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An Enriched Customer Journey Map: How to Construct and Visualize a Global Portrait of Both Lived and Perceived Users' Experiences?

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Abstract: Design is about understanding the system and its users. Although User Experience (UX) research methodologies aim to explain the benefits of a holistic measurement approach including explicit (e.g., self-reported) and implicit (e.g., automatic and unconscious biophysiological reactions) data to better understand the global user experience, most of the personas and customer journey maps (CJM) seen in the literature and practice are mainly based on perceived and self-reported users' responses. This paper aims to answer a call for research by proposing an experimental design based on the collection of both explicit and implicit data in the context of an authentic user experience. Using an inductive clustering approach, we develop a data driven CJM that helps understand, visualize, and communicate insights based on both data typologies. This novel tool enables the design development team the possibility of acquiring a broad portrait of both experienced (implicit) and perceived (explicit) users' experiences.

Keywords: multimethod measurement; customer journey maps; personas; neurophysiological measures; psychometric measures

1. Introduction

The user experience (UX) field within the User Centered Design (UCD) approach is nowadays well established and recognized in the community within the scope of the conceptualization and evaluation process [1]. However, the different facets of the UX design field and its complexity do not seem to reflect the resulting communicational tools put in to practice, such as the Personas and the Customer Journey maps (CJM) that stem from research. Hence, there is an important gap between UX design research and UX design practice [2]. User experience being mostly felt internally by the user [3], the research in this field has extensively explained the benefits of a holistic measurement approach including explicit as well as implicit data to better understand it. Herewith, not only is it important to obtain the user's perception on his experience (explicit measures), but also being able to highlight how he reacted unconsciously and automatically from an emotional and cognitive standpoint throughout his journey (implicit measures) [4].

Yet, practitioners use mainly an explicit measurement approach to better represent the user's patterns of behavior resulting in 95% of publications in the UX field [5]. As a result, their archetypal portraits are principally based on the user's personal perception as well as the researcher's perception. To our knowledge, little research has been done to include an implicit measurement approach: i.e., the user's unconscious cognitive and emotional reactions while interacting with a system. One research team tackled, in 2004, a new avenue by proposing the use of Electroencephalography

(EEG) and Eye Tracking techniques to understand the user's cognitive and affective states when experiencing a service, thus considering implicit measures in the user's experience analysis [6,7]. As they only used implicit measures in their research the authors called for research to develop ways to use both implicit and explicit data.

In this study, we thus aim to answer the following question: How to construct and visualize a portrait of both lived and perceived users' experiences considering their unique workflows? In other words, this paper aims to present through a case study a novel methodological and analytical approach to construct a CJM where observational, explicit and implicit user experience measures complement each other in order to help designers in their decision-making and design processes.

This paper contributes to the theory of design in different ways. First of all, it introduces a very detailed methodology that explains not only how to make the best of the observational, implicit and explicit measurements but also how to bridge them in order to tell an interesting story about the users and their experience. Secondly, this paper presents a unique way to visualize and communicate complex data that, otherwise, are hardly accessible to industrial partners. For design practice, this means that every question about the user can be answered in one single tool. Moreover, it helps different organizational departments to understand the user and better communicate between each other.

In order to understand the interest in investigating this avenue, we propose to take one step back and define, first, what exactly a User Experience (UX) is, and what underlies a Persona and a Customer Journey map. Secondly, the methodology deployed to collect the data and analyze it is clarified. Lastly, the proposition of an augmented Customer Journey Map is explained, from its construction to its visualization.

2. Defining Concepts

2.1. User Experience

"A major response to designs failing to gain approval and acceptance has been to consider it to be a matter of insufficient knowledge about people, their capacities, needs and desires and that design therefore needs to be based on the improvement of such knowledge" [8].

"People are active parts of the system, and because they are much less predictable and less well understood than the computers and other technological parts of the system, they require even greater study and understanding" [9] page 15.

The User Experience principles and practices have been for a long time now an important theme in design practices [10] and nowadays, are increasing in popularity, not only in academia but also in industry [11]. Still, there is no existing unanimous definition. For the purpose of this paper, User Experience underlies a "person's perceptions and responses that result from the use or anticipated use of a product, system or service" [1] page 727, responses that include "the totality of the effect or effects felt (experienced) internally by a user as a result of interaction" [3] page 19. According to this definition, a user's experience includes both explicit and implicit reactions in order to identify what the users see, feel and think about the system, what they like or not about its presentation and usage as well as the emotional impact during the physical interaction and the memory after the interaction [3]. Hence, when evaluating and validating a user's experience both measures should be considered, collected, and analyzed complementarily since "UX Design deals with the intertwining relationship between the objective and subjective, the internal and external aspects composing human–product interactions" [11] page 162.

When facing a system, a user presents a dual cognitive reaction unconsciously and consciously [12,13]. On one hand, the user refers implicitly to his associative structure and will express unconsciously a specific cognitive and affective state according to what he is living. When measured, this implicit experience can answer what and how the cognitive and emotional states are (activation, cognitive load, valence) and are expressing themselves (high/low activation, high/low cognitive load, high/low valence), and when they are happening (timeline). On the other hand, the user will refer explicitly to his knowledge and beliefs and express consciously his perception of the experience he is living [14]. When measured, the explicit experience answers the question why, explaining the reason for a cognitive or emotional specific user's reaction to a particular interaction with the system. In other words, a user lives implicitly and perceives explicitly an experience.

A user can simultaneously hold different implicit and explicit attitudes towards the same system [13]. Indeed, there are many conditions (context, added, missing or altered information, etc.) that might influence and disrupt a user's experience. It subsequently creates a gap between the explicit and implicit experience since implicit measures may show experimental effects that do not emerge on explicit measures [15]. It is, thus, crucial to capture both measurements. The perceived experience, when expressed, might also be altered by social norms, persuasive communication, cognitive and motivation resources as well as self-presentational concerns [16]. Qualified as subjective, self-reported and perceived measures give the users the latitude to summarize a great amount of information and better identify design ideas [1]. However, two important biases exist in self-reported measurements: (a) the human tendency of socially desirable responding as well as (b) users' memories of past experiences for which users forget the details of their experience [17]. A person, when asked to express his feelings, opinions or impressions, may self-constrain himself if he senses that his response does not agree with what is expected or feels that is expected, depending also on the way the UX researcher is interrogating him. In other words, the perceived experience might not reflect the lived experience.

Additionally, when asked to evaluate his impression or opinion of his experience, the user assesses an overall perception to his experience; positive, neutral or negative. Details of the user's cognitive and emotional states during each step of his journey are mainly lost. Indeed, a user might have a good global experience, even though he felt some point of negative emotion during the execution of a specific task. Likewise, a perceived experience is always evaluated according to a personal scale. So, when assessing a score to his experience, a user will evaluate in a subjective manner his recent experience in opposition to his previous ones and the context in which he presently is. It is then more difficult for the UX researcher to generate a baseline.

In order to broaden the global portrait of a user's experience, UX researchers also tend to collect observational measures from an external point of view [18]. These measures generally enrich the two first ones by answering the question where the experience is happening (context), as well as completing the how by reporting the user's performance of his interaction with the system.

Subsequently, it is important to report all three of these types of understandings in order to have a global portrait of the user's experience. (Table 1) When all the enriched data is collected and analyzed, the next challenge faced by UX researchers is to communicate it to the design and development team and put it to practice [17]. For that reason, personas and CJM are becoming increasingly commonly used User Experience (UX) tools, since they give designers the possibility to explore and sketch descriptions of users and interactions with design proposals, which can be validated with real users [2].

Table 1. Advantages and Limitations of data typologies.

