation

A Repeated Measures ANOVA was conducted with the EOU factor (Ease of use criteria), the UTI factor (Utility criteria) and the AES factor (Aesthetics criteria) as within-subject effects. As illustrated in **Table 2,** the explanatory factors (i.e. the three criteria) had significant influence on xylophone rating in Experiment 1, in video session 1 and 2 (n=50) and in playing session (n=10). **Figure 1** showed in more detail the mean rating of each xylophone (X1-X8) and for each criterion in video session and in playing session. The results indicated that our three criteria were well distinguished by the participants, in video session (for each criteria, $p < .001$), and in playing session (for each criteria, $p < .001$). In practice, this means that the construction of our xylophones has been verified: for example, a xylophone

defined as possessing the Ease of use criteria was rated higher in this criterion than a tool defined as not possessing the Ease of use criteria (and vice versa); in the same way, a tool defined as useful/aesthetics was rated higher in this criterion than a tool defined as useless/non-aesthetics (and vice versa). However, there was sometimes an interaction between criteria: a) between EOU factor and Utility/Aesthetic criteria (in video session 1 and 2, $p < .001$) (i.e. the participants tended to rate more useful and more aesthetics a xylophone that was easy-to-use), but this interaction disappeared when xylophone were played by participants (i.e. in playing session), b) between the factor UTI and the Ease of use criterion (in video session 1, $p = .02$) and the Aesthetics criterion (in video session 1 and 2, $p < .001$) (i.e. the participants tended to rate easier to use and more aesthetics a xylophone that was useful) and c) between the AES factor and the Ease of use criterion (in video session 1, $p = .048$). (i.e. the participants tended to rate easier-to-use a xylophone that was aesthetics)

< INSERT TABLE 2 ABOUT HERE >
< INSERT FIGURE 1 ABOUT HERE >

Discussion

The three criteria (Ease of use, Utility and Aesthetics) were well recognized by participants, whether it is in video (i.e; judgment before using the tool) or in playing session (i.e. judgement after a short use). The results allowed us to validate our tools, since a xylophone defined as easy-to-use/useful/aesthetic will also be defined as easy to use/useful/aesthetic by the participants. The results indicated the following hierarchy of criteria in acceptability: Ease of use was the factor that appeared to be the most influential in judgments of acceptability, since the results showed that it influenced our perception of the other two criteria (Utility and Aesthetics) when participants are evaluating tools based on video session, i.e. without using the tool. However, we noted that a short use (in the playing session) is enough to suppress this influence. The second most influential criterion was Utility, which influenced, but less often, the perception of Ease of use and Aesthetic criteria, when participants are evaluating tools based on video session. This influence also disappeared after a short use, in playing session. Finally, the Aesthetic criterion was the one that had the slightest influence, since it influenced only the perception of Ease of use criterion, during the first video session.

Experiment 2: Acceptance

Method

Participants

Thirty participants (eighteen women) took part in experiment 2. They were all undergraduate students in cognitive science at the University of Lyon (M_{Exp2} = 22 ± 3.1). Each participant gave informed consent to the study. All participants were non musicians and had never learned to play xylophone.

Materials

The same xylophones were used in Experiment 2. **Table 1** summarizes the different tools that participants had at their disposal. The physical differences between the xylophones were as follows: (1) concerning the Ease of use criterion (i.e. the difficulty of using the tool.), the four easy-to-use xylophones were provided with normal (rigid) rods, and the four non-easy-to-use xylophones were provided with modified rods (soft rods, thus making the action of striking on the keys of the xylophone more difficult) (2) Concerning the Utility criterion (i.e. the purpose of the tool), the four useful xylophones had keys (wooden slats) that produced a normal sound, and the four useless had some slats blocked and therefore non-functional (screwed hard enough so that the note does not resonate). (3) Concerning the Aesthetic criterion (i.e. visual agreeability of the tool), the four aesthetic xylophones were made of unvarying and dark colors, recalling the exotic wood colors, while the non-aesthetic xylophones were scribbled and bore various traces.

Procedure

Participants were warned that they would be evaluated on their xylophone performance during five sessions of approximately thirty minutes each. Each session was spaced with two-days breaks between every session. In each session the order of preferences of the xylophones was collected, from the eighth to the first position. To collect this rank during a session, participants were confronted with the eight xylophones (placed in a random order). They listened to a melody *A*, trained for six minutes on all eight xylophones without particular constraints (they could make the choice to use or not each xylophone). Then, the participant kept his four favorite xylophones, by designating one by one the four he liked the least (rank 8, 7, 6 and 5). The participant was then evaluated on a random xylophone among his four favorite xylophones, in having to play the melody *A* on which he had trained, with three attempts. In a second step,

