

The Role of Annoyance in the Interaction Design for Ethical and Behavioral Transformation

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ABSTRACT

This paper reports on research carried out to investigate the role of annoyance in the design of interactive systems aimed at enhancing the users' awareness of the issue Energy Consumption through an ethical reflection. Two different research-through-design short projects, *The Spray Lamp* and *The Noisy Shower*, have been developed in order to inquire into the possibility interactive systems have to elicit ethical reflection in users when annoyance and fulfillment are combined together. By reviewing some of the recent studies within the area of design for transformation, a theoretical framework on the effects produced by the combination of annoyance and fulfillment on the phenomenology of awareness, when interacting with intelligent systems, is elaborated and employed to develop the research project. Finally two separate tests and related analyses are performed. The general aim of this research is to understand how and to what extent combining annoyance and reward in the design of interactive systems, can be effective in transforming ethics and behavior of users.

Author Keywords

Ethical change; transformation; awareness; energy consumption; annoyance; shock; fulfillment; reward; interaction design; intelligent systems.

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): User Interfaces – *theory and methods, input devices and strategies, interaction styles*.

INTRODUCTION

Looking at the history of design in the West over the last two centuries, transformation, meant as a radical change in the everyday practices, in the way people are in the world as well as in the way they relate to each other within the complexity of a more and more sophisticated society, has

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always been a main trait of the protagonists of design culture. From the prolific creativity of Josiah Wedgwood, committed in the campaign for the abolition of slavery since 1787 [1], to the great project of social transformation of Bauhaus school and its leaders, passing through the social criticism of William Morris whom rejection of industrial civilization inspired several generations to come, the need to change the social paradigms people reproduce in the industrialized mass society by intervening within the material culture context, has characterized the history of design to the present day.

A main aspect which binds together the above mentioned personalities and experiences, is the challenging of the state of things, namely questioning the current dominating order, aiming for a different paradigm of society and humankind. Especially in the past century, such a challenge was dealt with breaking the existing schemes in a radical way; often making use of provocative design interventions. Shocking the audience, especially in art, but also in design, was a strategy to elicit awareness about social injustice and ethical issues. The reflection concerned by the present research is inspired by the historical role of shock, meant as a radical subversion of a normal and normative moral order, and drives the inquiry into the possible design strategies aimed at ethical and behavioral change in users. Is the belief of the undersigned that awareness and related change are fostered by profound experiences which often disturb the human soul. As transformation is by definition the disintegration of the old models and the establishment of new ones, a disrupting event is necessary in order to trigger such a process.

In this paper the strategy and the limitations of designing for ethical and behavioral transformation, are investigated by developing two short research-through-design projects where annoyance and fulfillment are combined together. In the first part, a brief review of some recent studies addressing social and ethical transformation, with particular regard to the inquiry into the *transformative qualities* in interaction design [2], is undertaken. It follows a discussion on the similarities between the reviewed works and the present research. Consequently, the issue World Energy Consumption is illustrated focusing on the role of design in changing the

users' behavior. A discussion on ethics in design for transformation and the proposal of a theoretical framework, draw the conclusions of this first part of the paper. In the second part of the paper, the design research process is illustrated by reporting both the stages of the design (concept and prototyping) and the performance of the test. The analysis conducted employing qualitative research methods and the findings, conclude the research paper.

DESIGNING FOR TRANSFORMATIVE QUALITIES

Recent studies

Some recent works addressing social transformation in the design field [2][3][4][5][6], though indebted historically to the Radical Design and assimilated movements, they are the bearers of a different and new paradigm which relates to the huge change society has undergone in the last forty years. One of the greatest differences lies on the role of technology and its being intertwined with cultural, political and existential matters. The ubiquity of advanced technological objects and systems in the contemporary society, leads these researchers/designers to addressing the interaction between human and computer (HCI) from a design perspective, not only focusing on the usability and efficiency, but also on the psychological, social and ethical implications of such an interaction [2]. Another aspect which significantly distinguishes the current movements aiming for social transformation from those of the past, is the foundation of specific research fields, supported by academic communities within a high cultured environment [5] and often financed by public funds. The merit of such a cultural investment is having made research rigorous, employing a systematic approach to the production and dissemination of knowledge. On the other hand, though a few attempts to walk out of the academic context [7], the communities inquiring into the possibilities design has to transform society radically, seem to struggle with offering a proposal accessible by most people either in terms of speech intelligibility and from the point of view of practicality (e.g. [5]). As a result of such a sheltering behind academia, another aspect alienates the nowadays claims to transformation from the radical experience of the 60s and 70s: the reconciliation with the established order. Growing within a regulatory environment as university is, leads to accepting institution(s) as a given fact, an indisputable precondition of any research project from which to start. The revolutionary nature which characterized the radical movements of the last century, based on the rejection of institution(s) as such, has been replaced by a softened stance mostly addressing the individual sphere, where people are already framed as users and the historical roots of the generation and development as well as the veracity of their needs, are never questioned.

Similarities with the present research

Regarding the concept of *transformation*, it is worth to mention what links this research with the inquiries conducted by the above mentioned researchers, especially with regard to [2], currently working on what can be defined as "design for transformation". A few points of agreement can be found between the two: 1) role of design and scope of transformation; 2) methodological approach to designing; 3) focus on ethics.

Role of design and scope of transformation

As "*the elementary role of design is to design artifacts embodying value propositions*" [2], a deep change in people's behavior and conception of life can only be achieved by dealing with the complexity of the interaction between people and artifacts ("space") within a specific system of relationships ("context"). Such a complexity lies in the proliferation of phenomena occurring simultaneously in the relationship human-environment, where the difficulty to identify the elements of such a system and to predict the origin, development and outcome of their relating to each other, makes hard the assessment of the design beforehand. Acknowledging the multidimensional nature of the phenomena constituent such a complexity, means dealing with both material and abstract aspects, trying to unravel the multiple knots which tie them together and to understand the dynamics of their relationships. The framework proposed by the researchers [2], though oversimplified by identifying only three main spheres of intervention, depicts the need to consider such a multidimensional character of the human experience in order to make the transformation deep and significant. In other words, as "*meaning [is] created in-between the human being and the world, based in the sensorimotor coupling between the two*" [2], the scope of transformation can only be multidimensional, involving practice and theory, perception and intellect, feelings and thoughts, etc.

Methodological approach to designing

The continuous transformation(s) and change(s) of the world induced by the ubiquity of design, makes hard the definition beforehand of the means by which the design process can be assessed. As "*the way we design and the way we assess our designs are dynamically interrelated*" [2], the evaluation criteria have to be flexible and related to the specific design process. Although defining such interrelations does not mean assessing the design a priori and it is possible as well as necessary, the acknowledgment of the unpredictability of the outcomes of a (research) design project, extends the creative potential of design. Moreover, considering design as part of the world being changed and, therefore, undergone to a change it itself, results in a more intellectually honest proposition than establishing universal self-proclaimed principles. Therefore, allowing the process to suggest designers how to change the criteria of the as-

essment in a research-through-design approach which favours “*reflection in and on action*” [2], seems to be suitable to the complexity of designing for transformation.