	Measures	Instruments	Advantages	Disadvantages and Limitations	Questions Answered about the User's Experience
Explicit data	Perceptual measures and Self-reported measures	Survey Interview Focus group	Easy to collect Summarize great amount of user's experience information	Biases: The human tendency of socially desirable responding users' past experiences Overall perception versus precision Self perceived scale	Why
Implicit data	Neurophysiological responses	Examples: Electro dermal sensors Electroencephalographic cask Micro facial recognition camera and software Eye tracking	Detailed lived experience in a timeline Baseline when calibrating the tools to be as objective as possible	Need instrumentation Costly Need of specific expertise to collect, postprocess and analyze the data	When What How
Observational data	Performance indicators	Examples: Camera Clickstream	Report all actions taken by the user and contextual factors	Limited in terms of understanding the user's emotional and cognitive state	Where How

2.2. Defining UX Tools

The persona is about creating global user portraits or an operational mental model [19] of a user based on UX research to generate patterns of needs, motivations, behaviors and emotions towards the product or service and other characteristics [20]. In other words, from the pool of potential users, segmentation according to common characteristics is performed to create these archetypal models of users. In this manner, the personas enable design, development, marketing and other teams to understand who the users are, what they want to accomplish, what motivations determine their behavior and how they experience the use, even going as far as to know how they think and how they make their buying decision. All the information is gathered in a narrative form in order to bring the persona to life, to humanize it and help to inform the resulting design decisions [21–23]. The main objective of the persona is, thus, to create a reliable and realistic representation of the user's patterns.

First of all, the persona helps to avoid the development team to design for themselves and become prisoners of their own environment [24,25]. Moreover, the focus of this tool is placed on specific users avoiding the trap of designing for everyone [26], which ends up as designing for no one. The persona also allows the designers to better understand both the intention and the context of human actions [27]. Finally, the information makes easier the prioritization in the discovery values, actions and motivations when designing the system and experience desired. However, personas also present some limitations. Firstly, the narratives can sometimes be too detailed distracting the development team and making it difficult for them to separate what is relevant and what is not [27]. In addition, personas are designed by user's goals and not by tasks, performance or satisfaction values. Subsequently, this tool does not allow the design team to understand the user's journey and experience through the interaction with the system. Personas are, thus, better suited to help in the conceptualization phase of the design process, but lack information when arriving at the validation phase. It is the reason why CJMs are also a common UX tool deployed in the design process.

The goal of a CJM is to create a better relationship between organizations and their customers or users. A CJM is principally described as a visual representation of the sequence of events a user is experiencing through his journey with a product or a service [28]. Thus, there are numerous aspects to consider when constructing one of them: (a) the user's steps and actions, (b) the user's expectations, (c) the user's perceptions, (d) the user's satisfaction and even (e) the user's demographic information such as cultural background which may influence his experience with the product, the service and his relationship with the organization [29]. It is thus important to always have in mind many fundamental aspects of the experience, which are, among others: (1) the touch points, (2) the emotional impact [30] as well as (3) the user's cognitive, social and physical responses towards the product, service or company [31].

For many authors, the user journey experience is the user's subjective interpretation of what a product, service or company represents and offers [32] in terms of usability: effectiveness (whether users can achieve what they want to do), efficiency (how long it takes them to achieve it) and satisfaction (their feelings and attitude towards the product) [33]. Consequently, most of the data collected in the user experience research and analyzed to build CJMs come from monitoring, observation, interviews, focus groups and surveys [33–35]. UX researchers principally use these techniques to collect the user's perceived experience when manipulating a product or receiving a service. Through observation, the researcher is able to identify and describe a sequence of events the user goes through when living the experience. Observation can also help to point out the touchpoints that represent barriers or, on the contrary, allow the user to successfully achieve his goal of use. The interview and focus group, for their part, are strategies deployed by the researcher with users in order to understand in more detail their perceived experience regarding the different stages they have been confronted with. This perceived experience usually translates into feelings of satisfaction or frustration. These techniques also allow the researcher to leave room for the user to express himself in order to better identify the needs, expectations and motivations of users vis-à-vis the ideal experience. Finally, surveys often complement the data collection strategies presented previously. The data coming from surveys are generally analyzed quantitatively with satisfaction measurements which give the opportunity for the researchers to create experience metrics [36].

Thus far, only Alves et al. (2014) [7] incorporate implicit data in the construction of CJM. They use Electroencephalography (EEG) and Eye Tracking to understand the cognitive and affective states of customers when experiencing a cantina service. These two instruments allowed them to quantify the users' experiences directly, providing their ability to infer customers' implicit awareness throughout a user journey [6,7]. Alves et al. (2014) [7] call for more research on enriching CJMs based on explicit measures with the introduction of implicit measures since they can help practitioners plan, train and execute UX evaluations.

As mentioned, the CJM can be based on different data sets collection and analysis strategies, which is often deployed in different steps such as (1) identifying a global understanding of the scope and its limitations, (2) pinpointing the primary and secondary touch points as well as (3) providing recommendations [37]. Consequently, the way UX investigators translate their research into a visualization differ in numerous ways. The most common form of representation is the presentation of the sequence of events the user passes through when living his experience of the product or service (Figure 1 [38]). This kind of visualization puts forward the primary and secondary touch points, as well as the order of the sequence. According to the richness of the data collected, the CJM can also be enhanced by adding a timeline and duration for each specific step as well as the level of user's satisfaction for each touchpoint identified (Figure 2 [30]). Finally, although rare, it is also possible to note some researchers that prefer a more statistical approach in the visualization of the CJM by putting forward the level of significance (the p-values) between the different touchpoints. This approach informs how the different experience aspects lived by the users influence each other (Figure 3 [39]).

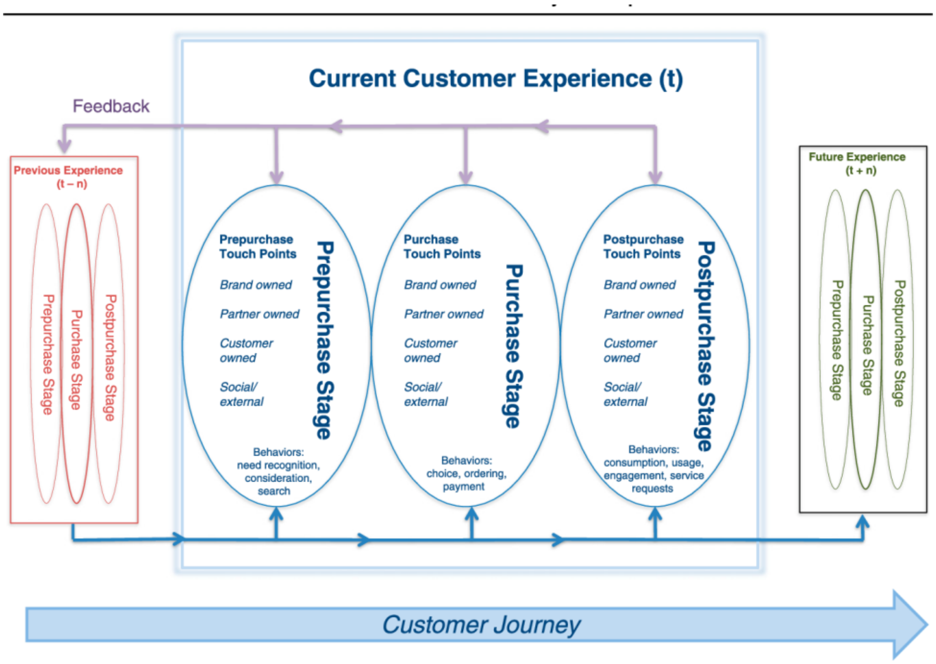

Figure 1. Customer journey maps (CJM) presenting the sequence of events [38].