the operation was repeated on the remaining four xylophones: a participant listened to a melody *B*, trained on his four favorite xylophones, then could choose two favorite xylophones by designating one by one the two he liked the least (rank 4 and 3), and then evaluated on the melody *B* randomly on one of the two remaining xylophones. Finally, in a last phase, participant chose from the two xylophones remaining his favorite xylophone (rank 1) and the one he removed (rank 2), and then played a new melody *C*, without training and in a single try. The melody *C* was always the same during the five sessions, in order to had a measure of the progression of the subjects and therefore their investment in the task, unlike the melodies A and B, which changed at each session. The melodies were all famous music (famous lullaby or famous film soundtrack for example) so that participants did not have to learn the melody. In addition, the participants had at their disposal, in front of each xylophone, simplified partitions which indicated to them the sequence of keys on which to strike to play the melody. All sessions (1-5) had the same protocol, and at the end of the fifth session, as in Experiment 1 each participant was asked to rate each xylophone on a 5-degree Likert scale, on its Ease of use, Utility and Aesthetics, on the following model: "*How would you describe this instrument, from useless to useful* ".

Results

Xylophone evaluation

A Repeated Measures ANOVA was conducted with the EOU factor (Ease of use criteria), the UTI factor (Utility criteria) and the AES factor (Aesthetics criteria) as within-subject effects. As illustrated in **Table 2,** the explanatory factors (i.e. the three criteria) had significant influence on xylophone rating in Experiment 2, after the five sessions (n=30). **Figure 1** showed more in detail the mean rating of each xylophone (X1-X8) for the 30 participants who rated each xylophone at the end of the session 5. The results indicated that the three criteria were well distinguished by participants after the main experiment (for each criteria, $p < .001$). In practice, this means that the construction of our xylophones has been verified: for example, a xylophone defined as possessing the Ease of use criteria was rated higher in this criterion than a tool defined as not possessing the Ease of use criteria (and vice versa); in the same way, a tool defined as useful/aesthetics was rated higher in this criterion than a tool defined as useless/non-aesthetics (and vice versa). However, there was sometimes an interaction between criteria: a) between the factor UTI and the Ease of use criterion ($p < .001$) (i.e. the participants tended to rate easier to use a xylophone that was useful) b) between the AES factor and the criterion Utility (in experiment, $p < .001$) (i.e. the participants tended to rate more useful a xylophone that was aesthetics).

Preferences

A non-parametric ANOVA was conducted on the number of preferences with the factor XYLOPHONE (X1, X2, X3, X4, X5, X6, X7 and X8) as within-subject factor. This analysis revealed a significant effect of XYLOPHONE in Session 1 ($\chi 2 = 102.16$, N = 30, df = 7, $p < .001$), Session 2 ($\chi 2 = 130.47$, N = 30, df = 7, $p < .001$), Session 3 ($\chi 2 = 149$, N = 30, df = 7, $p < .001$), Session 4 ($\chi 2 = 128.37$, N = 30, df = 7, $p < .001$) Session 5 ($\chi 2 = 140.62$, N = 30, df = 7, $p < .001$) and all the sessions ($\chi 2 = 634.02$, N = 150, df = 7, $p < .001$), indicating the existence of significant differences in preference positions between each xylophone. **Figure 2** showed a boxplot representation of each xylophone (X1-X8), showing their position in the ranking, from favorite (1^{st}) to least favorite (8^{th}), in session 1-5 and for all the sessions, cumulatively (*All Sessions*). **Table 3** showed the results of the Wilcoxon rank-sum test, showing the significant differences between each xylophone and resuming which xylophone was preferred over others. Utility criterion (X1, X2, X5, X6) is the one that most influenced ranking position. In a second step, it is Ease of use criterion that influenced ranking position: among the useful xylophones, useful and easy-to-use xylophones (X1, X2) seemed to be the combination of criteria preferred by the participants. The differences between them were not significant in each session, but significant in favor of X1 (the aesthetics one) when taking into account all the sessions.

< INSERT FIGURE 2 ABOUT HERE >
< INSERT TABLE 3 ABOUT HERE >

Use and temporality

A non-parametric ANOVA was conducted on the number of preferences with the factor XYLOPHONE (X1, X2, X3, X4, X5, X6, X7 and X8) as within-subject factor. This analysis revealed a significant effect of XYLOPHONE in Session 1 ($\chi 2 = 17.35$, N = 30, df = 7, $p = .01$), Session 2 ($\chi 2 = 66.61$, N = 30, df = 7, $p < .001$), Session 3 ($\chi 2 = 72.07$, N = 30, df = 7, $p < .001$), Session 4 ($\chi 2 = 41.78$, N = 30, df = 7, $p < .001$), Session 5 ($\chi 2 = 85.49$, N = 30, df = 7, $p < .001$) and all the sessions ($\chi 2 = 249.95$, N = 150, df = 7, $p < .001$), indicating the existence of significant differences in time spent on each xylophone. **Figure 3** showed boxplot representation of the time spent (in seconds, during the 6 minutes' participants had access to all xylophones) by participants on each xylophone in session 1-5 and for all the sessions, cumulatively (*All Sessions*). **Table 3** showed the results of the Wilcoxon rank-sum test, demonstrating the significant differences between time spent on each xylophone and resuming which xylophone was more used over others. X1 is significantly more used than all other xylophones, except X2, with which there were no significant differences. X2 is used more than all other xylophones except X5 and X6 (both have Utility criterion). As for rank position, Utility seemed to be the criterion that makes participants use xylophones, sometimes regardless of rank: X3