Focus on ethics

Despite the lack of a clear definition of the kind of ethics the researchers want to address [2], claiming the need to “*incorporate ethics and its values as a deliberate focus in the design process*”, introduces both an extension of the *raison d'être* of design research towards a more profound dimension, addressing existential matters and a metadesign intervention about methodology. As the focus is intended as dynamic and subjected to change [2], ethics constitutes only one aspect of the transformation. However, as the researchers stress the goal of “*enabl[ing] people to reach a higher level of awareness and of skillful engagement on ethical challenges*”, ethics, meant as the capability of being engaged in reflection(s) about moral principles, plays a huge role. In other words, ethics is seen as fundamental part of the phenomenology of awareness and, more in general, the dynamics of change/transformation.

WORLD ENERGY CONSUMPTION

A multifaceted issue

Production and consumption of energy are capital for the human existence itself, especially in the light of the exponential economic and demographic growth which has characterized the last two centuries [8]. As a consequence, the issue World Energy Consumption and the related sub-topics such as energy development, waste management, pollution, economic warfare, etc. have become primary in the international affairs and a key priority for almost all the countries around the world. An extensive literature summarizing data and forecasts on the Energy Consumption (since now on E.C.) is published every year by several authorities (e.g. EIA, IEA [9][10]) and researchers, made accessible to anyone wants to study the matter more in depth. The scientific discussion about the technical challenges of E.C. (e.g. [11]) or the forecasts about how the energy demand will change in the developed countries over the next upcoming years [12], are topics permanently in the agenda of the world debate on E.C., though often reserved to the experts able to handle data and technical jargon. Portraying a general overview of the social and economic processes related to the issue Energy Consumption, is therefore beyond the possibilities and the intent of the present paper. The research at hand started from analysing a non-exhaustive number of publications on the issue E.C. and dividing them in macro-categories. A main division between public and private scope (Appendix - A) was defined in order to deal with the multi-faceted character of the issue and to simplify its analysis. However, the categories private and public are not conceived rigidly and their definition served the identification

of the scope of intervention described in the following sub-chapter.

The role of values in domestic energy consumption

As portrayed in the diagram of the design process (Appendix - A), while in the public scope, design research relates mainly to energy development (renewable sources, new technologies, etc.), in the private scope, design is focusing on the domestic E.C., including the relationship between technology and users in the home environment (lifestyle, habits, behavior). As the present research aims at inquiring into the possibilities (interaction) design has to elicit ethical and behavioral transformation addressing the multidimensional character of the human experience, the home environment seemed an optimal context in which set the investigation. One's own home is among the most important things in life and the relationship/interaction with the objects which belong to it, goes beyond the notion of functionality, implying emotion, affect and social relationships. The way some of such objects are used, thus the people's behavior and the related values, determines the level of domestic energy consumption [13][14][15][16]. The relationship between values and household energy use, though complex and hard to define, can be investigated [17] making clearer what is the weight of behavior on energy consumption compared to that of other variables (e.g. socioeconomic). Moreover, an interesting and relatively unexplored inquiry into the unconscious character of the habits related to the use of technology [18], may further unveil the dynamics of the relationship between values and behavior in energy use. The above mentioned studies highlight how the ethical dimension of individuals is crucial in shaping their attitude towards societal issues they are part of. Such an insight led the preliminary research conducted so far, to focus on the review of some examples of design intervention within the home environment, specifically aimed at enhancing users/people's awareness about the issue E.C.

Energy consumption, behavior and design

It is worth to mention a first major difference between a purely engineering design approach, mainly focused on increasing the performance of the most energy demanding appliances (e.g. fridges and freezers) and a more industrial design approach working on how to design new products and services which induce a sustainable behavior of users. In the first case, the research is technology driven and focused on the efficiency of the systems integrated within the appliances and devices[19][20]. In the second case a further subdivision has to be made between researchers who prefer an analytical approach, focusing on the development of frameworks and methodologies [21][22][23], and researchers who accomplish the investigation by means of refined prototypes, focusing on aesthetics and interaction [24][25]. The research called *Static!* [25], conducted within the *Interac-*

tive Institute Swedish ICT, is a collection of projects addressing the awareness of energy consumption building upon the legacy of *Critical Design* [6]. A research-through-design, based on iterative and non-linear design process, where the prototype is the “*embodiment of theory*” [26], makes *Static!* a valid example of how to design for transformation addressing the multidimensional complexity of the human experience. In other words, considering the transformative qualities framework [2], such an approach to design research includes all the three dimensions (material, interaction, ethics) with a remarkable attention to details and subtleties.

DESIGNING FOR TRANSFORMATION

Ethics and artifacts

As previously stated, ethics plays a crucial role in people's transformation as the individual dimension of values shapes behavior by guiding choices and actions. Another good reason for considering *Static!* and the approach that characterizes its authors as a point of reference to set up a research project on how to design for transformative qualities, is the role of the artifacts and of the dynamics of the interaction with them. As technology or technological artifacts “*mediate human actions and experiences*” [27], they can be considered as a “*material form of intentionality*” [27], not only shaping behavior but also contributing to the decision-making process. In other words, as artifacts or, more in general, the material dimension contributes substantially to the engagement of people in everyday activities, making the experience a rich and complex phenomenon [28], the nature of the change induced by the interaction with them is multidimensional (physical and mental, emotional and cognitive, cultural and psychological, etc.). Therefore, by deliberately “playing” with the connections between artifacts and people/users at multiple levels simultaneously (emotional, functional, symbolic, etc.), it is indeed possible to elicit ethical reflection(s) upon societal issues and make people responsible for their own transformative process.

Ethics, emotion and design

With the emergence of the User Experience Design (UXD) studies, emotion and meaning(fulness) have gained a greater significance [28][29], not only as part of the overall experience which characterises the relationship between people and design systems (artifacts and services), but also as main components of a design project to be integrated within its development process [30]. Although a wide literature can be found about emotion in design and about the so called Empathic Design (e.g. [30][31][32]), scarce references have been found about how the empathic design approach can be used to steer users/people towards a behavioral and ethical transformation (e.g. see [33]). The reason of that lies on the general purpose underlying the UXD and

Empathic Design approaches, mainly hinged on identifying the users' needs and on adapting the design proposal to them. As a matter of fact, if transformation goes through the acknowledgment of a lack of awareness about certain issues, as long as such acknowledgment process does not start, those issues and the related designs will not be perceived as "needs" by people/users. Therefore, how can one design for a need which is not perceived as such? In other words, the lack of ethical, political and social criticism in the UXD and Empathic Design approaches, makes hard to apply them to the design for transformation.

The need for social criticism

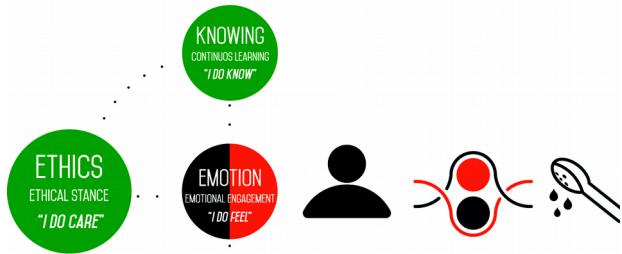
The above mentioned reflection leads to the conclusion that in order to design for ethical and behavioral change, the researcher(s)/designer(s) who carries on the project has to manifestly express a clear ethical and political stance on the societal issues he/she is addressing. E.g. in order to identify the myriad of scenarios expressing the lack of awareness about the issue E.C. in users/people, a clear definition of what is a good attitude and what is not, why reducing the consumption of electricity is important and how that contributes to improving the quality of life of the community, is necessary. Therefore, a critical approach to problems, constantly questioning the truth as well as the rightness of cultural and social patterns in turn induced by multiple of “structures” (technology, economic conditions, communication, etc.), is paramount (e.g. see [34][35] for a critical approach to the contemporary society). In brief, as needs are strictly related to the values individuals have and values are dynamically changing depending on the social, economic and cultural context, the value of the natural resources (whose finitude is one of the main problems of E.C.) does not pre-exist in people's mind, but must be learnt. Although such an acting as custodians of the truth (or a just truth) can seem as presumptuous and authoritarian, it is indeed necessary when designing for a deep people's transformation. The choice of E.C. as issue to address, relies also on its character of objectivity which makes it being across-the-board acknowledged as of great significance for the entire human society.