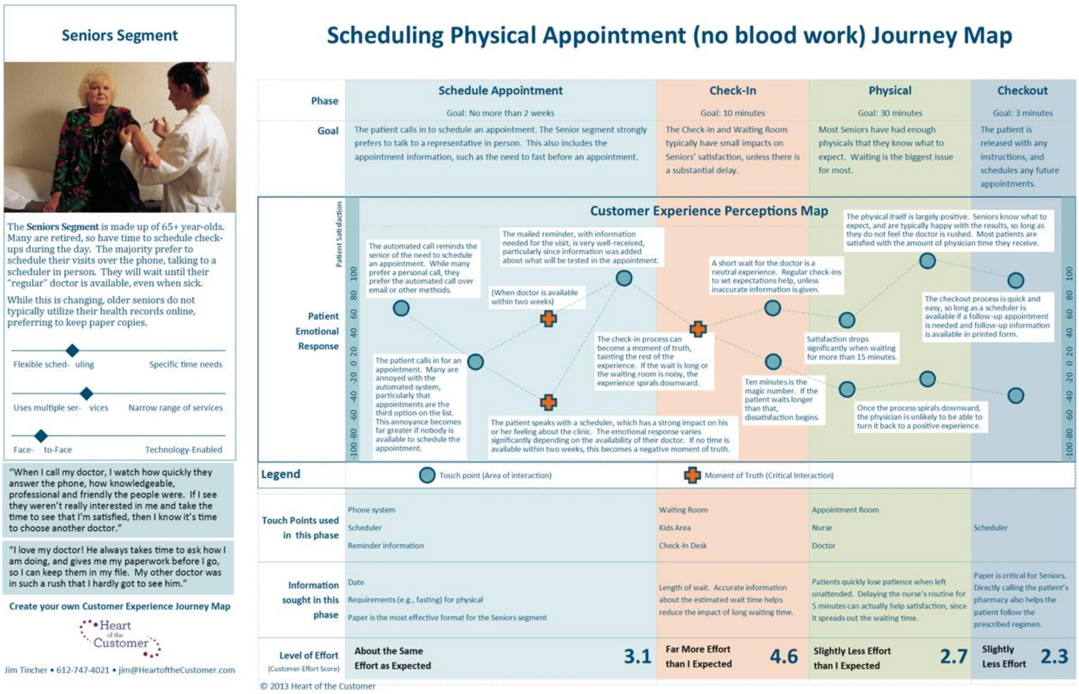

Figure 2. CJM presenting the satisfaction level for each User experience touchpoint [30].

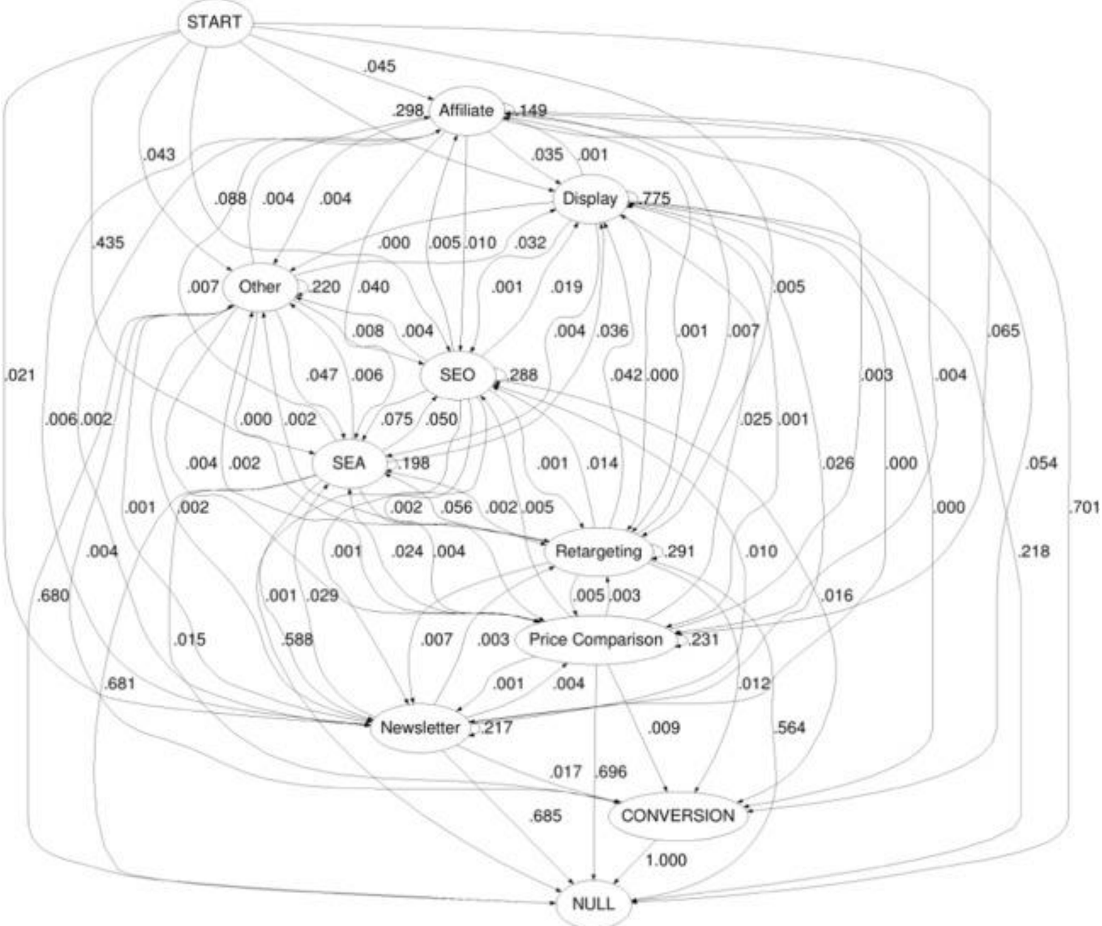

Figure 3. CJM presenting the level of significance between the touch points [39].

In sum, both personas and CJMs help to understand the user and his experience through the interaction with the proposed system (product, service). Table 2 summarizes the main characteristics of each tool.

Table 2. Summary of the Persona and Customer Journey map tools.

	Persona	**Customer Journey Map**
Orientation	Goal oriented	Task oriented
Presentation	Mostly narrative	Keywords Timeline
Design process step	Conceptualization	Validation
Common used instruments for data collection	-Surveys -Interviews -Group discussions	-Monitoring -Observation -Surveys -Interviews -Focus groups
Common used data analysis methodology	Verbatim	Touch points Statistics with satisfaction scales
Advantages	-Avoid self-perceived user by challenging assumptions -Understanding intentions and context of human actions -Prioritization of system requirements helping the design decision making -Require empathy for the user	-Having a global idea of the sequence of actions the user does through a timeline -Understanding intentions and context of human actions -Making a parallel in between the touchpoints and the user's needs and satisfaction levels
Limitations	-No implicit user information -Narrative with too much details	-No implicit user information -Lack of narrative details about user's needs and expectations, goals and skills

In this research, we develop a new method that combines both tools using observational as well as perceived, self-reported and physiological measures. Moreover, we propose a new approach for constructing and representing this data to help organizations better understand their users and their needs in every phase of the design process.

3. Method

3.1. Sample and Procedure

We conducted a multimethod data collection with 29 participants (17 males, 12 females) between 20 and 70 years old with diverse backgrounds who were recruited to participate in a UX lab experiment. In an experimental living room, each participant had to go through 4 main tasks: (1) unbox a new entertainment electronic device, (2) uninstall the old equipment, (3) install the new device and (4) return the old equipment. They were provided with a step-by-step instruction mobile application and an instruction guide that included 14 subtasks or steps. They were free to conduct the different steps of the task in whichever order they preferred. Consequently, the steps taken by participants did not all follow a linear pattern. The experiment ended when the participant believed they had completed the new electronic device installation successfully. The study was approved by the ethics committee of our institution and each participant received monetary compensation to participate in this study.

3.2. Apparatus and Instruments

Interviews were conducted before the participants started to interact with the system and afterwards. The participants were also asked to fill in three questionnaires, one at the beginning and two at the end of the experiment, in order to collect the participant's perception of their experience.

Three cameras were deployed around the task area in order to ensure that every manipulation done by the user was recorded. Those cameras enabled us to observe all the actions that could be reported in synchronicity with the other tools. We also strapped a GoPro camera on the user's chest to observe the manipulations (Figure 4). Finally, the user wore a mobile EEG headset and had electrodermal sensors (BIOPAC, Goleta, CA, USA) on the palm of his hand. All videos and neurophysiological signals were recorded and synchronized with Noldus Observer XT and Syncbox (Noldus Information Technology, Wageningen, The Netherlands) (Figure 5). All the synchronization was done based on Léger et al., (2014) guidelines [40,41].