and X4 are better ranked but significantly less used than X5 and X6 (both useful but not easy to use). About that, a correlation revealed a negative significant correlation between time spent on xylophone and ranking position, indicating that the more the time spent increases, the more the note went down (towards the best position 1). This relation was significant in all the session ($r = -.481$; $p < .001$), in Session 1 ($r = -.326$; $p < .001$), in Session 2 ($r = -.551$; $p < .001$) in Session 3 ($r = -.468$; $p < .001$), in Session 4 ($r = -.492$; $p < .001$), and in Session 5 ($r = -.549$; $p < .001$).

< INSERT FIGURE 3 ABOUT HERE >

Learning music

During each session, in order to measure the progress and therefore the involvement of the participants, the performance of the participants was evaluated during the last melody in each session (the only music that never changed). At each session, the participant had a score of 30 points: 10 points on the notes (measuring if they hit the right key), 10 points on the rhythm (measuring if the gap between the notes was respected) and 10 points on the tempo (measuring whether the speed of the song was respected). A Repeated Measure ANOVA was conducted with the factor of the rating score at each session. The effect of the number of sessions on learning music was significant ($F = 89.509$, $df = 4$, $p < .001$) indicating that rating score in Session 1($M_{S1} = 12.55 \pm 5.9$) < Session 2 ($M_{S2} = 17.36 \pm 5.2$), $p < .001$; there was no significant difference between Session 2 and Session 3 ($M_{S3} = 19.73 \pm 5.3$), $p = .073$; Session 3 < Session 4($M_{S4} = 24.23 \pm 2.9$), $p < .001$; and Session 4 < Session 5($M_{S5} = 26.73 \pm 2.1$), $p < .001$.

Discussion

The results showed that in Experiment 2 the three criteria were well identified by the participants, which confirms the validation of our tools observed in Experiment 1; moreover, the results showed the investment and the motivation of participants who progressed in learning music, with a significant effect of the time on xylophone skills. There was a hierarchy of criteria that influenced participants' judgment after 5 sessions of tool use (i.e. in tool acceptance): The Utility of a tool influenced judgment of Ease of use criterion, and the Aesthetics influenced judgment of Utility criterion. It was the Utility criterion that influenced the most the choice of the participants in the ranking position, i.e. the useful tools were preferred. Then Ease of use was the second most influent criterion, and it can be seen that aesthetics has little or no influence. The results showed that the same mechanisms underlay user behavior in the time spent on each xylophone, and we also observed that the favorite tools were also the most used.

General Discussion

The purpose of our present study was to investigate difference between acceptability and acceptance, especially in the influence of three criteria (Ease of use, Utility and Aesthetics) in a real tool use activity. The first key finding is that there is a difference between acceptability (judgement before tool use, a priori) and acceptance (judgement after real tool use, a posteriori). To judge and evaluate a tool regarding its Ease of use, Utility and Aesthetics, users do not react in the same way according to whether they were confronted with the tool or not. Indeed, the results showed that in acceptability, when users observed the tool being used (in video session, Experiment 1), they differentiated the three criteria (Ease of use, Utility and Aesthetics), but they cannot totally identify them independently, some criteria influencing others. Ease of use was the criterion the least influenced by the other criteria, and also the one that has the greatest influence on the other criteria, Utility and Aesthetics. On the other hand, as soon as the users use the tool, in a short-term use (Experiment 1) this influence completely disappeared. In a long-term use (Experiment 2), concerning acceptance, the results on user evaluation of the three criteria after 5 sessions showed that Utility of a tool will influence judgment of Ease of use, and Aesthetics will influence judgment of Utility. This last observation is in agreement with the works on the *aesthetic usability effect*, which describes a positive influence of aesthetics of the product on perceived usability (a criterion composed of Ease of use and Utility; Nielsen 1994) i.e. aesthetic tools are considered to be mode usable (Kurosu & Kashimura 1995; Sonderegger & Sauer 2010; Tractinsky, Katz & Ikar 2000). To summarize, if we look at how tools are perceived by users regarding their Ease of use, Utility, and Aesthetics, judgments in acceptability (before tool use) could therefore be influenced first and foremost by Ease of use criterion, and judgments in acceptance by Utility and Aesthetics criteria.

