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Article

Deleterious Effect of Participant Positioning on the Acceptability and Acceptance of a Wellness Management System under Development

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Abstract: Managing everyday wellness using sensors requires user buy-in and acceptance. The Unified Theory of Acceptance and Use of Technology (UTAUT) was used to measure at D-0 the acceptability (a priori), and at D-21 the acceptance of an ambulatory monitoring system under development, the SHERPAM system. Interviews with the participants revealed that they no longer viewed the system in the same way at the different stages of the study. The results of the qualitative analysis suggest that the time of the research led the participants to stop seeing themselves as potential future users and to take on the role of critical testers of the technology (which corresponds more to a user test). This role change led participants to question the usefulness of the technology, which affected their intention to use the technology in the future (5.30 vs. 4.24; t = 2.58 *). This research identified the reasons why it was crucial to have a fully functional device in the second phase (acceptance study). The results of this study suggest that it is inappropriate to undertake an acceptability study when the technology is under development. While the SHERPAM platform has been the subject of several user tests, none have been carried out in a situation of use. Thus, this study seems to suggest that the dysfunctions observed are more related to the absence of a development phase in the daily activity of the users. Thus, to ensure a good appropriation of the technology and to predict its use, the technology must not only be in perfect working order, but must also have been developed according to the daily activities of the individuals.

Keywords: user; acceptability; acceptance; sensor-based wellness management; deleterious effect of malfunctions on usage intent; human factors; usability engineering

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1. Introduction

Recent literature reports an increasing number of new connected and unconnected medical device proposals for ambulatory monitoring or simply for wellness monitoring. The technical aspects to be resolved often lead to rigorously tested solutions. However, many of these devices do not go beyond the prototype stage, particularly because the search for solutions does not include the human factor in these considerations [1]. It seems essential to take users' opinions into account in the very first stages, either to participate in the development of the system or to ensure good appropriation and, thus, satisfy a favorable acceptance judgment. The objective of this article is, therefore, to propose some recommendations, in the design phase of a medical device co-constructed between engineers and users. This relationship is made possible by recourse to the human sciences. It enables the needs of potential users to be taken into account in order to develop a technology that can suit its market. However, predicting and explaining the behavior of users of an ambulatory monitoring system is not an easy task. The challenge is to try to predict the intention to use a technological device that is not yet on the market and still under development. The approach used in this article is based on models of social cognition that consider acceptability as the study of social constructs towards a technology. The study of these social constructs make it possible to measure if the use of the technology is acceptable from the point of view of a potential user. These models of acceptability refer to a temporal dynamic. Indeed, after a user test design to adjust the functioning of the device, the relationship between the person and the technology is inscribed along a continuum that is based on three moments: preindustrial development (before the object is available), implementation in a practice, and post-industrial development. Acceptability involves three distinct measures related to these three moments: acceptability, appropriation at the time of implementation, and adoption by users to include it among the object used in their daily lives [2–4].

In this article, a case study was conducted to assess the relevance of studying acceptability during the industrial pre-development phase of the SHERPAM platform, which was developed for activity quantification and recognition. The models available in the literature for making this prediction refer to two theoretical fields: (1) the judgment towards the target behavior (i.e., the performance of a particular act, in a given time and space, towards a specific object) and (2) the judgment towards the technology whose use is to be predicted. Only this second field has been considered, which focuses on the practical and exclusive relationship between a user and a technology. Acceptability then depends on the user's intention to use the technology, the benefits he/she thinks he/she can get from its use, and his/her motivation to use it compared to the cost involved. In these models, acceptability is operationalized by behavioral intention, which is itself dependent on two perceptual determinants: perception of performance and perception of expected ease of use (Technology Acceptance Model, TAM) [5]. Expected performance is defined as "the degree to which a person believes that using the system will improve his or her performance" [6] (p. 982). Expected ease of use is "the degree to which a person believes that using a system will require no effort" [5] (p. 383). Both dimensions are dependent on external factors such as the characteristics of the system, the development of the process or the training that accompanies the deployment. Although TAM has demonstrated its robustness, it has, nevertheless, been criticized for the absence of a social dimension influencing behavioral intention [7]. A second version of TAM (TAM 2), [8] particularly develops extrinsic motivation through the study of social influence. The process of social influence reflects the impact of three interdependent social forces that reflect the social pressure to use technology: the subjective norm, the image, and the voluntary aspect of use.

In 2003, Venkatesh, Morris, Davis, and Davis, noting the excessive diversity of existing models, chose to propose a new model, the Unified Theory of Acceptance and Use of Technology (UTAUT) [9]. This model is based on a synthesis of the eight most robust models of behavioral intention: the Theory of Reasoned Action (TAR) [10]; the Technology Acceptance Model [5]; the theory of motivation [11]; the Theory of Planned Behavior [12]; the unified TAM-TCP model [13]; the Laptop Use Model [14]; the Information Diffusion Theory [15]; and the Socio-Cognitive Theory (TSC) [16]. By combining these models, UTAUT manages to correct the negative effects of too parsimonious models, while focusing the prediction of behavior on proven factors: behavioral intention and facilitating conditions. It also brings the two groups of models closer together: those focused on attitude towards the object and those focused on the object use behavior (Figure 1).