Figure 4. Three cameras were installed around the task area (**Left**) and 1 Go Pro camera on the chest of the participant (**Right**).

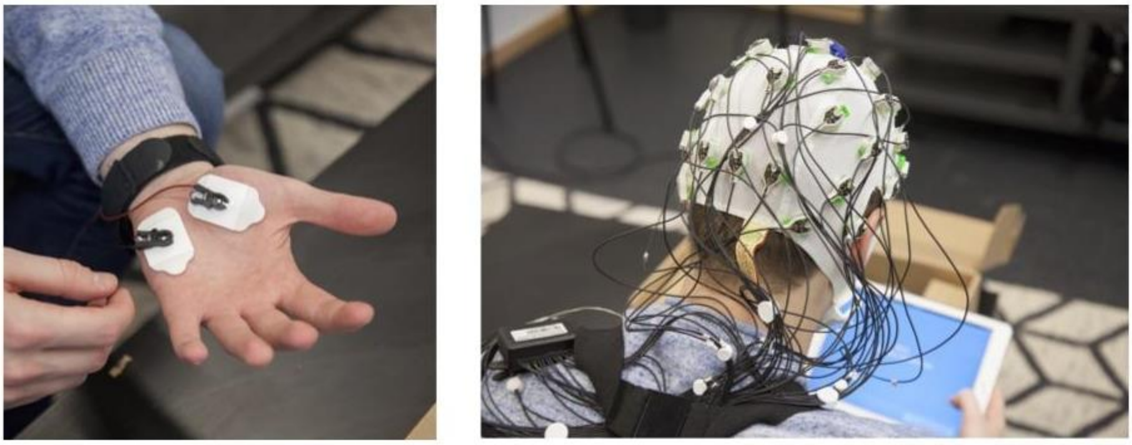

Figure 5. EDA Sensors (**left**) and electroencephalography (EEG) Headset (**Right**).

The EEG data was recorded from 32 Ag-AgCl preamplified electrodes mounted on the actiCap and with a brainAmp amplifier (Brainvision, Morrisville). We used NeuroRT (Mensia, Rennes) software for the EEG processing of the data. The acquisition rate was 500 Hz and FCz was the recording reference. Thus, we performed preprocessing steps in this order: down-sampling to 256 Hz, bandpass filtering with an infinite impulse response filter at 1–50 Hz, notch filtering at 60 Hz, blink removal through blind source separation, re-referencing to the common average reference and artifact detection by computing the riemannian distance between the covariance matrix and the online mean and removing the data when artifacts were present. A filter bank was used to isolate the following bands: alpha (8–12 Hz), theta (4–8 Hz) and beta (12–30 Hz). Valence was calculated as frontal alpha asymmetry, i.e., the difference between F3 and F4 in the alpha band (Reudering, C Muhl and P Mannes P + Davidson). Cognitive load was calculated with the formula beta/(alpha + theta) using the sum of channels F3, F4, O1, O2 [42].

3.3. Measures

The interviews were conducted to know about the participants' past experiences, needs and expectations as well as to measure their level of knowledge (novice or expert) concerning the installation of a new electronic device. The questionnaires' questions were structured in order to understand the user's self-efficacy [43]. For 6 different situations, the participants had to self-evaluate their motivation and capacity on a scale of 6 (completely true to completely false).

With the deployment of all these instruments, we were able to measure, for every main task and subtask, the participants' cognitive engagement [42] and valence [44] as defined by encephalographic activity. Cognitive load was calculated with the formula beta/(alpha + theta) using the sum of channels F3, F4, O1, O2 [42]. We also measured the participant's arousal in accordance with his skin conductance (Riedl and Léger, 2016) [45] when interacting with the system.

The success rate was evaluated with different performance indicators such as the completion of the task, the accuracy of the connections for maximizing the signal and the firmness of the cable fastening. Thus, success was achieved when the participant completed the installation with few or no mistakes. At the end of the experimentation, we did not tell him if he succeeded during the different tasks performed. Motivation, capacity and knowledge were assessed with interviews and questionnaires. We measured the user's installation motivation using a single item question developed specifically for this study (ranging from 1 (low motivation) to 10 (high motivation)) (Table 3).

Table 3. Summary of the data collection and analysis methodology.

	Instruments	Purpose	Analytical Program Used	Authors
Implicit Data	EEG_ Brainvision Electroencephalographic cask EDA_BIOPAC Electrodermal sensors	Measures user's cognitive engagement Measures user's valence Measures user's electrodermal activity	NeuroRT Mensia Acqknowledge	Pope et al., 1995 [42]; Davidson, 1992 [46]; Boucsein, 2012 [47]
Explicit Data	Surveys_pre and post experience Interviews_pre and post experience	Measures user's self-efficacy (concerning the self-reported motivation and capacity) Open question to better understand user's knowledge and expectations	Qualtrics Optimal workshop	Bandura, 1977 [43]; Goodwin, 2011 [48]
Observational Data	4 cameras (3 static and 1 Go Pro)	Identify user's behaviors in their interaction with the system as well as their workflow Evaluate, with the help of pre-determined indicators, the user's performance in succeeding or failing a specific task	Noldus Observer XT and Syncbox	

4. Results

This methodology enabled us to collect a great amount of explicit as well as implicit data. With all the data, we were able to construct an enriched CJM by following three main steps: (1) a statistical analysis following a Curve clustering methodology in order to extract, from the workflow, four different behavioral patterns, (2) a fine analysis of the encephalographic and electrodermal activities in order to shed light on the representative level of cognitive engagement, valence and arousal for each cluster and finally, (3) the analysis of the users' perceptions, knowledge, expectations, needs and recommendations in order to support the results of the two first ones, complement them and tell the users' stories.

4.1. Step 1: Inductive Statistical Approach

After extracting and post-processing all of the data, we were able to observe different workflow configurations depending on the order the participants performed the different tasks and subtasks. To confirm our hypothesis, we performed a Cluster Analysis [49]. The Cluster Analysis is a statistical method used in order to divide the observations and data into different groups and to better understand how the participants performed the tasks and subtasks during the experimentation. This method was used in many fields and especially in marketing segmentation. Even though there are many classification systems and algorithms for clustering analysis, the k-means procedure [50] seems to be the most relevant and robust hierarchical method.

We based our cluster analysis on the participant's workflow (i.e., the sequence of subtasks performed) because of the nonlinearity of the experiment. Following the curve clustering definition, we wish to demonstrate two things: (1) that behaviors are similar within a same segment and (2) that behaviors are different in between the segments. First, to induce similarities within the pool of participants, we draw for every participant a curve of his workflow in a graph where the x-axis represents the steps executed and the y-axis, the subtask completed. We then group the participants who had similar patterns according to the order in which the tasks were completed. Three clusters were identified based on the 14 subtasks defined as 14 main steps. (Figure 6) Participants who did not perform all the subtasks identified in the experience, or in other words, users who completed less than 14 steps, formed the 4th cluster.