The second key finding is that there is a hierarchy of criteria in acceptance, when we observe user preferences, whether in the ranking of their favorite tools or concerning the time spent on each tool. Utility criterion is the most influent criterion in acceptance. Indeed, the results showed that both in ranking position and time spent on xylophones, useful xylophones were always preferred to others, then among the useful xylophones, easy-to-use xylophones were preferred. Nevertheless, it is observed that the Aesthetic criterion has no influence on user preference. The results showed the same hierarchy of criteria concerning the time spent on each tool, and we observed a significant correlation between the two phenomena: the more users spend time on a tool, the more it will be preferred. This would mean that even if in user evaluation of tool, one criterion can be influenced by the other criteria (notably the Ease of use in acceptability and Utility and Aesthetics in acceptance), in practice, when users have to decide their preferred tools, Utility (i.e. the aspect of productivity and gain of the tool) will influence the choice. In a second step, once users have

selected the useful tools, they taking into consideration the effort needed to use the tools, by preferring the easiest tools. These preferences are particularly consistent in the behavior of users, since this hierarchy of criteria is identical concerning the time spent on different tools, the preferred tools being those on which users spend the most time. This difference in the hierarchy of criteria between acceptance and acceptability seems to show that there is a difference between actually observing and using a tool, both in our perception and in our judgment of the tool. We can interpret this as follows: When observing someone, tool user pays more attention to Ease of use, and the effort required to use the tool, perhaps because he puts himself in other's shoes or because he focuses on the action rather than the tool itself; on the other hand, when using the tool, he tends to forget how easy-to-use it is to focus on the purpose of the activity and the goal of the tool, using Utility to make his preferences.

These results allow us to make some theoretical remarks. The difference in importance and influence of the three criteria in acceptability (where we observe that the representation of tool criteria by the users is mainly influenced by Ease of use) and in acceptance (where we observe that a) the representation of tool criteria by the users is influenced by Utility and Aesthetics, and b) the ranking position of preferred tools and the time spent on each tools is influenced mainly by Utility, then Ease of use in a second time) would explain the highly variable and sometimes contradictory results of acceptance models (Legris, Ingham, & Collerette 2003, King & He 2006, Alexandre et al. 2018). However, our results on acceptance consolidate the first results of the Technology Acceptance Model (TAM) which shows that perceived Usefulness has the strongest link (50% more in influential than perceived Ease of use) on use and intention of use (Davis 1989; Keil et al. 1995; Legris et al. 2003). Similarly, our results on acceptability are consistent with works that had shown that Ease of use has an influence on intention to use (Chau 1996; Legris et al. 2003) and on user perception of Utility criterion (Igbaria 1997; Legris et al. 2003).

Finally, even though the subjects are involved and have actually made significant progress in learning music, some aspects of the task indicate that further research is needed, in particular by varying experimental conditions. Indeed, we also find that Aesthetic criterion has little or no influence in tool preference and time spent on tool. This may be because having an aesthetic tool or not has no influence on the participant, especially because he is alone during the experiment and does not suffer from the judgment of his peers. Future experiments should be built with more ecologically valid tools which have a real influence on participants.

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Table 1. *List of eight xylophones available to participants in Experiment 1 & 2, each xylophone possessing (+) or not (-) each criteria*

	Criteria		
	Ease of use	**Utility**	**Aesthetics**
Xylophone			
X1	+	+	+
X2	+	+	-
X3	+	-	+
X4	+	-	-
X5	-	+	+
X6	-	+	-
X7	-	-	+
X8	-	-	-

Table 2. *Results of the Repeated Measures ANOVA showing link between explanatory factors (i.e. our three criteria) and xylophones rating, in Experiment 1 (in video session 1 & 2 (n=50) and in playing session (n=10))and Experiment 2 (n=30)*

Repeated Measures ANOVA

			Phase	p
Ease of use Criteria	EOU Factor	Experiment 1	Video session 1	*** p < .001
			Video session 2	*** p < .001
			Playing session	*** p < .001
		Experiment 2	After 5 sessions	*** p < .001
	UTI Factor	Experiment 1	Video session 1	* p = .02
			Video session 2	NS
			Playing session	NS
		Experiment 2	After 5 sessions	*** p < .001
	AES Factor	Experiment 1	Video session 1	* p = .048
			Video session 2	NS
			Playing session	NS
		Experiment 2	After 5 sessions	NS
Utility Criteria	EOU Factor	Experiment 1	Video session 1	*** p < .001
			Video session 2	*** p < .001
			Playing session	NS
		Experiment 2	After 5 sessions	NS
	UTI Factor	Experiment 1	Video session 1	*** p < .001
			Video session 2	*** p < .001
			Playing session	*** p < .001
		Experiment 2	After 5 sessions	*** p < .001
	AES Factor	Experiment 1	Video session 1	NS
			Video session 2	NS
			Playing session	NS
		Experiment 2	After 5 sessions	*** p < .001
Aesthetics Criteria	EOU Factor	Experiment 1	Video session 1	*** p < .001
			Video session 2	*** p < .001
			Playing session	NS
		Experiment 2	After 5 sessions	NS
	UTI Factor	Experiment 1	Video session 1	*** p < .001
			Video session 2	*** p < .001
			Playing session	NS
		Experiment 2	After 5 sessions	NS
	AES Factor	Experiment 1	Video session 1	*** p < .001
			Video session 2	*** p < .001
			Playing session	*** p < .001
		Experiment 2	After 5 sessions	*** p < .001

Table 3. *Results of the Wilcoxon rank-sum test, showing the significant differences between each xylophone in Experiment 2, concerning the rank position (from the first to the eighth) and the time spent on each xylophone, in session 1-5 (S1, S2, S3, S4 and S5) or for all the sessions, cumulatively (All)*
** p < .05; ** p < .01; *** p < .001.*