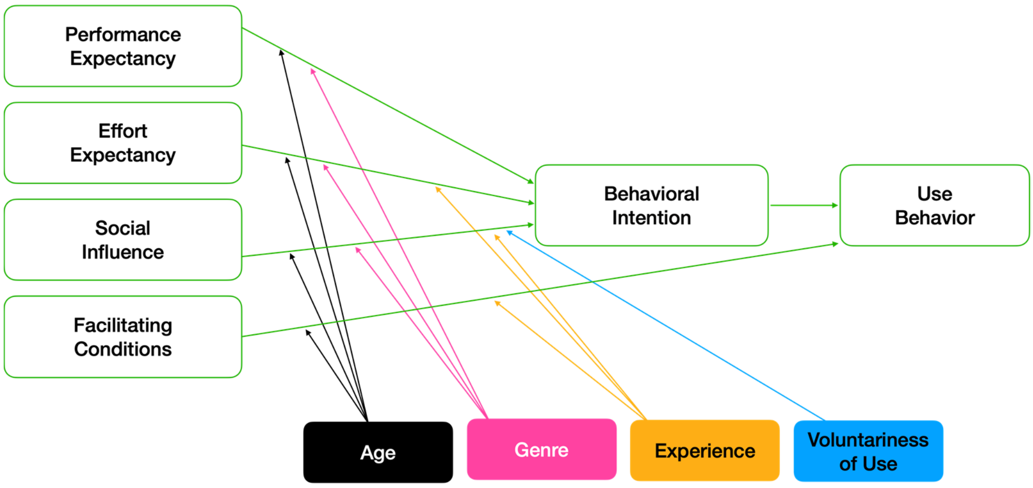

Figure 1. The Unified Theory of Technology Acceptance and Use (UTAUT) according to Venkatsch et al. (adapted figure) [8]. "Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job" [9] p. 447. "Effort expectancy is defined as the degree of ease associated with the use of the system" [9] p. 450. "Social influence is defined as the degree to which an individual perceives that important others believe he or she should use the new system" [9] p. 451. "Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system" [9] p. 453. Behavioral Intention is defined as intending, predicting, or planning to use the system in the next months. The effect of these four determinants is moderated by age, gender, experience, and voluntariness of use (the degree to which use of the innovation is perceived as being voluntary, or of free will).

The UTAUT model has been used in many domains and countries. For example, to predict computer use behaviors in Saudi Arabia [17], MP3 players [18], banking services [18,19], instant messaging [20], mobile internet [19], collaborative writing systems [21], and family dispute settlement systems [22]. While there are many studies on the social acceptability of new technologies [23], few have been carried on medical technologies [24]. One of the problems with existing work is that it often deals either with emerging technologies, before the technology exists [25] or after the technology exists and it is already too late [26]. In the first case, one is often out of step with real situations of use and in the second case the results obtained often only consist of identifying the strategies to be put in place to convince users to use the technology studied. It is, therefore, a marketing issue rather than a question of usage specialists and their prediction. Studying the relationship between actors and innovation can be considered, as mentioned above, at three points. A first measurement, called acceptability, can be carried out before use. Then the device, theoretically in perfect working order, can be made available to people to study its acceptance. The challenge here would be to study the evolution of the determinants of the intention to use over time. Finally, a third phase will be carried out during which the appropriation of the device by the users will be studied on a daily basis. Therefore, while a prototype that is not yet operational can be presented in the acceptability study, it is essential to present a completed device in the acceptance study [3]. In this way, the target user can use the device in his daily life and, thus, have a direct day-to-day experience. It can then be observed how the innovation has been appropriated by the potential users in order to identify the appropriation problems that may arise and, thus, propose recommendations.

If the technology is not as reliable as the technicians had hoped, then dysfunctions are likely to affect the user's position. The latter, no longer able to consider himself as a user, then adopts a tester's approach.

2. Description of SHERPAM Platform

The case study presented in this article is based on the acceptability study carried out in the SHERPAM project. The different technologies integrated in the SHERPAM platform have been developed for the medical environment, with the aim of transmitting a data stream (i.e., health data) to a remote server. Thus, the platform (Figure 2) has been designed to cover all stages of data acquisition, transmission and processing, while meeting the following criteria:

- **Extensibility:** since distinct pathologies may require different types of data, the system is not limited to a pre-defined, unchanging set of sensors. On the contrary it is scalable so that it can easily accommodate new types of sensors or data processing algorithms if required.
- **Self-sufficiency:** the system allows that data acquired by sensors to be processed either "locally" or on a remote site. Local processing makes it possible for the sensing system worn by a subject to run autonomously—although possibly in a degraded mode—when no communication network is available. In contrast remote processing makes it possible to run advanced (CPU intensive) algorithms on the data acquired by the sensors. An aggregation server for data collection. This segment, like the previous one, is equipped with all the necessary means for encryption and data security.
- **Agility:** the system is agile in terms of network connectivity. It switches between cellular networks (2.5G/3G/4G) and Wi-Fi hotspots depending on their availability, but also other parameters such as the nature of the data to be transmitted or the power consumption related to the use of each type of network.
- **Disruption-tolerance:** Transmissions in the system are "bundle-oriented", which allows network disruptions to be tolerated (including long disruptions as can be observed in "white zones" that are not covered by any wireless network) without ever losing important data.