Phenomenology of awareness: a framework

As a conclusion of the research, analysis and reflection on E.C. from a design for transformation perspective, a framework which both describes the phenomenology of awareness and serves as a design tool in the (design) research process to enhance such an awareness, is proposed (**fig.1** – for an extensive overview of the framework, refer to Appendix – B). It is worth to mention that the framework has been developed throughout the entire research and only at the end of the process it acquired the current structure. Such an interpretation of the phenomenology of awareness builds

upon the persuasion that there is a strong relationship between the acknowledgment of ethical values and the feeling of lack. In order to explain such an idea, several reflections are needed. First of all, as the worthiness of things and ideas depends on the attribution of value to those things and ideas by individuals, an important question is how value attribution works. It is believed by who writes that attributing value to things and ideas and the consequent engagement which results from it, mainly depends on the emotional state individuals experience when facing those things and ideas. Moreover, as emotions are strictly related to motivation and intertwined with cognitive activity [36], there is a relationship of interdependence between what it is felt and what it is thought. More in general, the social and cultural context in which people grow up, strongly influences the way emotion are experienced [37] and, therefore, what specific emotions correspond to specific event (e.g. in a Western country letting the water flow for several minutes may result in a feeling of relaxation and tranquility, while in an African country may result in a feeling of frustration and anxiety). Second of all, a negative emotional state is often related to the lack of something (a beloved, a desired object, self-confidence, self-esteem, money, etc.). Such a condition of missing “something” pushes individuals to change their value attribution on that something and on what is related to it. Therefore, coming back to the relationship between

ANNOYANCE/FULFILLMENT MIXED INTERACTION



DOUBLE-SIDED INTERACTION

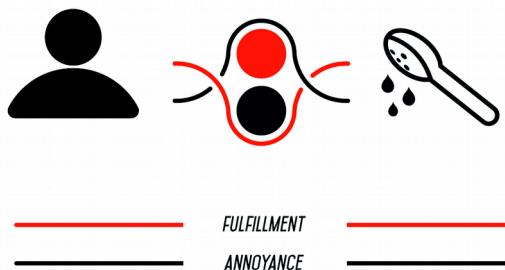


Figure 1. Double-sided interaction framework

lack and value, it can be said that a negative emotional state it is more likely to elicit the cognitive process needed to change one's own value attribution, rather than a positive one. Actively changing values and behavior requires efforts, commitment and sometimes also sacrifice. Why individuals should change mindset and behavior about their lifestyle if they feel fully satisfied by it? Introducing a source of dissatisfaction, a feeling of lack, be it shock, annoyance or bother, it seems to be a strategic element of designing for transformation.

Combining fulfillment and annoyance

Although culturally and methodologically related to the projects developed at the Interactive Institute Swedish ICT, the present research project starts from a different point of view on how to enhance awareness about E.C. In particular, the idea of visualizing the energy consumption by means of aesthetics (of objects and of interaction) focusing on the pleasantness of it, is replaced by the combination of annoyance and fulfillment in the aesthetics (of objects and of interaction). In the majority of projects related to *Static!* [25], the component of a pleasurable, unexpected and beautiful aesthetic experience, overshadows the priority of the ethical reflection needed in order to gain more awareness about the issue E.C. In other words, the focus of users is on the quality of the aesthetic features rather than on their veiled meaning and on what they denounce. This generates a paradox when, in the case of the *The Heat-Sensitive Lamp* [25], users may be pushed to use it for longer, namely to increase the consumption of electricity, in order to appreciate the interactive materiality design. Therefore, as portrayed in **fig.1**, inquiring into the effects of a combination of fulfillment and annoyance in the design of interaction, is considered at the basis of the present research.

RESEARCH QUESTION

How and to what extent the combination of reward and punishment (fulfillment and annoyance) in interacting with a designed system/object arouses an ethical reflection regarding Energy Consumption (or/and its sub-topics) deep enough to generate a growth of the awareness about the issue itself?

HYPOTHESIS

The combination of fulfillment and annoyance (reward and punishment) in the interaction with a designed object/system, if carefully and meaningfully designed, arouses ethical reflection in users about specific issues (e.g., Energy consumption) to the point to enhance their awareness about the issue itself.

THE SPRAY LAMP (FIRST CONCEPT)

Ground and conception phase

As previously highlighted, emotions play a central role in the process of value attribution and therefore they can be identified as driving force of thought and behavior also and especially in the interaction with an intelligent object/system. Although emotions are intertwined with cultural and social “structures”, they have a biological bases [30] being strongly related to human senses and, more in general, to perception. Given the powerful effect of smell on the association and recall of memories [38], a first idea consisted in using a diversity of smells and scents, associating them to the consumption of the appliances within the home environment. More in general, the concept can be described as an interactive artifact whose purpose is to test whether, how and to what extent, (interacting with) an annoying smell associated to the consumption of electricity can elicit an ethical reflection about E.C. and increase the user's awareness about it. Although the prototype was initially meant as an exploration mainly focusing on annoyance, after a long period of test in the field and several questionnaires (see Test performance section), it was discovered that depending on the specific design of the interaction, the perfume used in the test can be perceived either as pleasurable and as annoying. Therefore, this artifact can be already considered as relevant to the framework previously mentioned (fig.1).

Prototyping phase

Physical prototype

As the test was meant to be performed following a field approach, a preliminary inspection within the context (home environment) was conducted and some useful information about possible hurdles to the test was collected. E.g. because of the size of the house (a student flat of about 35mq), employing strong and malodorous substances was impracticable, leading to the use of perfume. Another technical limitation was the impossibility to connect the current