		X1	X2	X3	X4	X5	X6	X7	X8
X1 EOU + UTI + AES +	Position		Higher rank * All	Higher rank *** S1, S2, S3, S4, All	Higher rank *** S1, S2, S3, S4, All	Higher rank *** S2, S3, S4, S5, All	Higher rank * S2, S4 ** S3, S5 *** all	Higher rank *** S1, S2, S3, S4, All	Higher rank *** S1, S2, S3, S4, All
	Time		NS	More used * S4 *** S2, S3, S5, All	More used *** S2, S3, S5, All * S4	More used * S3, All	More used * S5, All	More used *** S2, S3, S5, All	More used ***S2,S3, S5, All
X2 EOU + UTI + AES –	Position	Lower rank * All		Higher rank *** S1, S2, S3, S4, All	Higher rank *** S1, S2, S3, S4, All	Higher rank * S4 ** S2, S3, S5 *** All	Higher rank *S3 ** S2, S5 *** All	Higher rank *** S1, S2, S3, S4, All	Higher rank *** S1, S2, S3, S4, All
	Time	NS		More used * S1,S4 *** S2, S3, S5, All	More used * S1 *** S2,S3, S4, S5, All	NS	NS	More used ** S3,S4 *** S5, all	More used * S1 ** S4 *** S3,S5, All
X3 EOU + UTI – AES +	Position	Lower rank *** S1, S2, S3, S4, All	Lower rank *** S1, S2, S3, S4, All		NS	Higher rank *** S1, S2, S3, S4, All	Higher rank ** S1 *** S2, S3, S4, S5, All	Lower rank * S1	Higher rank * S3
	Time	Less used * S4 *** S2, S3, S5, All	Less used * S1,S4 *** S2, S3, S5, All		NS	Less used * S4 *** S2, S3,S5, All	Less used * S1 ** S2 *** S3, S4, S5, All	Less used * S3	Less used * S3
X4 EOU + UTI – AES –	Position	Lower rank *** S1, S2, S3, S4, All	Lower rank *** S1, S2, S3, S4, All	NS		Higher rank *** S1, S2, S3, S4, All	Higher rank *** S1, S2, S3, S4, All	NS	NS
	Time	Less used *** S2, S3, S5, All * S4	Less used * S1 *** S2,S3, S4, S5, All	NS		Less used ** S3 *** S2, S4, S5, All	Less used * S1, S2, S4 ** S3 *** S4, All	Less used * All *** S3	Less used * All
X5 EOU – UTI + AES +	Position	Lower rank *** S2, S3, S4, S5, All	Lower rank * S4 ** S2, S3, S5 *** All	Lower rank *** S1, S2, S3, S4, All	Lower rank *** S1, S2, S3, S4, All		Higher rank * S1, All	Higher rank *** S1, S2, S3, S4, All	Higher rank *** S1, S2, S3, S4, All
	Time	Less used * S3, All	NS	More used * S4 *** S2, S3,S5, All	More used ** S3 *** S2, S4, S5, All		NS	More used ** S2, S4, S5 *** All	More used ** S2, S3, S4, S5 *** all
X6 EOU – UTI + AES –	Position	Lower rank * S2, S4 ** S3, S5 *** all	Lower rank *S3 ** S2, S5 *** All	Lower rank ** S1 *** S2, S3, S4, S5, All	Lower rank *** S1, S2, S3, S4, All	Lower rank * S1, All		Higher rank *** S1, S2, S3, S4, All	Higher rank *** S1, S2, S3, S4, All
	Time	Less used * S5, All	NS	More used * S1 ** S2 *** S3, S4, S5, All	More used * S1, S2, S4 ** S3 *** S4, All	NS		More used * S2 ** S3, S4 *** S5, All	More used * S3 ** S2 *** S5, All
X7 EOU – UTI – AES +	Position	Lower rank *** S1, S2, S3, S4, All	Lower rank *** S1, S2, S3, S4, All	Higher rank * S1	NS	Lower rank *** S1, S2, S3, S4, All	Lower rank *** S1, S2, S3, S4, All		Higher rank * S4
	Time	Less used *** S2, S3, S5, All	Less used ** S3,S4 *** S5, all	More used * S3	More used * All *** S3	Less used ** S2, S4, S5 *** All	Less used * S2 ** S3, S4 *** S5, All		NS
X8 EOU – UTI – AES –	Position	Lower rank *** S1, S2, S3, S4, All	Lower rank *** S1, S2, S3, S4, All	Lower rank * S3	NS	Lower rank *** S1, S2, S3, S4, All	Lower rank *** S1, S2, S3, S4, All	Lower rank * S4	
	Time	Less used ***S2,S3, S5, All	Less used * S1 ** S4 *** S3,S5, All	More used * S3	More used * All	Less used ** S2, S3, S4, S5 *** all	Less used * S3 ** S2 *** S5, All	NS	