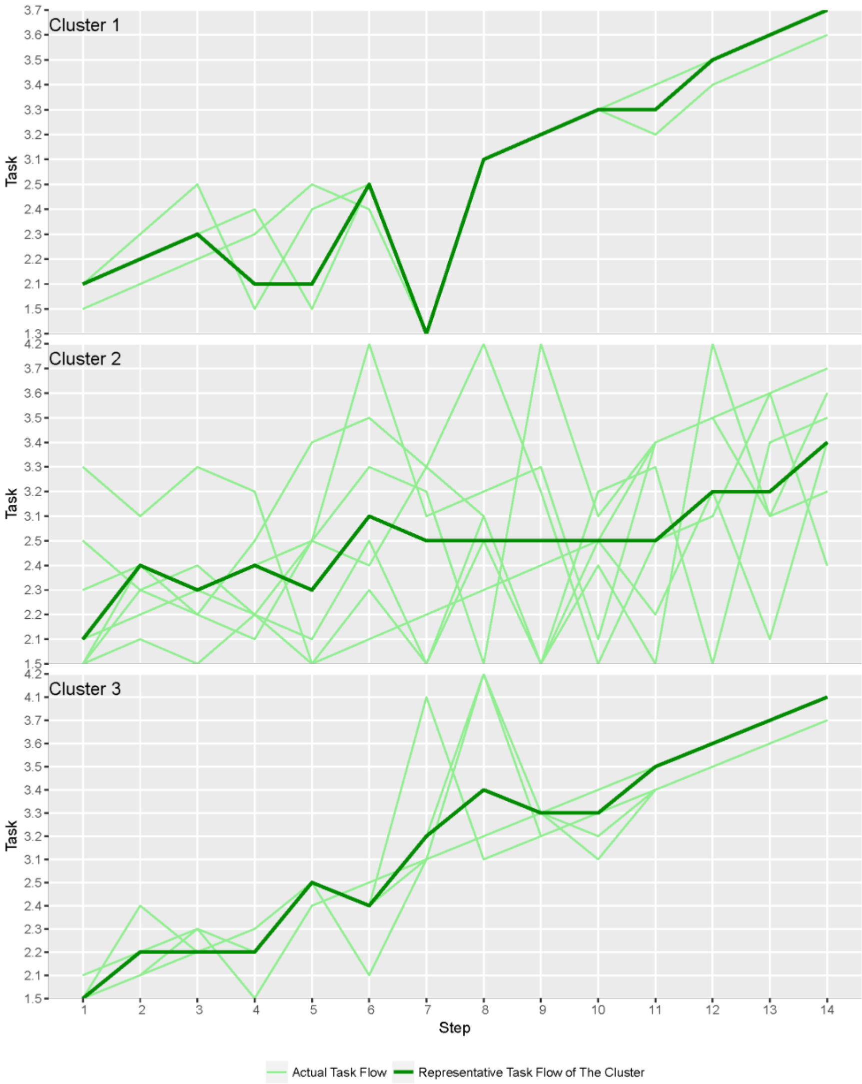

Figure 6. Curve Clustering graphs (3 clusters).

This graphic represents three distinct patterns and the workflow for each participant. As it is possible to notice on this graph, each cluster was named with a specific number as we wanted to compare the differences between each variable. To test statistically the differences between clusters, we used a Fisher Exact Test. We compared how each cluster differs on two key variables: if the user read the instructions and when ((1) at the beginning, (2) after starting the experience or (3) never, as well as if he succeeded in performing the tasks); success, partial success or failure. (Figure 7) Concerning the reading of the instructions, the curve clustering graphs allowed us to define easily the key moment in the timeline of steps when participants of each cluster did it. This variable already gave us an indication of cluster differentiation: Cluster 3 read the instructions at the beginning of the experience as opposed to Cluster 1 and 2 that read the instructions after starting the experience. Participants of Cluster 4 never read the instructions. Thus, we were able to compare the different proportions and found that there was a significant difference between each cluster except when we tested the first cluster versus the second one.

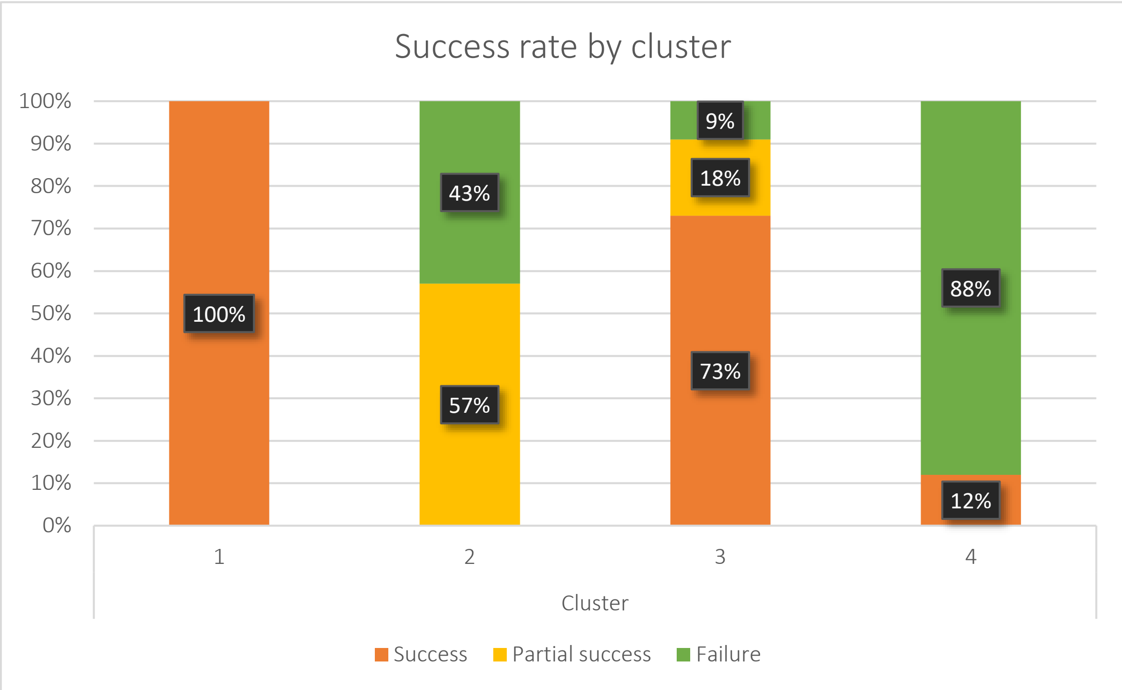

Figure 7. Success rate by cluster.

Due to the difficulties of the organizations to clearly understand and interpret this kind of graphic, a new data visualization model was mandated. Moreover, we were curious to analyze how the participants of each cluster lived cognitively and emotionally the experience in order to identify the potential friction and opportunity points.

4.2. Step 2: User's Cognitive Engagement, Valence and Arousal

As we noticed no (or little) significant difference between clusters for the participant's overall valence, arousal and cognitive engagement during the experiment (Figure 8) (although there may seem to be a difference between the clusters when looking at the user's arousal, the low number of participants in each cluster does not allow us to pinpoint a significant difference), we decided to identify every subtask in order to describe the evolution of the users' cognitive and emotional states. This triangulation of data allowed us to better understand the actual experience lived by the users during the execution of each task and subtask. Moreover, it allowed us to pinpoint the friction points encountered by the users during their experiential journey.

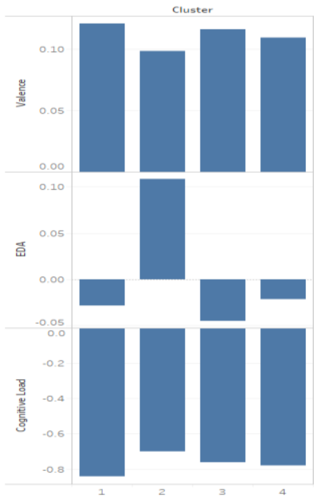

Figure 8. Participants' overall valence, arousal and cognitive engagement during the experiment.

To visualize it in an accessible way, the three physiological aspects of users were represented in one single image: a color circle (Figure 9). First, the size of the circles represents, from the smallest, a minimum effort to the greatest, a major effort. Second, the valence of the user is illustrated by different color tones. The darker the color, the more negative the emotion is. Finally, a scale on the y-axis represented the user's arousal from bottom "somnolence" to "alert" at the top. By representing the four clusters in this type of visualization, it was easy to identify which task and subtask represented a challenge in terms of cognitive efforts and represented a stressful and frustrating experience in terms of negative emotions and high arousal.