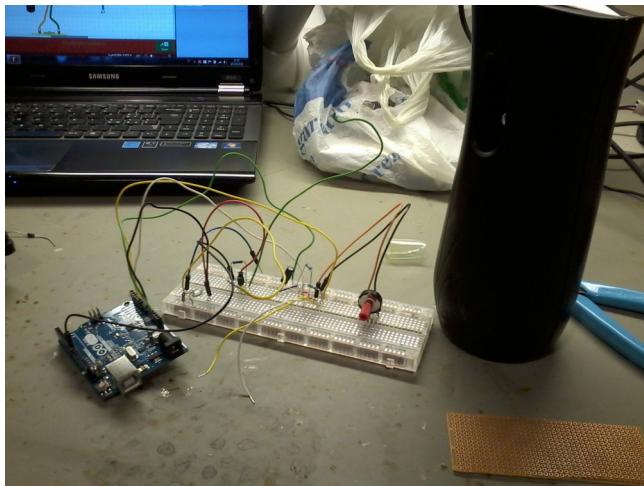


Figure 2. Low profile prototype

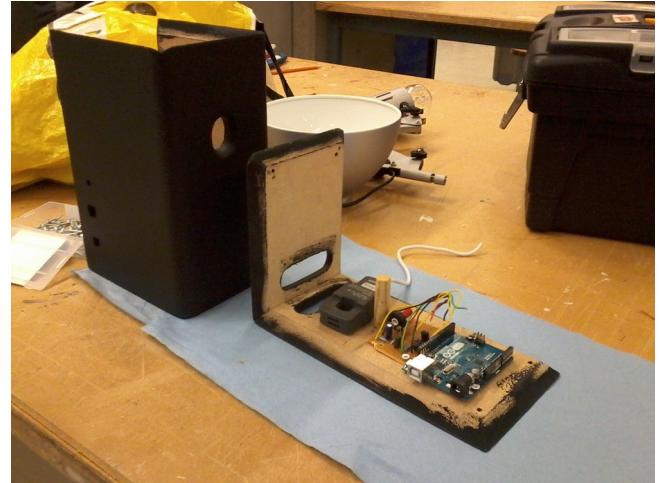


Figure 3. Construction of the high profile prototype

sensor, necessary for the measurement of the electricity consumption, to the appliances or to the electricity meter of the house. Such constraints shaped both the characteristics of the object and the quality of the interaction. As portrayed in fig.2, a first low profile prototype was built connecting a bulb lamp (halogen lamp of 75w), a current sensor and an electric perfume dispenser to a microcontroller (Arduino Uno). By using a simple code, the functioning of the prototype and a basic interaction were tested: whenever a certain threshold of watt-minute is overcome, the microcontroller triggers the spray of the perfume dispenser, spreading the scent out in the environment. A reflection on the first test, led to the use of a unique scent as the spray mechanism of electric perfume dispensers only works with gas perfume bottles and testing specific scents resulted not possible. Given the above mentioned technical constrains and in order to make possible carrying out the test, it was decided to connect a desk lamp to a simple box containing the electronics (fig.3). Thereby, the artifact became portable and easily adaptable to any home environment, solving the problems related to the installment. The compromise was renouncing to a differentiated test on appliances and devices, in order to be able to quickly install the artifact and test the related interaction for a longer period of time (fig.4).

Interaction(s) design

The dynamics of the interaction has been changed over time, eventually testing three different programs/kinds of interaction.

In the first program (Appendix C - First program) the threshold for the trigger of the spray was set to 37.5 watt-hour. As the bulb lamp provided was a halogen lamp of 75w, the spray was triggered every thirty minutes of actual use. The code guarantees to keep count of the consumption

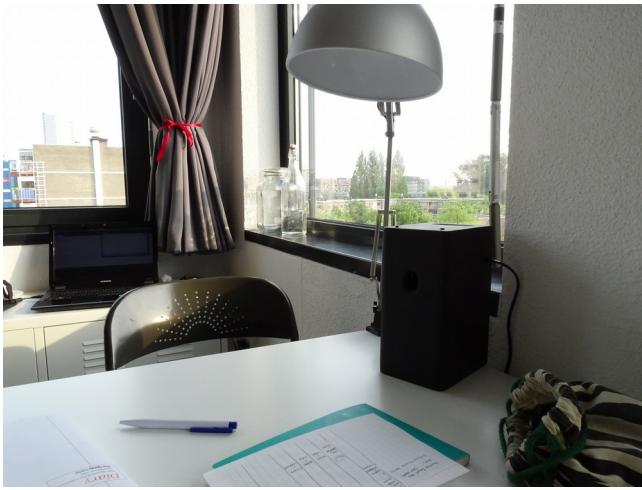


Figure 4. Prototype in the context

between a break of use and the other. The interaction has been tested for almost four weeks and assessed over time by means of weekly questionnaires.

The weekly assessment of the first interaction led to reducing drastically the threshold to about 9.3 watt-hour. The decision was based on the fact that after almost one month, the user being tested was clearly accustomed to the smell. Thereby, the level of annoyance increased suddenly and considerably giving the opportunity to test an experience qualitatively opposite to the previous one and eventually compare the two.

By quickly analysing and assessing the last questionnaire, a new and more dynamic kind of interaction was designed (Appendix D - Second program): the longer the usage of the lamp, the higher the spray rate. In other words, the level of annoyance grows proportionally with the increase of electricity consumption and viceversa. Such an interaction was tested for about ten days.

Test performance

Approach

The research at hand mainly builds upon the Constructive Design Research methodology [26], partly referring to the theory and practice of User Experience Design (UXD) [28] [29]. As the understanding of the complexity which characterises the people's experience is the general purpose underlying the present research, the Field approach was one of the main references, especially for the practical performance of the investigation. The main tools and techniques borrowed from the ethnographic studies applied to design [39], have been combined with quantitative data research tools in order to suit the assessment of the specific research case. That is because, as already mentioned and referring to [2], design intervention and assessment strategy are dynamically interrelated. However, qualitative data play a central

role in the present research as they fit the need to assess the dynamics of thoughts and emotions in users. On the other hand, quantitative data have been used for an assessment over time, during the test, mainly aimed at understanding the immediate response of the user and adjusting the interaction accordingly. Such a twofold data gathering technique was designed on the basis of the specific research case and supports the quality of the experience rather than the quantitative measurement of the change/transformation.

Context, user and duration

The test was carried out within a student flat of about 35mq. (Appendix E) The size of the flat and its characteristics (one single room) influenced the test of the interaction as the perfume pervaded the whole environment. Moreover, as the artifact was placed in the kitchen/dining room area, well lit during the day, its use was limited to the time after dinner (Appendix F).

The user was a student, woman, about twenty-four years old. She was made aware about the research purpose and how the test would be conducted. The only thing she ignored was how the specific interaction (behavior of the lamp) would work and change over time. As learnt from the interview, the user was already sensitive to the topic E.C.

The test was performed for about sixty days with the following arrangement: first interaction thirty days c.a.; second interaction ten days c.a.; third interaction ten days c.a.

Measurement and assessment tools

The main assessment tools employed were: 1) weekly questionnaire (Appendix G); 2) final questionnaire (Appendix H); 3) diary throughout the test (Appendix I); 4) final interview.