Figure 1. *Rating of each xylophone (X1-X8) for each criterion (Ease of use (EOU+/-), Utility (UTI+/-) and Aesthetics (AES+/-)), in video session 1 & 2 (n=50) (Experiment 1), playing session (n=10) (Experiment 1) and Experiment 2 (n=30)*

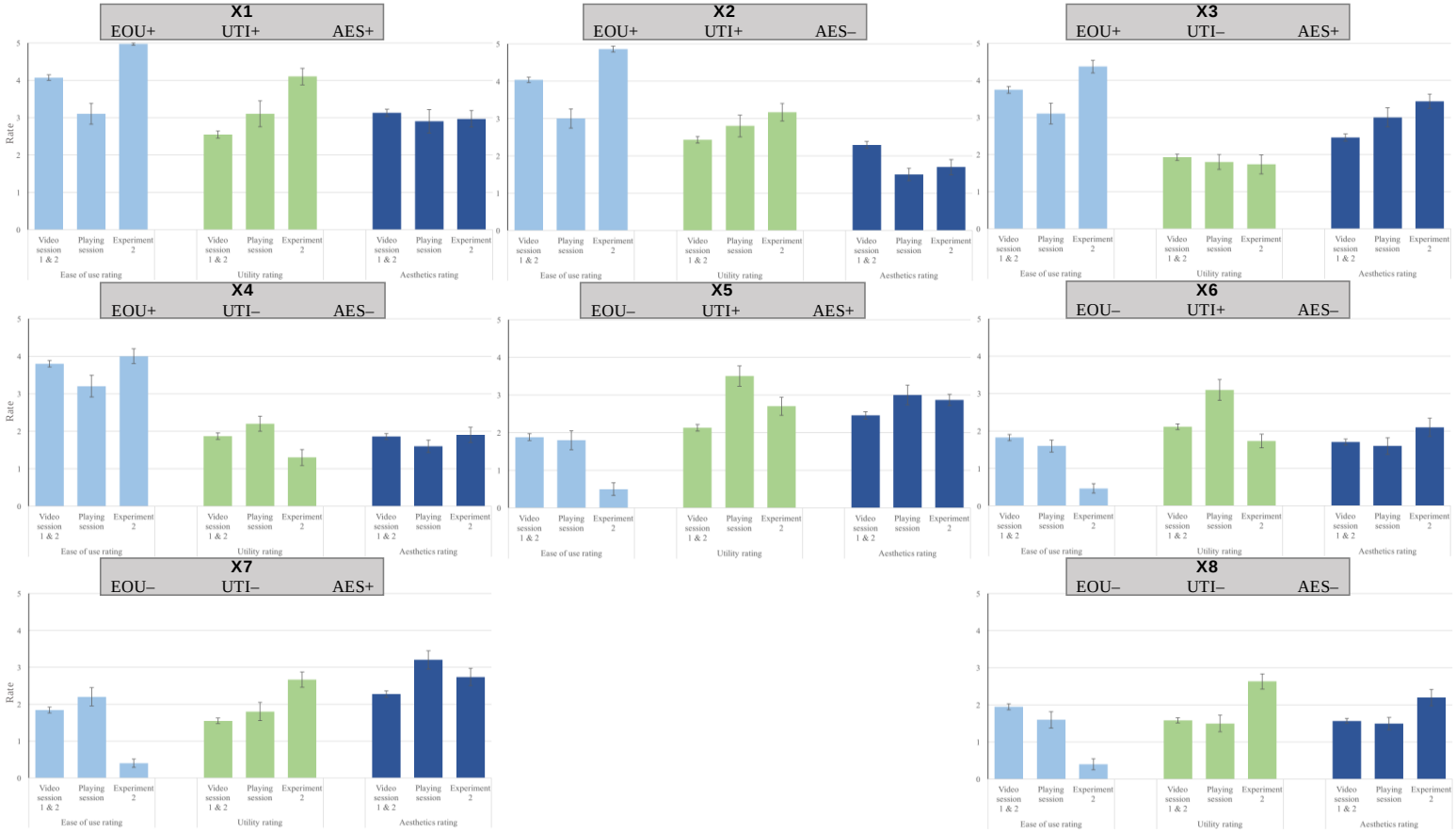
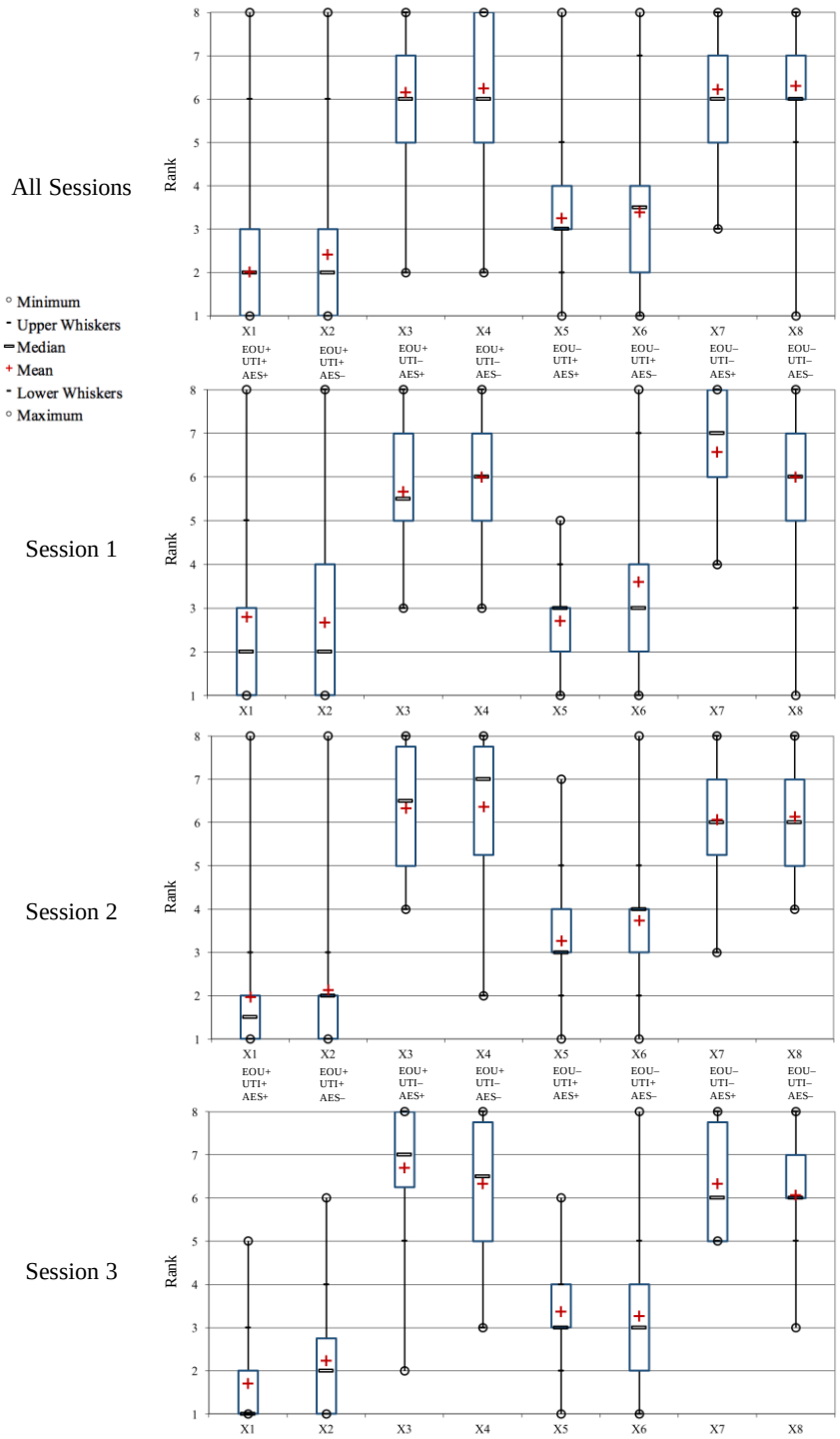
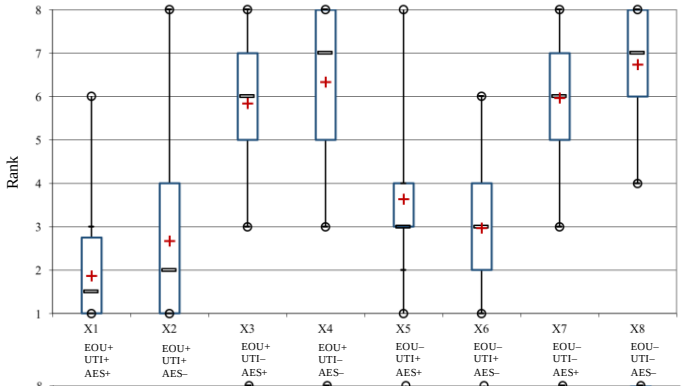