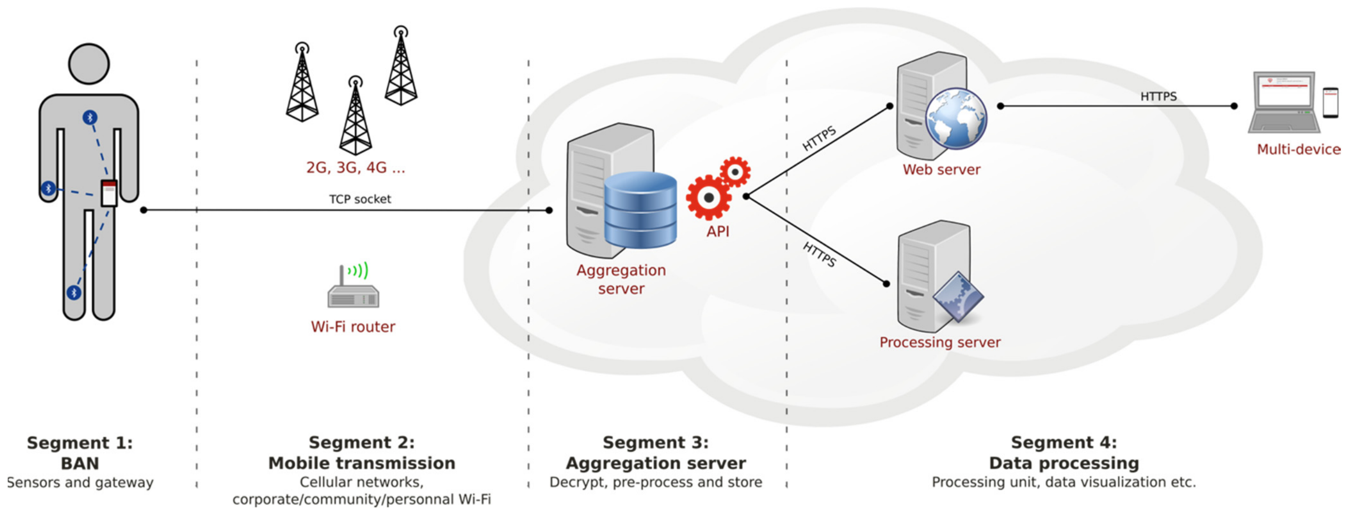

Figure 2. Synthetic view of the SHERPAM platform used in this study. The SHERPAM platform is a system device capable of transmitting a data stream to a remote server. A full description of the project and platform can be found at the following address, https://project.inria.fr/sherpam/ accessed on 20 September 2021, where project presentation, results, publications, and members are detailed.

These constraints and considerations led to the SHERPAM platform. To provide a better understanding, a very brief description is given here. The frontend is crucial, it aims to establish communication between a smart-phone and a set of sensors available on the market. For the present study, the Zephir and the Actigraph were retained, as were the communication channel, which aims to establish a communication system that adapts to the existing mode of communication (3G, 4G, WiFi) [27], and the aggregation server for data collection. This segment, like the previous one, is equipped with all the necessary means for encryption and data security [28]. The data processing targets different populations. A first one regrouping cyclists and Cardiac patients. For this population, the objective was to monitor heart rhythm. For Heart rate estimation, either for cyclists or cardiac patients, the proposed algorithm described in [29] was used. A third population was studied: patients with peripheral arterial disease (PAD) with monitoring of physical activity (number of steps and stops, distance travelled). The proposed algorithm, developed in [30,31], was used for data processing. It is worth mentioning that no specific activities were recommended. Indeed, cardiac and PAD participants were only asked to perform their daily routine activities, and for cyclists, their classic recurrent cycling activities. It is also important to note that, due to the clinical trial being an observational trial, no feedback was sent to the participants on possible arrhythmias (which is interventional). The following paragraph shows that this condition the use of the SHERPAM platform.

The SHERPAM platform was developed in several successive phases which took into account the feedback and judgments of the testers during the first user tests. Thus, several features have been reviewed and modified such as:

- The addition of real-time feedback to the user of the collected data that can be consulted during the physical activity session (duration, speed, distance, heart rate, and respiratory rate).
- The modification of the visual codes of the application.
- The modification of the words used on the application so that they can be understood by the largest number of people.
- The importance of reducing the number of sensors in order to ease its installation.
- The importance of reviewing the display and taking into account the difficulty of reading the data in real time.
- The importance of restructuring the server interfaces in order to offer users the possibility to consult their history.
- Various technical issues such as Bluetooth connectivity between sensors and smartphone.
- This also allowed the development of a user manual to facilitate the use of the device.

At the end of these user tests, the SHERPAM device, which is supposed to work, is the subject of a study designed to predict the intention to use it in two phases. The aim is to first study an initial acceptability judgment before use, and then to study the acceptance judgment after 21 days of use. The study that was carried out subsequently shows that the dysfunctions that occurred during these 21 days will lead users to move from the role of user to that of tester of the device. This change of role will affect the judgment made on the determinants of use.

3. The Acceptability and Acceptance Study of SHERPAM

3.1. Participants

The acceptability study was conducted with 10 cyclists (10 males) and 10 cardiac patients (3 females and 7 males). These participants are in the age range of potential users (54 to 74 years old).