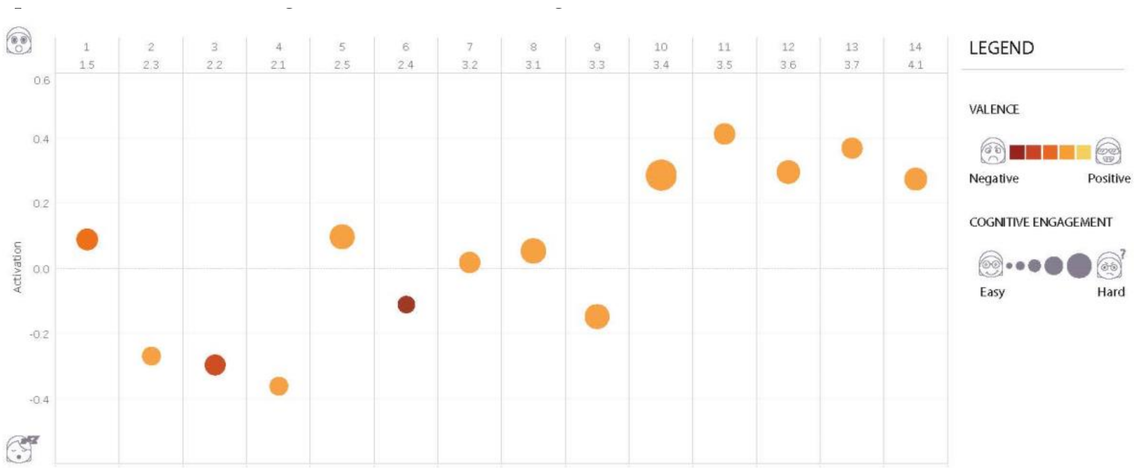

Figure 9. Visual representation of the three physiological aspects of user's experience (cognitive engagement, valence and arousal.

4.3. Step 3: Qualitative Data to Story Tell the Customer Journey

Once the CJMs based mainly on the physiological data were generated, we enhanced them with an analysis of the qualitative data collected during the experimentation (observations, surveys and interviews). This analysis allowed us to name the cluster and to tell a story that was able to explain the reason of the different friction points lived by the users and, moreover, to identify some opportunities for improving the product.

Thanks to the information obtained through the surveys, the personas are better constructed and more detailed allowing us, thus, to understand what type of user went through that specific journey and sequence of steps. This same information also helped to identify the user's aspects that were statistically significant and influenced the user in his experience of the product. (Table 4)

Table 4. Presentation of the 4 personas.

	Number of Participant	Success Rate	Self-Perceived Motivation (1-Low to 5-High)	Self-Perceived Capacity (1-Low to 5-High)	Electronic Knowledge Level (1-Novice to 5-Expert)
Persona 1. The Clever	3	100% succeeded	2	2	2
Persona 2. The Distraught	7	57% succeeded partially 43% failed	3	3	3
Persona 3. The Applied	11	73% succeeded 18% succeeded partially 9% failed	1	2	2
Persona 4. The Presumptuous	8	12.5% succeeded 87.5% failed	4	3	2

Our main objective with these personas and augmented journey maps was to tell a story about each cluster and provide a new way to communicate an array of implicit, explicit and observational data to designers and development team in order to facilitate the design process. The users' perceived and self-reported data are presented in a column at the left side of the CJM where users' gender, age, motivation, capacity and knowledge level are indicated. The observational data are presented through the success rate and the tendency to read or not read the instructions. Additionally, the contextual data monitored through observation are found in the story description at the top of the CJM. Finally, the users' physiological responses are represented according to the task's completion order through colorful circles in the middle of the CJM. We named the personas based on psychophysiological data patterns and qualitative data (interviews, observations, surveys). (Figures 10–13)

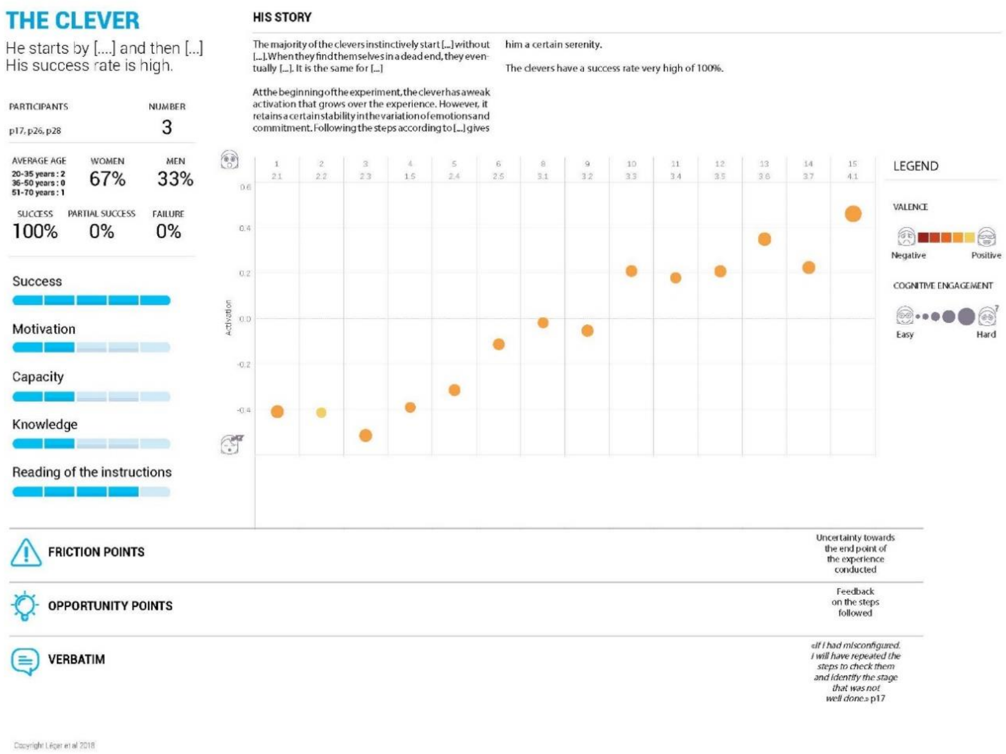

Figure 10. CJM of the Clever.

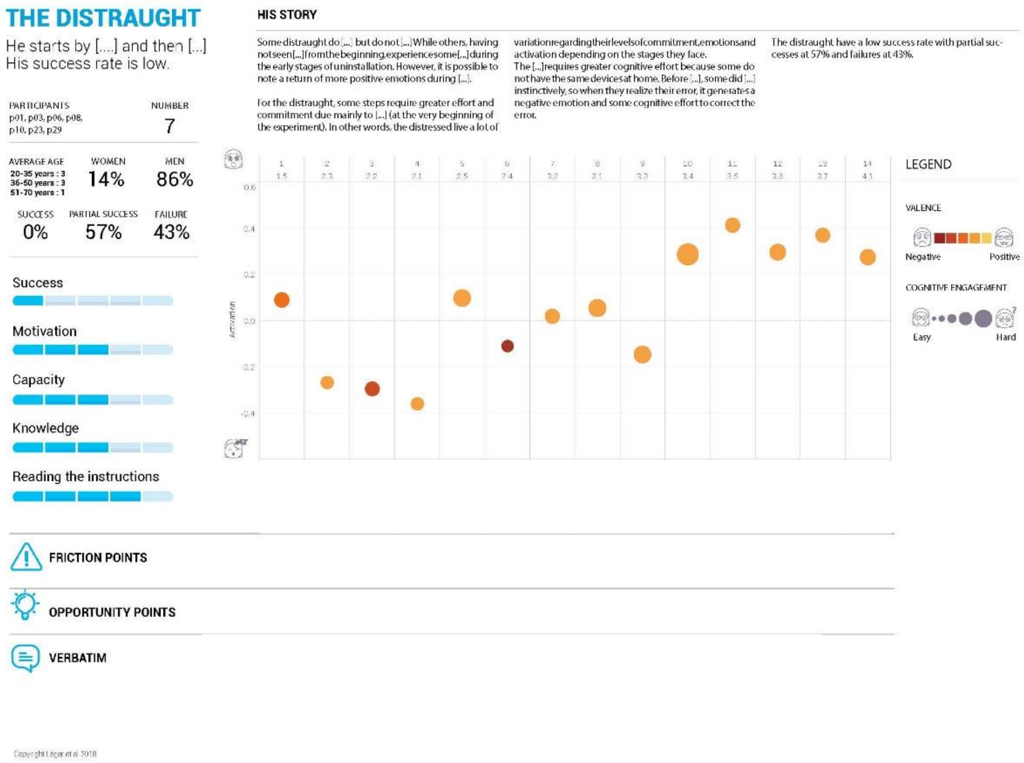

Figure 11. CJM of the Distraught.