- 1) The weekly questionnaire was aimed at understanding the immediate response of the user and changing/adjusting/fine-tuning the interaction during the test accordingly. The questionnaire is a mix of closed and opened-ended questions, with a predilection for quantitative measurement. Although quantitative, the data collected were used for an assessment over time of the quality of the experience. As a matter of fact, interpreting the quantitative measurement by integrating the qualitative data within the analysis of the questionnaire, a quick overview of the weekly experience was constantly gained. The content of the questionnaire focuses on a twofold aspect of the experience: emotional state and ethical reflection. The goal of the inquiry was to assess: a) whether and to what extent a negative emotional state (shock, bother, etc.) occurred; b) whether and to what extent an ethical reflection occurred (general and specifically related to E.C.); what the recipro-

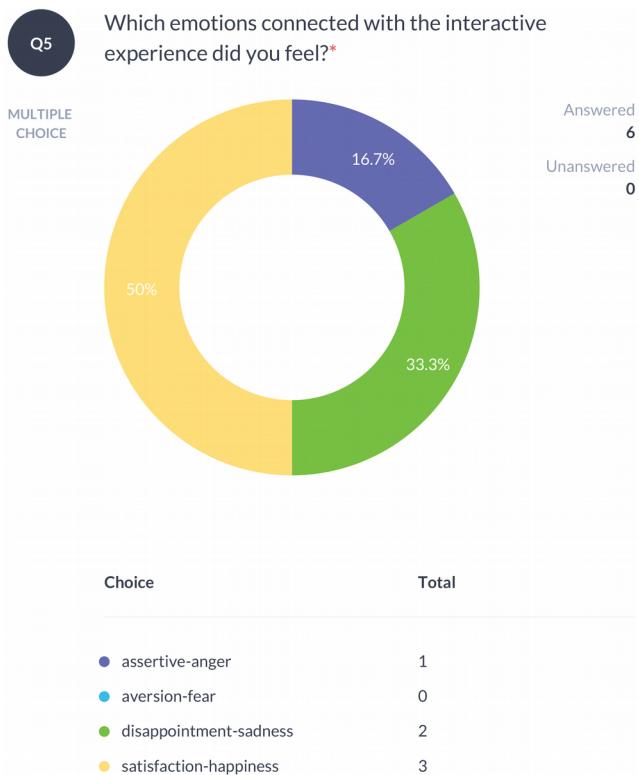


Figure 5. Emotions in the interactions

cal cause-effect relationships between the two phenomena. For the assessment of emotions and ethical reflection it was referred to [40][41].

2) The final questionnaire was aimed at gathering qualitative data about the overall experience of the user by means of opened-ended questions. A retrospective self-reflection

of the user on the dynamics of emotions and thoughts aroused throughout the entire test, was encouraged. Moreover, a self-reflection and self-evaluation on the nature and on the quality of the transformation occurred, were boosted.

3) A paper diary where to record daily thoughts about the experience was designed, including all the information the user might need to use it correctly (Appendix I). Diary methods are largely used in Psychology research [42], providing an important source of qualitative data. In the specific research case, using the diary allowed the user to freely express and carefully record the dynamics of the (ethical) reflection and emotion arousals. Such an intimate and private relationship with the recording tool, fosters the authenticity of the thoughts expressed, making the measurement more qualitatively significant. Moreover, having the opportunity to instantly record/assess one's own experience (Ecological Momentary Assessment - ECM), prevents or, at least reduces, the phenomenon known in Psychology as *memory bias* [43]. To properly design the diary, it was referred to [44].

4) The interview was the final stage of the assessment, mainly aiming at gathering useful qualitative data to compare to those collected in the final questionnaire. Despite the similarities with the final questionnaire, according to [39] the final interview had a flexible structure following the trend of the conversation and the user's narrative (not fixed questions).

Analysis

Method

Given the combination of quantitative and qualitative data, the analysis is performed making use of a diversity of methods. However, as previously mentioned, quantitative mea-

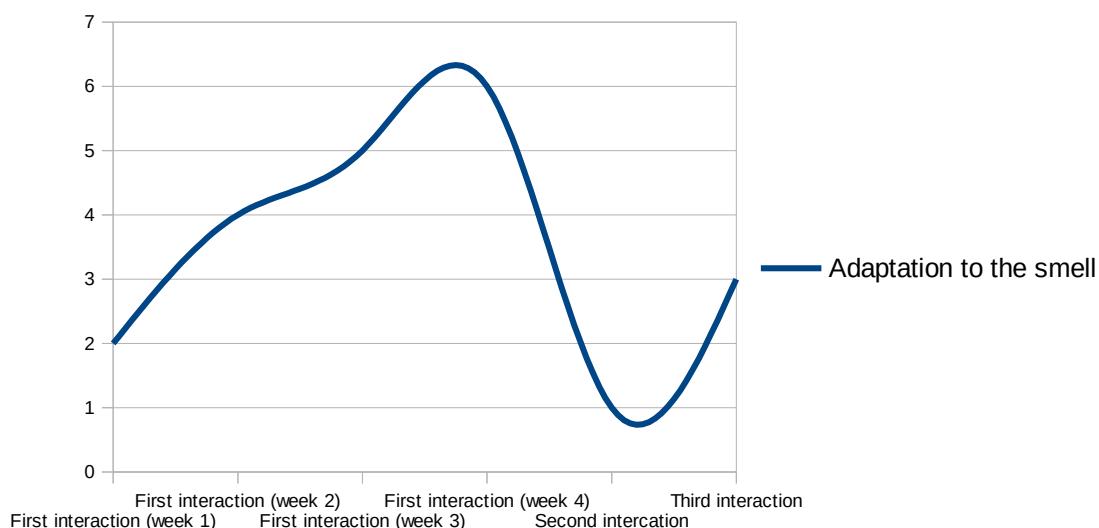


Figure 6. Level of adaptation through the test

surements are mainly used for a qualitative assessment over time, during the test and to support the overall qualitative analysis. In this regard, the *Grounded Theory* (GT) [45], a systematic approach for the construction of theory through the analysis of data, has gained a large weight in the social sciences field. The methods developed by the followers of this approach, are meant to serve the qualitative research on the field and are mainly employed to inquire epistemological and ontological research questions [46]. Following this method [46], the present research addresses an exploratory research question aimed at understanding a phenomenon.

Quantitative and qualitative data (through the test)

In the weekly questionnaire (Appendix G), half of the questions are aiming at assessing the emotional “shock” (annoyance) occurrence and the remaining half at assessing the ethical reflection arousal. The closed-ended questions mainly test the occurrence of the two phenomena while the opened-ended questions investigate the meaning-making relationships between the dynamics of ethics and emotion.

Emotional “shock” (annoyance)

The emotions are divided in four broad categories according to [47]. As portrayed in **fig.5**, the emotional states related to the experience have varied over time. Looking at the relationship between the kind of interaction and the emotional state experienced, it can be said that the second interaction (high frequency of spraying) results in emotions such as assertive-anger and disappointment-sadness. However, satisfaction-happiness is the prevailing emotion overall the entire experience. The first interaction is firstly perceived as pleasurable because “*The smell is nice and marks time passing*”, then bothering (“*Is not more a surprise*”) and then indifferent as “*I’m getting used to it, sometimes I forget that the spray is there*”. The second interaction is considered as bothering and the third interaction as funny. Such mix of quantitative and qualitative data suggests that beside the spray frequency, an important role in the user’s emotional response is played by the control the latter has over the interaction. The third interaction, though can result in an even higher spray frequency than the second interaction, it is perceived as predictable and controllable as follows the user’s behavior. Such a gradual growth depending on the user’s response, reduces the negative emotion (satisfaction-happiness was rated 2 in a scale from 1 to 6 in the last interaction). The level of adaptation to the different kinds of interactions is well described by the **fig.6**.

In synthesis, it can be said that beside the actual annoyance generated by the intensity of the perfume, the predictability, being controllable and the expression of the interaction play an important role in the quality of the emotion felt/aroused.

Emotions and Ethical reflection about E.C.