3.2. Procedure

Each participant used the monitoring system for 21 days, during each sports outing (cycling, hiking, etc.). The study was conducted in two stages. The first stage was an acceptability study at D0, and second stage was an acceptance study at the end of the 21 days of use (D + 21). At each stage of the study, participants were asked to complete a questionnaire about their judgment of the SHERPAM platform. The investigator assisted the participants in completing the questionnaire scales. Then, a directive interview was conducted with each participant, during which they were asked to comment on and justify each of their answers to the questionnaire questions.

3.3. Measures

3.3.1. Qualitative Measure

Justifications and comments. Comments and justifications were collected during the directive interview about each of their answers to the questionnaire items. These comments form the basis of the qualitative analysis which aims to identify the role(s) assumed by the participants during these two measurement periods.

3.3.2. Qualitative Data Analysis

In accordance with the initial hypothesis, a grid was developed to characterize the comments according to the role assumed by the participants during the test phase and according to the valence (positive or negative) of the comment. This assumption made it possible to classify their comments along two axes:

- The first identifies the relationship with the technology endorsed by the participant, which leads him either to remain in his role as a tester ("T" category, which includes judgments against the technology) or to project himself as a future user ("U" category, which includes judgments about himself as a user).
- The second axis determines the valence of this response (favorable, "+", or unfavorable, "-", to the monitoring system).

Thus, three independent judges (a Professor, a Ph.D., and a psychologist specialized in acceptability), classified the verbatims, each independently of the other two (before pooling the results of their categorizations), according to the grid developed. This made it possible to characterize the role of tester (i.e., comments on the ergonomics of the device) or future user (i.e., judgment on oneself as to the intention to use the device). A measure of inter-judge agreement was carried out to check that the different judges categorized the verbatims in the same way. This was calculated using the kappa (k) agreement coefficient [32]. This indicator is between 0 and 1; the closer the number is to 1, the more consistent the observations are with each other. For the first axis the Cohen kappa is considered as average (k = 0.54; 69.21%) and good for the second axis (k Cohen = 0.70; 79.88%) [33].

3.3.3. Quantitative Measure

Unified Theory of Acceptance and Use of Technology. A 42-item questionnaire measured on 7-point Likert scales was developed based on the material used by Venkatesh et al. [9] (see Appendix A). Participants completed a scale adapted for the SHERPAM platform. To assess *Performance Expectancy* 11 items were used (e.g., "In your opinion, the use of the SHERPAM platform ... to know the intensity of my physical activity"). To assess *Effort Expectancy* 11 items were used (e.g., "Based on the presentation of the SHERPAM system, would you say that its use ... would be easy for me"). *Social Influence* was assessed by 7 items (e.g., "In your opinion, the use of the SHERPAM platform ... will have a positive impact on those around me"); *Facilitating Conditions* were assessed by 8 items (e.g., "In your opinion, with the SHERPAM platform ... I will be able to be medically monitored"). And finally, *Behavioral Intention* was assessed by 5 items (e.g., "Based on the presentation of the SHERPAM system, would you say that ... I intend to continue using this system after the clinical trial period.").

3.3.4. Quantitative Data Analysis

The technological dysfunctions noted by the participants may have led them to adopt a different role at D0 and D + 21: a correlational study will be conducted on the quantitative data collected at these two measurement moments. After conducting reliability analyses of the scores of each UTAUT variable (using their Cronbach's alphas, classically used in psychology to evaluate the relationship between several items responding to a particular dimension—including the UTAUT), the relationships between these variables will be observed, by constructing correlation matrices using Pearson's correlation coefficient. Finally, the evolution of the scores will be controlled between the two measurement times by a Student's *t*-test, which will make it possible to identify the consequences of these positions on the factors related to the Behavioral Intention.

4. Results

4.1. Qualitative Study of Acceptability According to the Role Assumed

In total, 632 responses were analyzed and placed in one of four possible categories (U+; U−; T+; T−). This categorization was determined either unanimously (for 56% of responses) or by majority (for 19.7% of responses). A response categorized differently by each of the three judges was discarded ("N/A" category—26.3% of responses). Table 1 gives some examples of the responses collected and their distribution in the different possible categories.

Table 1. Examples of Verbatim by Category and Response Time—SHERPAM project.

	U+	U−	T+	T−
D0	"Can allow me to detect an anomaly and see if I'm not too far in the red"; "Allows me to evaluate a person's cardiac capacity, how far they can go and schedule workouts"; "It will reassure my wife"; "It reassures me to be monitored"	"Does not show the most interesting data"; "I am already equipped: this tool can generate stress and over-control"; "I am afraid of doing something stupid."	"Real-time data"; "Discrete device"	"Bad ergonomics: too many devices to carry"; "I couldn't look at it while I was pedaling"; "It lacks geolocation to call for help"; "The use seems complex"
D + 21	"Allows you to know what you have done and have cardio data"; "Allows for activity tracking and remote control"; "Allows me to manage my effort by looking at the phone during the activity"	"I already have the information with my meter"; "I don't know how to analyze the information it gives me"; "I am already equipped"; "I don't need this"	"The data transmission function is good; "The belt is nice»; "Once you get the hang of it, it's good."	"Setup time for short trips"; "Lack of history"; "The belt is awkward behind, on the spine and the ribs"; "The devices are awkward for walking"; "The belt is awkward on the back"; "The belt is awkward on the spine and the ribs"; "The belt is awkward on the back"; "Devices are awkward for walking"; "Heart rate data is not accurate"

Table 2 shows the distribution of responses in each category, whose frequency of occurrence at each measurement time is the first indicator.