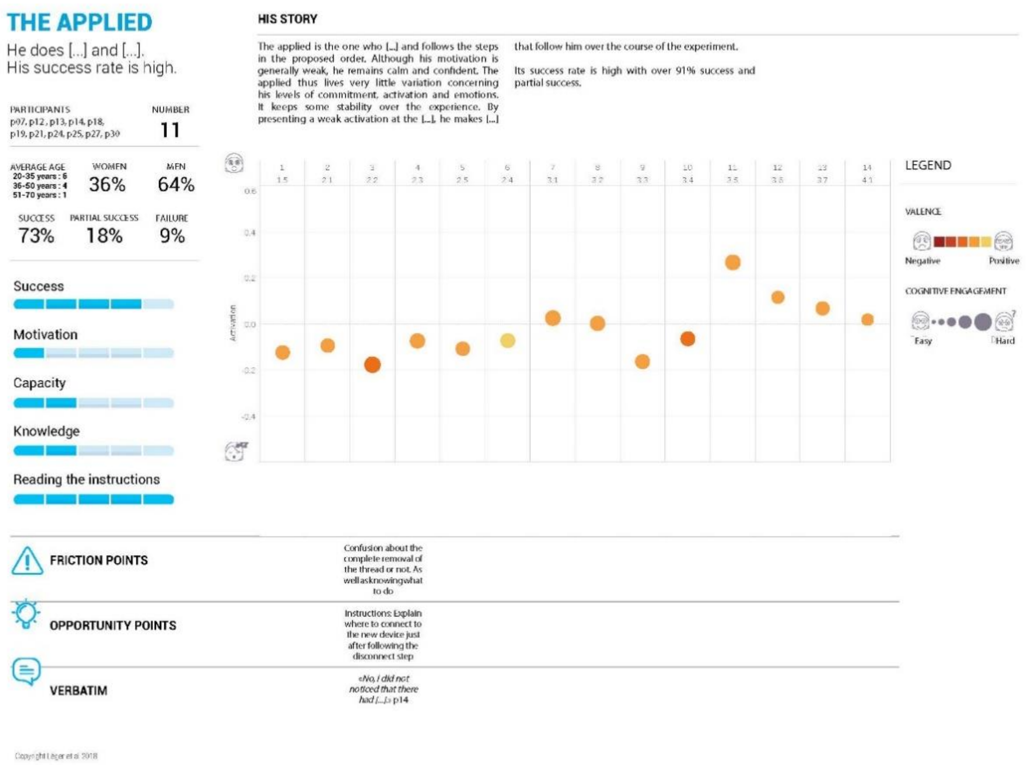

Figure 12. CJM of the Applied.

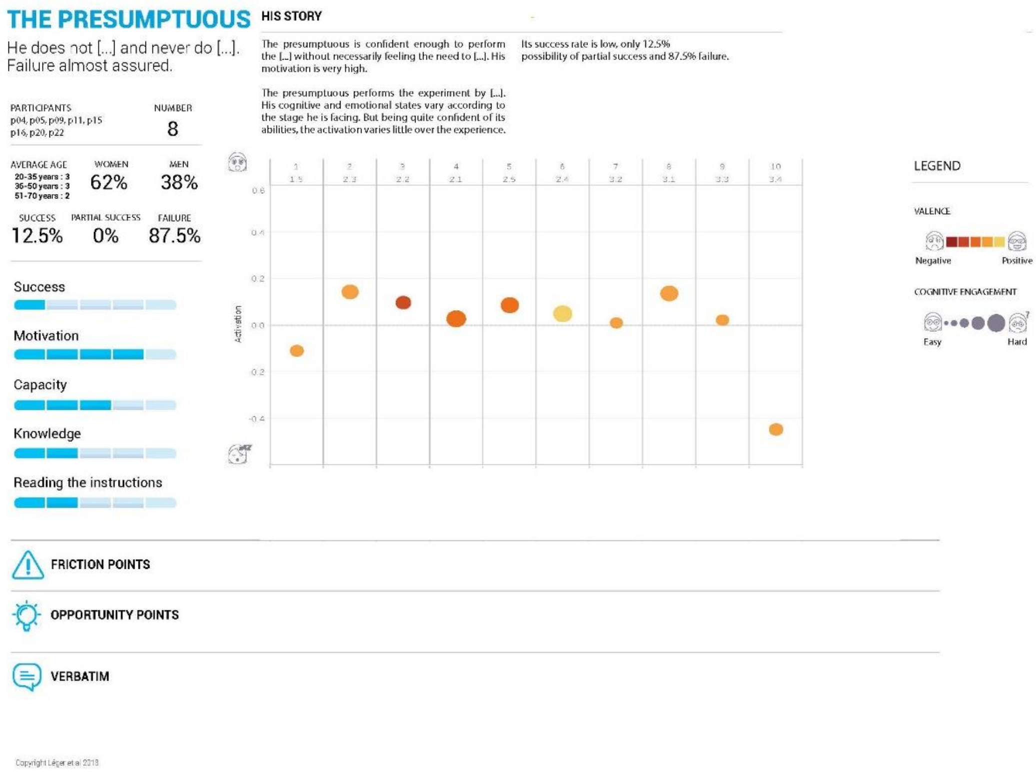

Figure 13. CJM of the Presumptuous.

To better understand those journey maps, we decided to analyze one task in particular and explain it with our four clusters. At first glance, it is possible to notice that each of the personas goes through a sequence of different events presenting a non-linearity of the experience differentiating each type of potential user. Moreover, each persona lived the same task in different ways and in different moments. Let us take, for instance, the task 1.5. The Distraught and the Applied completed task 1.5 as their 1st step in their journeys. However, they experienced it completely differently. On one hand, the Distraught was more cognitively engaged and animated, which also influenced negatively his emotion toward the execution of that precise task. On the other hand, the Applied was serene (low activation) when executing this task. Thus, even though his cognitive engagement was as important as the Distraught, his emotional state was more positive. The Clever, meanwhile, completed that task as a 4th step in his journey and lived it with a low average cognitive engagement, a neutral emotion and with little excitement. In other words, the Clever lived the 1.5 task with a neutral state, not giving it a special importance. Finally, most of the users illustrated by the Presumptuous persona did not execute the task. However, the one that did, experienced it as a first step with an average mental effort, a neutral emotion, neither positive nor negative and with low excitement. With only those implicit measures, we can conclude that for the Distraught and the Presumptuous, this task is considered as a Friction point which it is not for the Applied and the Clever. Nonetheless, it is impossible to know the reasons of this friction: The Why?

The interviews, in turn, mainly helped to present the user's perception of their experience. The resulting verbatim was put forward to better understand and explain the reason of the friction points lived by the users. It also helped to identify some improvement opportunities and even make some recommendations. In other words, the story told by the users and captured through observation, surveys and interviews gave life and humanized the personas statistically constructed with quantitative data. Moreover, it helped us to better understand the empirical results. For instance, we first notice an important cognitive engagement and a negative emotion of the presumptuous when realizing the task 2.2. When investigating the reason for this negative physiological response, we were able to understand that this uninstallation subtask was unclear for those users. When the time to disconnect the specific cable came, those users were confused about the reason of the action, as well as its consequences in the realization of the subsequent subtasks. The verbatim helped us understand that this vagueness made the participants uncomfortable and doubt themselves. From the better understanding of friction points, we then were able to propose alternatives to the way instructions were made and visual design clues were presented on the electronic device.