Although the user always links the emotions felt to the interactive experience (Appendix J - Q.11), she almost never associates the ethical reflection had to the emotion arousals (Appendix K - Q13). However, the overall emotional experience is almost always associated to the ethical reflection on ENC. (Appendix K - Q15). Such an apparent contradiction can be explained by: 1) the difficulty of the user in identifying her own bodily response (Appendix J - Q7); 2) the influence the interactive experience has on the user’s life over the specific time span in which the interaction happens (Appendix Ms - Q24). As also confirmed by the interview, the user tends to describe the emotions felt in a meaningful way, rather than associate them to her bodily reaction. This likely leads the user to ignoring the tie between the bodily response and the ethical reflection, and attributing more importance to the overall experience.

About the ethical reflection itself, it is worth to mention that the higher the adaptation to the smell, the higher the profundity of the reflection is rated (Appendix L - Q21), with a drop as the interaction changes. The same can be observed regarding its duration and the frequency of its occurring (Appendix L, Ms – Q22,23). Similarly, the increase results

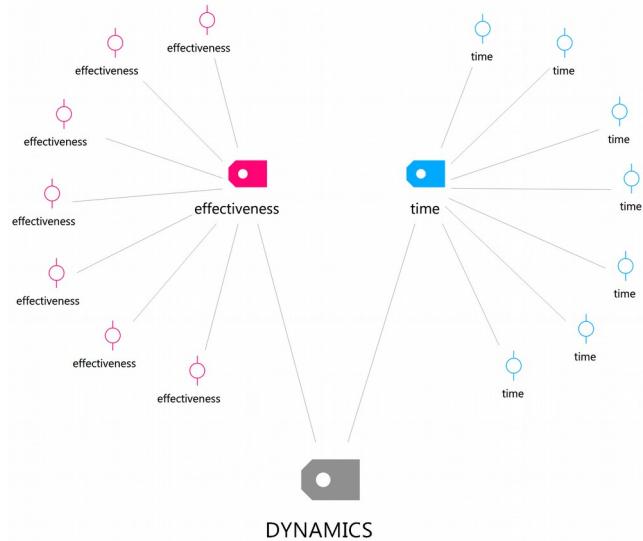


Figure 7. Example of category mapping

in a higher relevance to the issue ENC. (Appendix N - Q28). Such a phenomenon suggests that a gradual decrease of the annoyance and the consequent “disappearing” of the interaction, can have an even higher effect in eliciting ethical reflection

about ENC. than a gradual increase. This may be true depending on the user’s attribution of meaning to such a change and the matter of the ethical reflection which follows. In particular, as emerges from the qualitative data of

both the weekly questionnaire and the interview, the user's acknowledgment of her own level of adaptation to the smell, led to reflecting more about ENC. and the consequences of being inured to certain habits.

Qualitative data analysis (after the test)

According to [46], the analysis of final questionnaire and interview, was performed starting from *coding* the entire text and video using a dedicated software for qualitative analysis (MAXQDA Release 12.1.4, trial version). A selection of relevant thoughts from the diary were used as memos within the coding of the video, integrating the data gathered from it. The first cycle of coding consisted in labeling single segments of text and video attributing meaning to them in a condensed form (Appendix O). The significance of the single codes was assessed by analysing their frequency of occurrence in both documents (video and questionnaire). Three different types of relationship have been considered (Appendix P,Q,R): 1) the most frequently occurring codes; 2) the most frequently occurring codes in any single document; 3) the frequency of any single code in both documents. Identifying such relationships helped in pinpointing the most important codes and in proceeding with the analysis of the underlying meaning among them. Such a procedure was essential for the following *sorting* stage, allowing to start the identification of categories and subcategories the codes could fall into. After several re-coding operations, fourteen categories were defined (Appendix S) and the frequency of occurrence was analysed by using the above mentioned matrix (Appendix T). Although some categories such as *Thinking and reasoning* and *Transformation* resulted being more frequently occurring than others, it was decided to proceed by employing a more narrative approach (*Pattern coding* and *Selecting coding methods* [46]). A first general overview helped in conceptually building meaningful connections among codes, sub-codes and categories, facilitating the definition of concepts/themes. Due to the complexity of the general overview, the categories were analysed separately by mapping them one by one (Appendix U,W,X,Z,A.0,B.0,C.0). Five themes were defined (Appendix D.0) trying to grasp subtle aspects related to the categories and starting already with the interpretation of their meaning, in respect to the raw data analysed in the beginning. E.g. the theme called *Fear of losing control*, catches, gathers and interprets several aspects emerged from the data and described by the related codes and categories. In particular, the user's answers such as "*The diary has been a quite annoying part of the experience. It was too free for me.*" or "*[...] maybe at the university someone could smell such a smell on me*" or "*I was scared by the sound*" and many others sharing the same leitmotif, contributed to the definition of such a theme. In order to facilitate the elaboration of a theory without omitting meaningful parts, each theme and related categories were put in a row and specific concepts were attributed to them. Thereby, the conceptualisation

could be more accurate in respect to the content of each theme. Afterward, the concepts linked to the categories were mapped in order to define macro-concepts related to the themes (Appendix E.0). The five macro-concepts resulted were finally synthesized in one theoretical construction (Appendix F.0).

Results

The following theoretical construction resulted from the analysis:

Annoyance/provocation (in the interaction with intelligent systems) works as a trigger for ethical and behavioral change mainly where there is a "breeding ground". When such a receptiveness misses, other strategies more complex have to be designed in order to achieve the same goal of transformation. In particular, three main aspects have to be carefully designed: 1) balance between annoyance and reward; 2) relatedness/adaptability of the system to the specific context; 3) humanization of the system (preserving user's identity/power).

THE NOISY SHOWER (SECOND CONCEPT)

Conception phase

Building upon the first idea, it was decided to investigate the combination of fulfillment and annoyance within the interaction by addressing a different micro-system of the home environment. In particular, the water consumption related to the showering was considered as a relevant setting for a more advanced design intervention. A brainstorming phase brought to the concept of re-designing a common shower faucet so that it could emit different sounds depending on the water consumed by the user. Working with the sound has several advantages: 1) sound can be designed ad hoc in a potentially unlimited variety; 2) sound can be perceived as a reward or as a punishment depending on the quality; 3) the change in the quality (volume, speed, typology, content, etc.) can be triggered by a microcontroller. One of the goals set was to realise a credible prototype in terms of aesthetics. Such a goal derived from the persuasion that users pay a great attention to the aesthetics of the objects they own. Striving for a nice look of the faucet was strategically aimed at making the prototype psychologically acceptable by the users during the test.

Prototyping phase

Faucet

In order to start making the prototype, a common shower faucet was disassembled and its shape was studied (fig.7). A quick model in clay was realised materially "sketching" the new shape so that the size could be measured in scale 1:1. A 3D model was realised integrating a placement for the speaker at the top of the shower faucet and a conduit for the



Figure 7. Physical sketch (redesign of a shower head)

wiring along the internal part of its handle (**fig.8**). The 3D model was then printed in HIPS (High Impact Polystyrene) and ABS, sanded and cleaned (**fig.9**). As the prototype was designed to be installed in a real shower, fully working, and the 3D printed model was too brittle, a silicone mold and a rigid polyurethane casting resin were made (Appendix G.0). The two halves were glued together and the internal cavity was silicone-coated in order to make the object watertight. The shower head was finally refined and coated. Beside the faucet, a box for the electronic components was built with an insulation system (inter space all around the box) to make it watertight (Appendix H.0). Lastly, standard flexible pipes were used for the connection to the water supply valve.