Table 2. Categorization of qualitative data—SHERPAM project.

Role Mobilized for the Response	N	Valence	N	%
Future User (U)	266	+	195	30.9%
		-	71	11.2%
Taster (T)	200	+	20	3.2%
		-	180	28.5%
Subtotal			466	73.7%
N/A			166	26.3%
Total			632	100.0%

Finally, the main role of each participant (using the answers they gave) was categorized for each measurement time: those with a majority of "U"-oriented answers were identified as participants in the role of future users. Those with a majority of "T" responses were identified as participants in the role of tester. When it was not possible to identify a majority role, the most frequently answers were used to select the role associated with it (one case at D0 which used the answer U+ three times out of six). If there was no majority response, the participant was removed from the analysis (one case at D + 21).

Thus, each participant was placed in one of the two groups created on the basis of this categorization (U vs. T), whose behavioral intention can be compared.

The first result shows that the raw frequency of occurrence of each response category differs significantly between D0 and D + 21. Indeed, the dispersion of responses reveals a complete inversion of the participants' positioning (Figure 3).

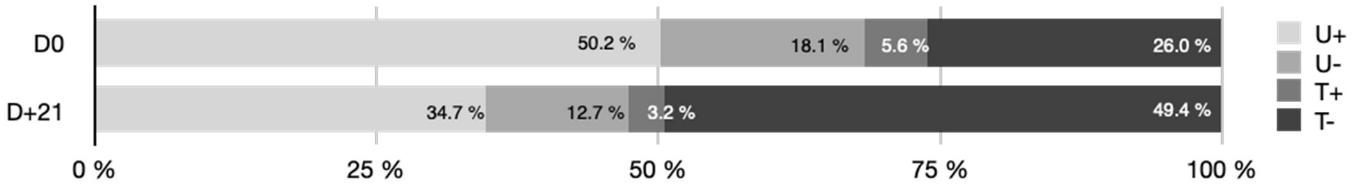

Figure 3. Dispersion by measurement time of judgments about the system, categorized according to the role taken and the valence of the response (SHERPAM project).

While the majority of the answers collected at D0 were oriented towards a future user position (the aggregation of U+ and U−, i.e., 68.3%—of which 73.5% were positively valenced answers), at D + 21 the answer were oriented towards a tester position since they represented 52.6% (i.e., T+ and T−) of the answers (of which 93.9% were negative) reported a judgment on the technology (χ^2 (466) = 190.20; $p < 0.001$). Furthermore, the initial positive impression that probably led participants to take part in the study at D0 (55.6% of responses) suffers from the dysfunction of the technology, since 62.2% of the categorized responses at D21 are negative (of which 81.4% concern a judgment of the technology—χ^2 (466) = 23.12; $p < 0.001$).

However, it is mainly the change in the participant's self-assigned role that provides an explanation for the decrease in the intention to use. In fact, if 95% of the participants position themselves at D0 in the role of a future user "U", 61.1% of them changed roles at D + 21 and positioned themselves in the role of tester "T" of the system (χ^2 (18) = 11.00; $p < 0.001$). This role change is, therefore, particularly marked during the 21 days. This change is reflected in the migration of the majority of responses given by participants, U+ at D0 (for 85% of participants) to T− at D + 21 (72%—χ^2 (38) = 16.1; $p < 0.001$). While the decrease in the number of favorable mentions of the technology with regards to participant's projection as users is not significant between D0 and D21 ("U+": 5.4 vs. 4.6; t (19) = −1.35; ns), it appeared to be highly significant with regard to the increase in the number of mentions unfavorable to technology as a tester ("T−": 2.0 vs. 6.5; t (19) = 7.43; $p < 0.001$—see Figure 4).

Finally, participants who take on the role of future user consider the device to be more useful than those who only project themselves in the role of tester (4.37 vs. 3.19, cf. Table 3). This difference is probably due to the real and ongoing malfunctions of the technology tested. However, even more problematic, the latter (those who see themselves as testers) have less intention of using the device (3.93) than the former (those who see themselves as future users, 5.25).