5. Discussion

Essentially, this research presents the interest of bridging the different types of measurements (explicit, implicit and observational) when understanding the user's experience in its totality. First, the collection of observational data allowed us to identify the key moments when the user was doing a task or subtask, the order in which the user was doing it, the time it took to complete them as well as the success or failure of their execution. Secondly, the collection of implicit data enabled us to understand with a lot of precision how the user reacts unconsciously when interacting with the system. Thanks to the precision these typologies of data allowed us to have, we were able to determine for each task, the cognitive and emotional user's state, and therefore, identify the main friction points lived by the user. Moreover, by pinpointing which state is more affected, the cognitive, the affective or both, it made it easier to shed light on specific recommendations. Finally, the collection of explicit data provided us the information to better understand the user's overall expectations, needs and level of knowledge, motivation and capacity to realize the tasks asked. These data, presented under the form of verbatim and different scales, enabled us to tell a story, give names and humanize the user in the eyes of the development team. Moreover, this data gave supplementary solution's outlines. In other words, bridged all together, the observational, the implicit and the explicit data enabled us to understand the user's experience in a holistic perspective by drawing a complex two scaled portrait where the user's unconscious reactions are evaluated with precision and the user's conscious reactions are examined overall. Thus, we were able to identify every friction point lived and perceived by the user. By making this differentiation, we were able to better target and define the opportunities and solution outlines. Our main objective with these augmented CJMs is to tell a story about each cluster representing different target user segments and providing a new way to communicate both implicit and explicit users' experiences to organizations.

5.1. Contribution for Theory

As we mentioned at the beginning of the paper, personas and CJMs presented in the literature are mainly built on observational and explicit data coming from the user's personal perception. To our knowledge, few papers acknowledge the interest of integrating the implicit data or, in other words, the unconscious reactions of the user when interacting with the system. Thus, this paper contributes to the theory of design in different ways. First of all, it introduces a very detailed methodology that explains not only how to make the best of the observational, implicit and explicit measurements but also how to bridge them in order to tell an interesting story about the users and their experience. Secondly, this paper presents a novel way to visualize and communicate complex and enriched data that, otherwise, is not always accessible to industrial partners.

5.2. Implications for Design Practice

Consequently, on one hand, this research aimed to explain the importance of collecting and analyzing three types of measures, the observational, the implicit and the explicit data, in order to ensure that every question about the user could be answered. Moreover, for the design practice, this paper explores the advantages and limitations of both common UX tools, the persona and the Customer Journey Map when combining lived and perceived user's experience.

Enhancing the Customer Journey map by adding implicit data, offers new information that can be crucial to the design process. For example, in this study case, while making the experimental design, the development team was anticipating many difficulties for the users in the completion of the task 2.5 because of a technical maneuver they were asked to perform. Thanks to observation, it has been possible to note that, as anticipated, most of the users presented some struggles in executing this precise task. The interviews and questionnaires offered complementary information by revealing a confusion about the nomenclature of the unknown object. However, the implicit data revealed complementary information to add to the story. The majority of the users presented a positive emotional and cognitive state when executing the task although they expressed it as being difficult. Consequently, in this precise case, the design team can infer from this global portrait that the difficulty of performing this task is not related to the manipulation of the object as anticipated, but by the way it is presented. While challenging the user, a positive emotion emerges from succeeding or understanding how to do it autonomously; a positive emotion that could be interesting to keep. Hence, when all this data is put together, an enriched story emerges.

This Enriched Customer Journey map gives the designer the opportunity to have, in one visualization tool, an overview of the user's profile (age, sex), motivation, capacity, knowledge and success rate in performing specific tasks as well as his journey experience based on his workflow, cognitive load, valence and activation for each task completed. All this information mutually completes one another by answering the who (persona/user), what (system validated), where (context), when (timeline), how (user's workflow; cognitive engagement, valence and activation for every task done) and why (narrative of the experience) of the user's experience. Consequently, by shedding light on the implicit and explicit user's experience, this tool offers a global portrait of the users for which the system is being designed. In brief, this Enriched Customer Journey map puts forward the advantages of both the persona and the Customer Journey map.

In the practical field, designers are also searching for guidance to project the next phases of a product or service development as well as for new products or services. Theses maps are an interesting tool to help the designers pinpoint the friction points to target for future developments. In other words, these maps can help designers sketch the design recommendations and design principles.

From these maps, designers can also create customer experience scorecards that could help them evaluate and validate their products and improvements throughout the customer journey. These experience scorecards created accordingly to the customer's needs, expectations and how he or she reacts to the different interaction designers build for him or her, are a constant reminder to put the customer in the center of the development.

Additionally, the clustering analytical process enables the design team to draw behavioral, emotional and cognitive patterns amongst the targeted users, according to what information is prioritized. Indeed, when confronted with the user's journey, the clusters give the design team the opportunity to avoid the amalgam of journeys in one single typology. Instead, the clusters shed light on the user's diversity and enables the design team to choose which one to target when developing their system and system's experience.

5.3. Implications for Experimental Design Practice

On the other hand, because one of our concerns was to ensure the collection of an array of information about the user's experience, the challenge for this case study was to set up an experimental design that deploys and synchronizes an arsenal of different instruments. Indeed, as we wished to make the experience for the user as authentic as possible, we gave them the opportunity to move and manipulate the objects as they saw fit. This complicated not only the laying of collection instruments on the participant (EDA, EEG, Go Pro) but also the way to limit the noise in the data. Subsequently, we restricted the participants' movement possibilities by positioning all the objects to be handled in the same work area as well as on a specific height allowing us to better position our cameras and ensure viewing the participant's manipulations and reactions at all time. In addition, light sensors were strategically positioned inside the room so at least one camera could capture a light signal every 120 s. This signal helped us to synchronize manually the cameras with the other instruments when needed. This R&D and learnings helped us to identify the strength and weaknesses of this type of experiment and then, better align the next experimental designs.

5.4. Limits of This Research

This work presents a first reflection on how to generate a communication tool that helps to facilitate knowledge transfer coming from the UX in-depth research field (which includes neurophysiological and psychological data) to the practical design process field. Understandably, as a first attempt to propose a novel representation of user experiences, this case study presents some limitations. First, in order to present a spare visual tool that helps to communicate the critical information of the lived and perceived user's experience, the proposed Augmented CJM withdraws the narrative details of the user's needs, objectives, expectations and satisfactions. This lack of information, essential during the conceptualization phase of the design process, can represent a disincentive to its use. Moreover, this proposition is based on one specific case study. Consequently, it is still difficult to know the potential of this tool and the way it can be applied in practice.

5.5. Future Research

This research presents different theoretical novelties for the User Experience field. First, the paper demonstrates not only the interest of integrating different types of measures and data when studying a user's experience, but also an interesting approach to analyze them and bridge them together in such a way as to tell a coherent story. Indeed, our research team went through different statistical and analytical methodologies until finding a novel path to ensure the construction of a methodology that enabled the construction of an accessible and vulgarized communication tool. Moreover, the workflow clustering methodology to analyze and communicate all the enriched data is also a novelty presented in this paper. However, many questions related to this choice appear. For instance, on what aspect of the user's experience can the clustering analysis be done beyond the workflow if tasks are performed in order? What other information can be revealed? With the objective of building a Customer Journey Map, what are the limits and possibilities of such a methodology?

6. Conclusions

Yet, in just this case study, this Augmented Customer Journey map presents an array of rich information that attracted different departments within an organization. In the specific example of this case study, the first step in the user's experience was an unboxing task. Consequently, the user's cognitive and emotional reaction to seeing the box, opening the box and manipulating for the first time the equipment in the box influences the success or failure of the rest of the tasks, as well as the global user's experience [51]. Thereby, it provided crucial information for the marketing and communication department which were transformed in helpful design requirements. Indeed, the Enriched Customer Journey map is a versatile tool that can be used beyond design teams and may prove useful to other departments within any organization.

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