Electronics

The need to simplify and make the electronics more compact, led to the use of a driver shield designed for playing music with the Arduino microcontroller (Appendix I.0). The shield consists of an amplifier, an SD card reader module and a socket for the speaker/headphones. Connecting the shield to the microcontroller, the intensity of the sound was tested. Lastly, a flow sensor was connected to the microcontroller and worked as a trigger for the sounds.

Sound(s)

The capacity of the SD card, allowed to store relatively large files and use any kind of sound. In order to assure the annoyance, only highly disturbing sounds such as dentist's drill, screams, engine sounds etc., were employed. For the second interaction, as opposed to the annoying sound, Bossa nova music was used, assuring a feeling of fulfillment.

Interaction(s)

Two different kinds of interactions and related programs were used to perform the test.

In the first program, after 35 l of water consumption, the annoying sound is triggered by the microcontroller with a variable intensity depending on the flow rate. As the average of the flow rate in the shower is usually circa 12.5 l/min, the sound is triggered after about three minutes if the water supply valve is opened to the maximum. Dividing the maximum value of the flow rate in four ranges, it was possible to make the knob working as a potentiometer. Thereby, reducing/increasing the water flow handling the knob, the volume of the sound increases/decreases accordingly. The user can turn down the volume of the annoying sound reducing the water flow. However, the volume turns up again as soon as the user increases the flow. Similarly to The Spray Lamp, such a program focuses on the annoyance/punishment and its expression within the interaction.

In the second program, the threshold for the trigger of the annoying sound is reduced to 25 l of water consumption (about two minutes if flow rate is maximum) and a rewarding sound is introduced within the interaction. As the annoying sound is triggered, the user can reduce the volume turning down the water flow. Reducing the flow, the volume automatically turns down to the minimum and if the flow is not increased again, after about two minutes the sound switches from annoying to pleasurable. In other words, the user is rewarded with a pleasant sound if the water conservation is maintained.

Test performance

Context, user and duration

The test was carried out within a shower box of a flat rented by students. The size of the shower box was slightly underneath the standard, in a unique environment separated from the bathroom (Appendix J.0). Such specific characteristics made the acoustic excellent as the sound was not dispersed and well audible.

The user was a cohabiting couple of about twenty-four years old, students, woman and man. They were made

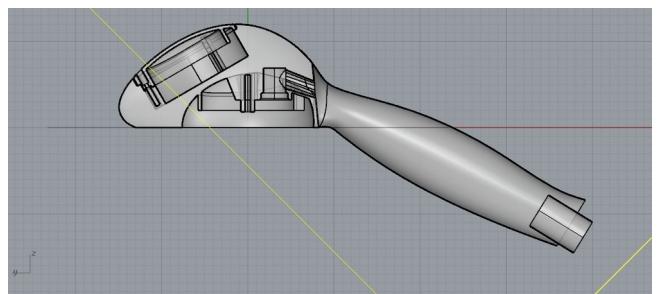


Figure 8. 3D model of the shower head
aware about the research purpose and how the test would be



Figure 9. 3D printed model of the shower head

conducted. The only thing they ignored was how the specific interaction (behavior of the shower head) would work and change over time.

The test was performed for about eight days with the following arrangement: first interaction three days; second interaction four days.

Measurement and assessment tools

The main assessment tools employed were: 1) questionnaire between the two interactions (Appendix K.0); 2) final interview.

Analysis

Quantitative and qualitative data (through the test)

The structure of the questionnaire builds upon the one used to test The Spray Lamp, assessing the emotional “shock” (annoyance) occurrence, the ethical reflection arousal(s) and the relationship between them. Given the shortness of the test, an assessment over time was not possible and the quantitative and qualitative data only record the experience related to the first interaction.

Emotional “shock” (annoyance)

It is worth to mention that although both participants (since now S. and M.) define the experience as considerably annoying (Appendix L.0 - Q4), a qualitative and substantial difference can be observed in respect to the emotional state related to it. In (Appendix M.0) can be seen that S. experiences *fear-sadness* during the shower, while M. one experiences *aversion-anger*. The reason lies on the personal associations the sound induces. S. tells about passed traumatic experiences evoked by the sounds (Appendix L.0 - Q1), while M. focuses on the annoyance of hearing those sounds early in the morning. Although in both cases such an emotional state persists for a short amount of time (Appendix N.0), S. rates the feeling to be influenced between one

shower and the other (meaning during the day) as high (Appendix O.0). Likewise, S. rates her level of adaptation to the sound over the week 5/6 and the increase of annoyance over the week 4/5 (Appendix P.0,Q.0). The answers suggest that although after a few days S. was accustomed to the sound, her annoyance grew as she continued to associate the sounds with “*horrifying images*”. A similar case, though with opposite values, is given by M. who rates the level of adaptation 1/6 and the increase of annoyance 2/6. Although the low level of adaptation, the annoyance has not increased over time. As emerges from the interview, the reason lies on the fact that the level of annoyance was considered by M. at its maximum level since the beginning of the experience.

Emotions and Ethical reflection about E.C.

As M. does not experience any form of ethical reflection (Appendix R.0), the assessment of the ethical reflection arousal only focuses on the S.'s experience. The lack of ethical reflection connected with emotions in the M.'s experience is further investigated within the interview.

Conversely, S. experiences an ethical reflection described in detail in (Appendix S.0). Although S. associates the ethical reflection occurred to the issue E.C. (Appendix T.0), the content of the reflection expresses a different meaning. The reflection addresses the ethical implications of changing people's behavior by means of psychological conditioning. S. clearly declares a bias against the method by which the research is performed. It can be assumed that the intensity of the negative emotions felt by S. in interacting with the shower, sharpened her bias against the research method employed, leading to focus on herself rather than on the issue E.C. Therefore, a lack of ethical reflection related to the E.C. is observed in both participants. However, the S.'s experience suggests that an excessive annoyance in the design of the interaction results in a defensive behavior of the user. Such a reaction reduces the openness to change and pushes the user to stand against the purpose behind the design.