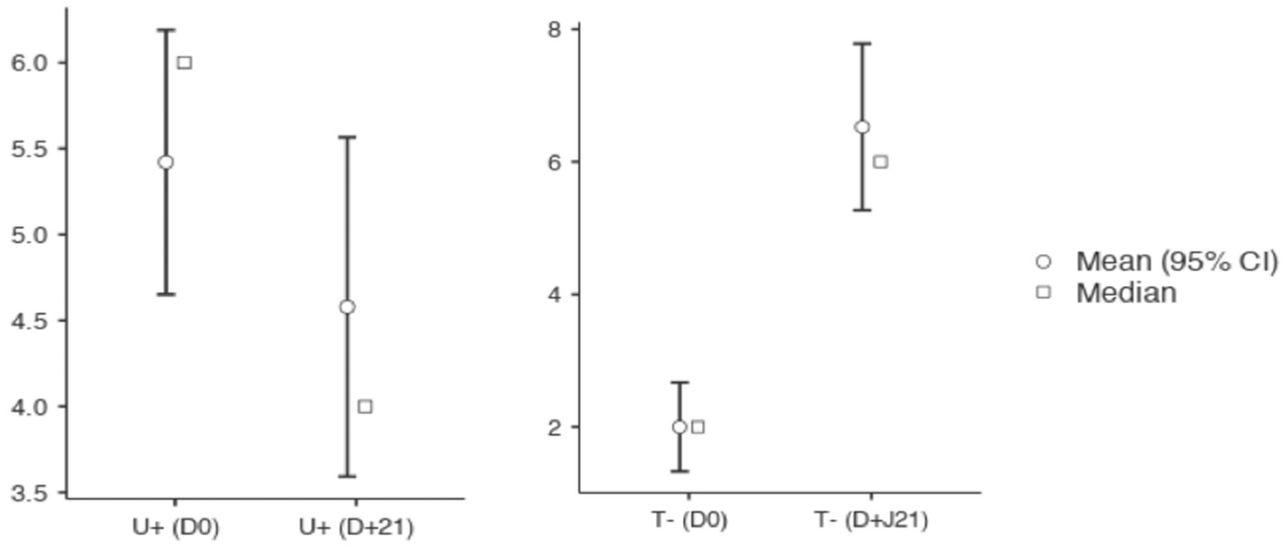

Figure 4. Evolution of the average incantation of U+ and T− responses per participant according to the measurement time (SHERPAM project).

Table 3. Categorization Global evolution of the average dimensions of the UTAUT according to the role mobilized—SHERPAM project (Independent Samples *t*-Test).

Dimension	Role	M	Mean Difference	SE Difference	*t*	Cohen's d
Performance Expectancy	U T	4.37 3.19	1.172	0.494	2.372 *	0.828
Effort Expectancy	U T	5.35 5.19	0.157	0.290	0.543	0.189
Social Influence	U T	4.13 3.22	0.913	0.462	1.976.	0.690
Facilitating Conditions	U T	4.78 3.83	0.946	0.534	1.770.	0.618
Behavioral Intention	U T	5.25 3.93	1.319	0.494	2.668 *	0.931

Note: * $p < 0.05$.

4.2. Quantitative Acceptability Study

4.2.1. Analysis at D0

It can be seen that at D0, only the facilitating conditions and the effort expectations are related to the intention of use (Figure 5).

It seems that at the moment of their engagement in the research, everything happens as if the participants had no doubts about the usefulness of the technological device for which they agreed to become an experimenter, and, therefore, this dimension does not in any way determine their intention to use the technology. Indeed, they imagine that their commitment to using the device is conditioned by some effort necessary to master the technology. And so, they expect everything to be done to ensure that the conditions allow them to use the technology; these facilitating conditions then appear to be a determining factor in their commitment to use the technology. This is observed through the correlation matrix at D0 (Table 4).

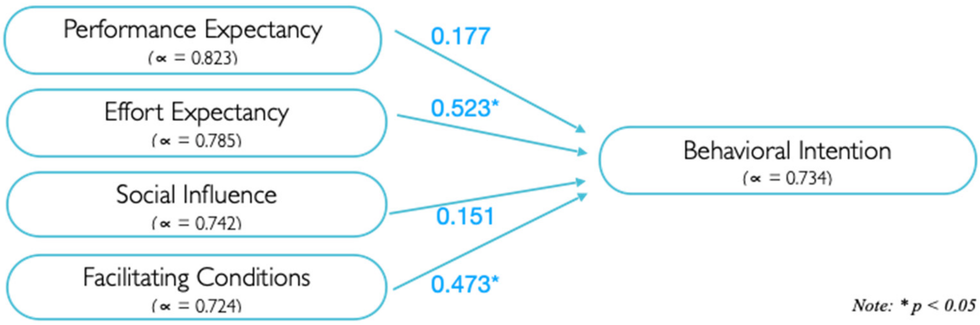

Figure 5. Correlation between the different dimensions of the UTAUT at D0—SHERPAM project. At D0, two variables are related to Behavioral Intention: Effort Expectancy and Facilitating Conditions. There was no effect of moderators on the results at D0.

Table 4. Correlation Matrix UTAUT dimensions—SHERPAM project D0.

	Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Behavioral Intention
Performance Expectancy	—				
Effort Expectancy	0.555 *	—			
Social Influence			—		
Facilitating Conditions	0.735 ***	0.523 *		—	
Behavioral Intention				0.473 *	—

Note: * $p < 0.05$, *** $p < 0.001$.

4.2.2. Analysis at D + 21

After 21 days (D + 21), users still condition their intention to use the technology on sufficient facilitating conditions and effort expectations. However, they add to these two elements an attribution of utility to the technology, since it is observed that performance expectations determine the intention to use 21 days later, which was not the case 21 days earlier (Figure 6 and Table 5).