Figure 2. *Boxplot representation of each xylophone (X1-X8), showing their position in the ranking position, from favorite (1 on y-coordinate) to least favorite (8 on y-coordinate), in session 1-5 and for all the sessions, cumulatively (All Sessions).*



Session 4



Session 5

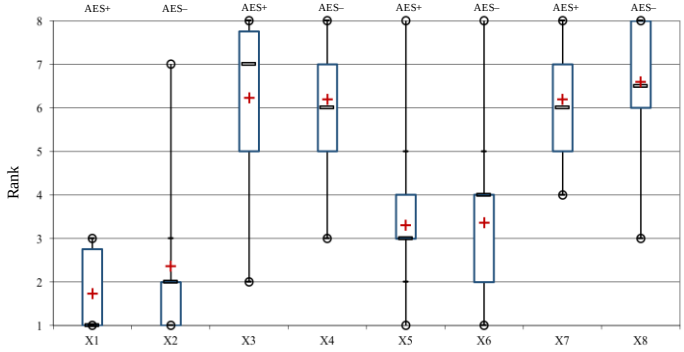
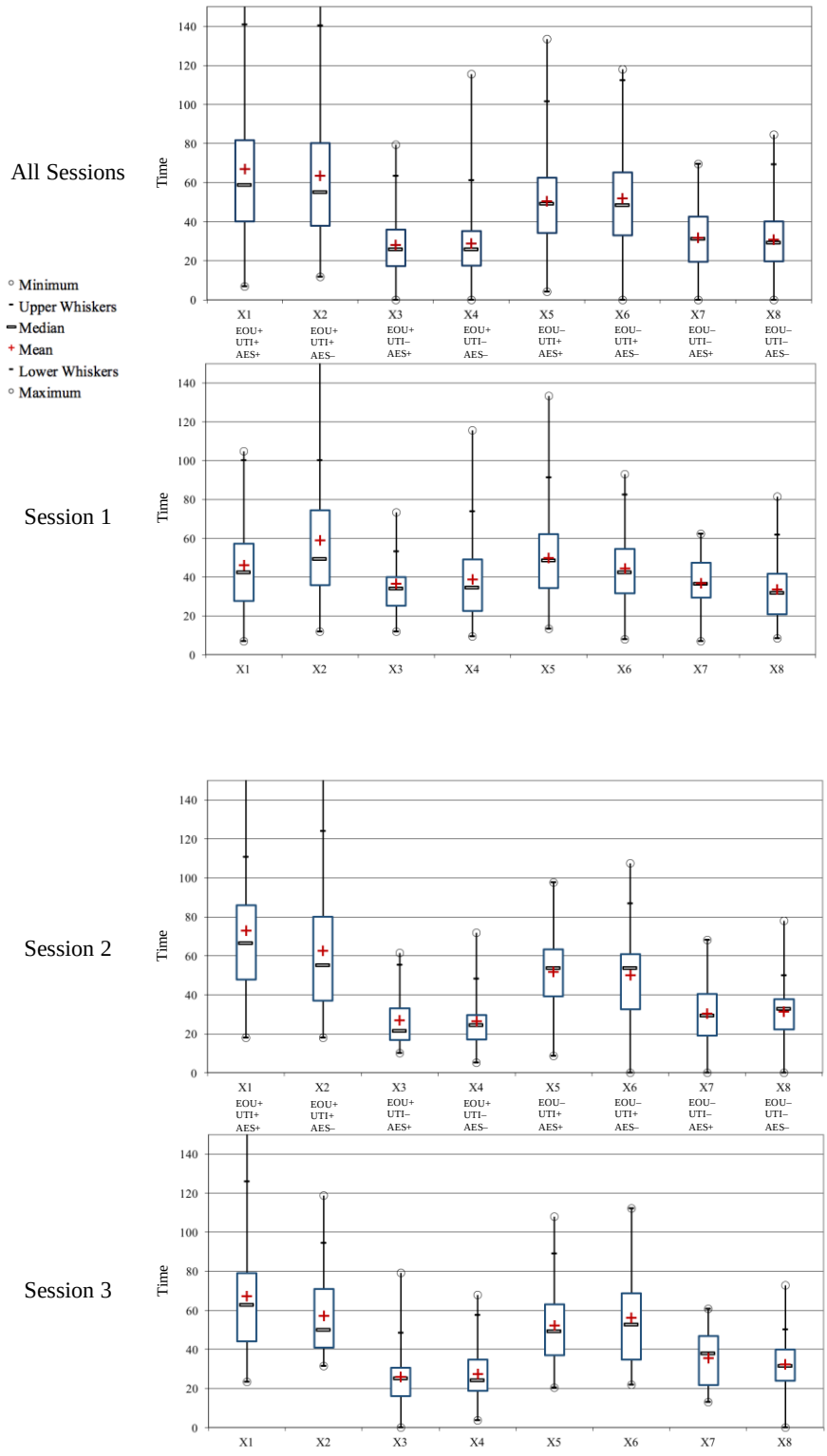
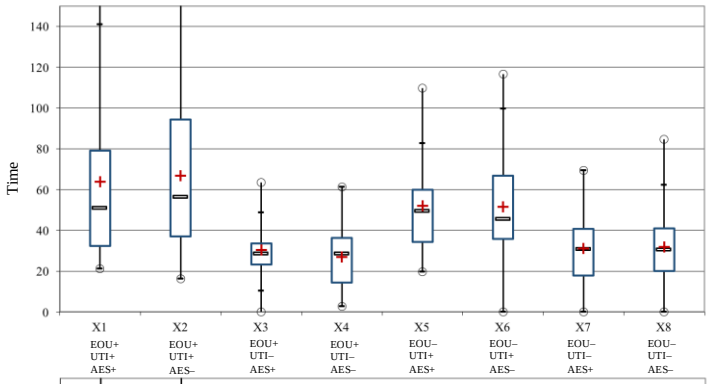


Figure 3. *Boxplot representation of the time spent (in seconds) by participants on each xylophone in session 1-5 and for all the sessions, cumulatively (All Sessions).*



Session 4



Session 5