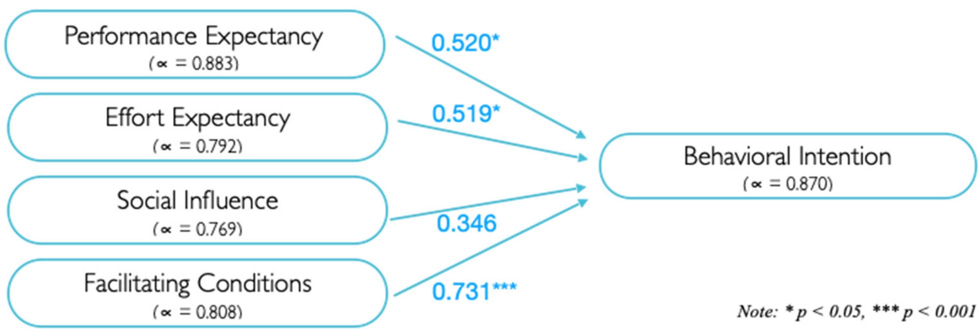

Figure 6. Correlation between the different dimensions of the UTAUT at D + 21—SHERPAM project. The main difference is related to expected performance: this relationship is significant at D + 21, whereas it was not at D0. Moreover, at D + 21 the same correlation between Effort Expectancy/Behavioral Intention and Facilitating Conditions/Behavioral Intention as at D0 was found. There was no effect of moderators on the results at D + 21.

Table 5. Correlation Matrix UTAUT dimensions—SHERPAM project D + 21.

	Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Conditions	Behavioral Intention
Performance Expectancy	—				
Effort Expectancy	0.740 ***	—			
Social Influence			—		
Facilitating Conditions	0.680 ***	0.538 *	0.622 **	—	
Behavioral Intention	0.520 *	0.519 *		0.731 ***	—

Note: * $p < 0.05$, ** $p < 0.005$, *** $p < 0.001$.

Despite prior user testing, the technology offered to users for 21 days did not work optimally. As a result, the participants' performance expectations were disappointed. As a result, they rated the technology as less useful compared to their initial judgment.

The analysis of comparisons of each of these variables provides insight into the pre-used judgment versus the post-used judgment (Table 6). The Student's *t*-statistics confirm this point of view. It is observed that judgments about expected performance, as well as facilitating conditions and intention to use, become less important in people's judgments. Thus, the judgment about the expected performance of the technological device loses one average point after use compared to the judgment made before use.

Table 6. Evolution of the average dimensions of the UTAUT between D0 and D + 21 SHERPAM project (*t*-Test Sample Pairs).

Dimension	D	M	Mean Difference	SE Difference	*t*	Cohen's d
Performance Expectancy	0 21	4.50 3.50	1.0042	0.234	4.295 ***	0.9604
Effort Expectancy	0 21	5.30 5.35	−0.0409	0.175	−0.234	−0.0523
Social Influence	0 21	4.04 3.60	0.4417	0.291	1.516	0.3391
Facilitating Conditions	0 21	4.88 4.10	0.7750	0.268	2.108 *	0.4714
Behavioral Intention	0 21	5.30 4.24	1.0625	0.410	2.588 *	0.5788

Note: * $p < 0.05$, *** $p < 0.001$.

Overall, the intention to use the SHERPAM platform decreased between D0 and D + 21, an evolution strongly linked to the important decrease in judgments of the expected performances of the device. This decrease is the result of the numerous dysfunctions during this 21-day test period.

5. Discussion

The objective of predicting the use of an innovation is not an easy task. However, the stakes are high, since the aim is to accompany, as far as possible, the market launch of a technology that is likely to meet its public. To face this challenge, it is customary to work on the acceptability of a technological innovation or a service. The literature, mainly in human sciences, leads the authors to collect information from future users at three stages of the technology's development. A first measure, called acceptability, is carried out before the technology is used in order to identify the psychological dimensions considered a priori (i.e., before the user actually uses it) by the future user as essential in his intention to use the innovation in the future. After a development phase and several user tests, the system, theoretically in perfect working order, can be made available to future users to study its acceptance. The challenge is then to assess the way in which the latter are able to use the technology and to make good use of all its functions without any particular effort. During this first phase of interaction with the device, which can last as long as wanted, it is possible to study the evolution of the relationship with the technology. Thus, it is possible to verify whether the psychological dimensions identified in the acceptability measure remain good predictors of the intention to use the innovation. Finally, a third phase (appropriation phase) will make it possible to observe day after day how the user will use (or not use) the innovation to carry out his daily activities. It is then possible to see whether the innovation becomes an indispensable instrument in the ordinary life of its user.

This research identified the reasons why it was crucial to have a fully functional device in the second phase (acceptance study). Indeed, it has been observed that a technology considered a priori (acceptability phase) as perfectly acceptable for which future users have expressed a certain intention of use (i.e., useful, adapted to their daily life), could lose in usefulness, in adaptation and consequently in intention of use, during a period of use characterized by dysfunctions and not by optimal functioning. Thus, the unreliability of a technology can lead participants to adopt a tester status over the course of malfunctions at the expense of the user status they were initially assigned. Considering themselves as testers of the device, the participants stressed the need to be accompanied in the use (social influence) and the need to make efforts to use the technology. At the same time, the participants would downgrade their judgment of its usefulness, considering it less useful than they had estimated it to be, and subsequently showed less willingness to use it.

In line with other studies [25], the results of this study suggest that it is inappropriate to undertake an acceptability study when the technology is under development. While the SHERPAM platform has been the subject of several user tests, none have been carried out in a situation of use. Thus, this study seems to suggest that the dysfunctions observed are more related to the absence of a development phase in the daily activity of the users (which was ultimately the subject of this case study). This implies, as Bobillier-Chaumon [4] suggests, that to ensure a good appropriation of the technology and to predict its use, the technology must not only be in perfect working order, but must also have been developed according to the daily activities of the individuals.

Based on these results, it seems that two issues need to be addressed. What is at stake in an acceptability measure? At what stage of development such measure should be launched? Measuring acceptability has the advantage of predicting the intention to use a new technology while offering the possibility of identifying the subjective determinants involved in that intention [3]. There is, therefore, an interest in measuring the probability that the technology will meet an audience of future users. It is also useful to identify the levers that can be used to improve the intention to use the technology. However, let's understand that at too early stage of development, the ordinary dysfunctions that arise naturally from use prevent testers from projecting themselves into the role of user that is proposed to them. This lack of projection affects the development of judgment about the technology since the participant cannot fully appreciate its functionality. Hence, the measurement of acceptability should not occur either too early or too late in the development of a technology. If it is considered too early in the development process, the results of the acceptability measure may, as in this study, deteriorate with the day-to-day use of the device. If considered too late, the acceptability judgment will not have the impact it can have if considered before the technology is actually implemented.

However, this study has some limitations; first, the small sample size. Indeed, a larger sample size would have allowed statistical individuals to have less impact on the data collected. In addition, although the qualitative elements collected shed interesting light on the positioning of individuals during the acceptability and acceptance study, they do not allow for a complete generalization of the results beyond this case study. However, these elements raise questions about the strategies to adopt during these studies (i.e., acceptability, acceptance, and appropriation) to control or measure the positioning of individuals. Second, this study did not go to the appropriation phase. With the changes made to SHERPAM in the first two stages, it would have been interesting to measure the evolution of the participants' role and their intention of use (did they abandon the role of tester and adopt the role of user again) during this third phase. Nevertheless, the purpose of this case study was not to study all three phases but rather to explore during the acceptability and acceptance phases how individuals can structure their judgments about a technology. Future research could study the evolution of the structuring of judgments in the daily activity of individuals.

Finally, the support of innovations should, as Iba [34] has shown, consider setting up focus group sessions with future users in the early stages of development. They would provide engineers with the necessary material to adjust the technology to the daily reality of the user, which is known to be made up of constraints, lack of knowledge, and insufficient technical skills. Only after these many dysfunctions have been resolved will it be possible to predict the intention to use by providing future users with a technology that is in perfect working order in all its functions.

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Institutional Review Board Statement: The ethics committee considered that the study was outside JARDE LAW and did not contravene medical ethics. The decision was reached the 09/06/2018, Opinion N° 18.47.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The database was constituted during a French national project (SHERPAM), The database is available for the partners of the project during one year after the end of the project. In France, regulations are precise concerning the reuse of personal health data and then, in accordance with French policy, the data will be shared in a near future through the health-data-hub (https://www.health-data-hub.fr/, accessed on 20 September 2021) where it will be fully available and in respect of French regulation.

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Appendix A

The French version of the following items was used to collect our data. Participants were asked to rate themselves on a 7-point Likert scale for each item (1 = Strongly disagree; 7 = Strongly agree).

Performance Expectancy

In your opinion, the use of the SHERPAM platform...

. . . to secure my physical activity.
. . . to estimate my energy expenditure.
. . . to assess the pain level of physical effort during a physical activity session.
. . . to measure the level of fatigue experienced during physical activity.
. . . to know the intensity of my physical activity.
. . . to measure my speed.

. . . to quantify the duration of my physical activity.
. . . to assess my recovery from exercise.
. . . to evaluate the total distance I have covered.
. . . to encourage me to be physically active.
. . . to support my motivation to be physically active.

Effort Expectancy

Based on the presentation of the SHERPAM system, would you say that its use...
. . . would be easy for me.
. . . will require little effort to understand.
. . . will require little effort to learn.
. . . require little effort to memorize.
. . . will make it easier to interpret my heart and breathing values/make it easier to interpret my ability to walk over a set time
. . . make it easy to visualize my progress.
. . . make it easier to monitor the intensity and duration of my physical activity.
. . . will require little effort to set up.
. . . will require little effort to connect the sensors.
. . . require little effort to start the application.

Social Influence

In your opinion, the use of the SHERPAM platform...
. . . will have a positive impact on those around me.
. . . will have a positive impact on my social and professional life.
. . . will a positive impact on my quality of life.
. . . will be encouraged by those around me (family, friends, and carers).
. . . will be recommended by the medical professionals who follow me (general practitioner, sports doctor, and cardiologist).
. . . will give me a positive image of myself.
. . . will be encouraged by people whose opinion I value.

Facilitating conditions

In your opinion, with the SHERPAM platform...
. . . I will have the necessary technological resources to carry out my physical activity with confidence.
. . . I will be able to be medically monitored.
. . . A specific person (or team) will be available to assist me.
. . . I will be able to control the intensity and duration of my physical activity.
. . . I will be able to manage my stress better.
. . . I will be able to secure the conditions for physical activity.
. . . I will be able to be medically monitored at a distance during my physical activity.
. . . I will have the necessary knowledge to improve my health.

Behavioral intention

Based on the presentation of the SHERPAM system, would you say that...
. . . I will plan to continue using this system.
. . . My attitude towards the system would be positive.
. . . My satisfaction with the system would be positive.
. . . The system leaves me with a pleasant feeling.
. . . . I intend to continue using this system after the clinical trial period.

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