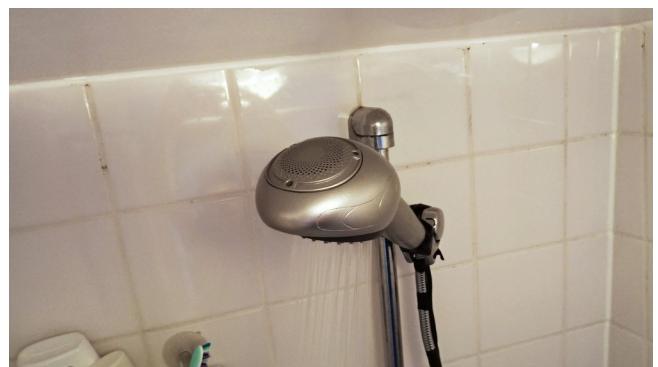


Figure 10. The Noisy Shower within the context

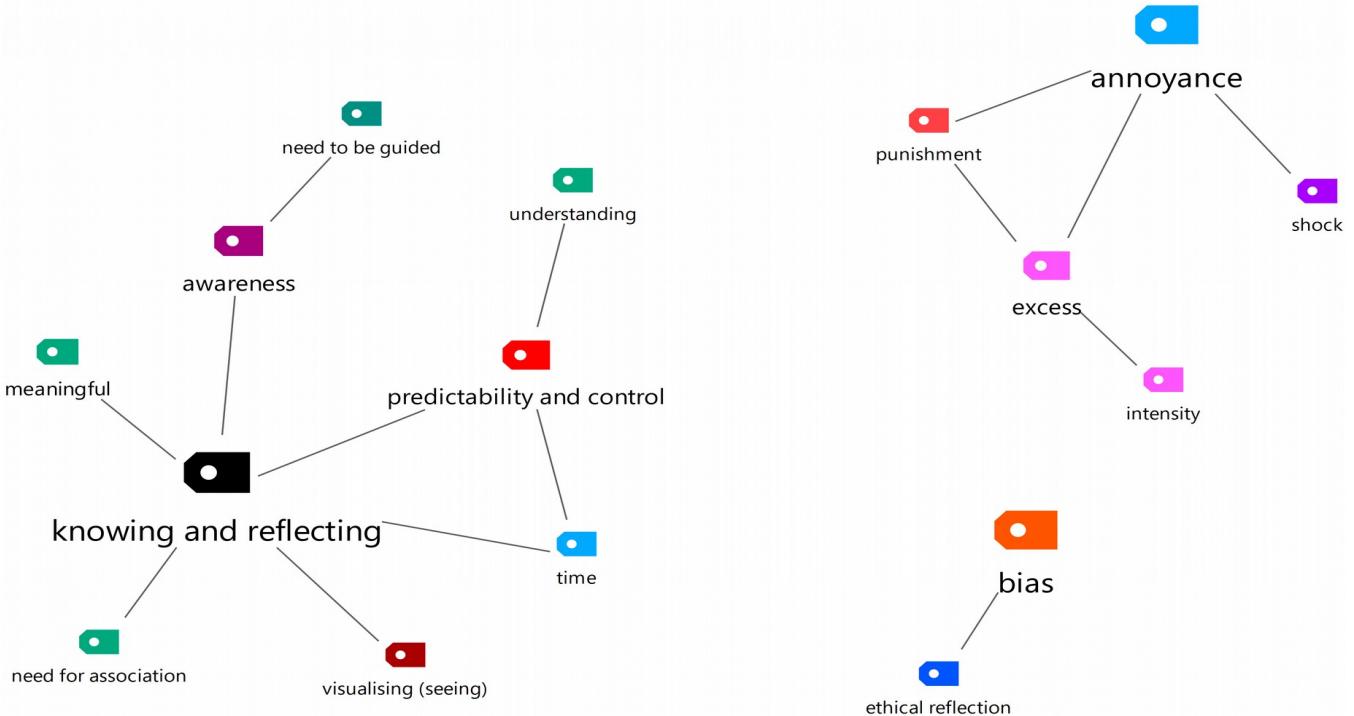


Figure 11. Co-occurrence relationship among codes

Qualitative data analysis (after the test)

The method of analysis of the two interviews is consistent with the previous analysis performance (see Analysis of the first concept) and started from coding separately the two videos. The significance of the single codes was assessed by analysing their frequency of occurrence in both interviews. The three different types of relationship already mentioned in the previous analysis have been considered (e.g. Appendix U.0). Moreover, the co-occurrence of the codes was analysed in order to define meaningful relationships among them (appendix). Identifying such relationships helped in both pinpointing the most important codes and in proceeding with the analysis of the underlying meaning among them. As *sorting* activity, twelve categories were defined (Appendix V.0) and the frequency of occurrence was analysed by using the same matrix used for the analysis of the lamp. A narrative approach was employed preferring *Pattern coding* and *Selecting coding* methods [47]. Such an approach led to build meaningful connections among codes, sub-codes and categories, facilitating the definition of concepts/themes. Consistent with the previous analysis, the categories were analysed separately by mapping them one by one (an example in Appendix W.0). Six themes were defined (Appendix X.0) by synthetically describing subtle aspects related to the categories, in respect to the raw data analysed in the beginning. In order to facilitate the elaboration of a theory without omitting meaningful parts, each theme and related categories were put in a row and specific concepts were attributed to them. Thereby, the conceptualisation could be more accurate in respect to the content of each theme. Afterward, the concepts linked to the categories

were mapped in order to define macro-concepts related to the themes. The six macro-concepts resulted were finally synthesised in one theoretical construction (Appendix Y.0,Z.0).

Results

The following theoretical construction resulted from the analysis:

Balance between annoyance and fulfillment and the meaningful character of the experience are conditio sine qua non of the ethical and behavioral change as well as of the awareness increase process. Such a balance can be achieved by designing two essential components of the experience: 1) user's control (making people responsible for their change and feel empowered to manage the outcome of the interaction); 2) meaningful references (fostering the cognitive activity which is required to attribute value to actions and ideas).

FINDINGS

Comparative analysis and interpretation

By comparing the two theoretical constructions elaborated in the analysis of the qualitative data, several similarities can be observed. A crucial aspect emerging from both tests is the need for a balance between annoyance and reward in the interaction with the intelligent system. The main components of such a balance are: a) the intensity of both positive and negative stimuli resulting in negative and positive

emotions in users; b) the proportion in the quantity and the quality between such negative and positive stimuli. Another essential finding is the users' need to control or feeling to be in control of the system they are interacting with. Two main aspects foster such a need: a) the fear of losing the dimension of meaning; b) the unbearable sense of being dominated (restriction of freedom). It is worth to mention that the feeling of being subjected to other's power, not only encourages ethical reflection on the preservation of oneself rather than of the community, but also increases or generates the bias against the ethical purpose on which the interaction design builds on. In other words, restriction of freedom undermines the power (interactive) design has to inspire an ethical reflection on social issues, as individual interest becomes a priority. This is observed either in the case of a "breeding ground" (user of the first test, Spray Lamp) and when a bias or a prejudice against the ethical significance of the research is expressed (user M. in the second test, Noisy Shower). Although both related to personal identity, such a finding suggests that feeling of being in control plays a greater role in the ethical and behavioral change process, than the bias users already have. Finally, the meaningful references are also crucial in the process of attributing value to the experience of the interaction. Partly related to the fear of losing control observed in both tests, perceiving the interaction as meaningful at a cognitive level, seems to be a priority for the users. Without readable and logically understandable references, the link between the emotional experience and the social and ethical implications of one's own behavior is hard to make for the users. This suggests that the sensory experience and the emotional states it produces, are ineffective in generating ethical reflection and change when not directly associated to a specific meaning rationally expressed. In other words, as a meaningful reference upon which building one's own reflection misses, the emotional experience is judged as senseless and the behavior change as not worthy.

CONCLUSION

Therefore, in respect to the research question, it can be said that the combination of fulfillment and annoyance in interacting with an intelligent system (specially designed), arouses ethical reflection about the issue Energy Consumption in users, enhancing their awareness about it, if and to the extent that the design of the interaction includes the above mentioned requirements in the best form the specific context and users suggest. In other words, such a combination may be effective in generating a (non temporary) transformation, if the aspects such as *users' role* (being in control of), *meaningfulness of the experience* (cognitive and perceptual activity); and the *balance in conflicting emotions* (reward and annoyance proportioned in quality and quantity), are introduced within the design of the interaction in a form which suits the specific context and users.

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The main aspect which has characterised my educational experience over the last six months, is certainly the meeting/clash with the research as conceived in this department; an intense and exhausting process where the endeavor of building and making from scratch, merges with the challenge of the scientific inquiry, all focused on the scope of verifying and evaluating. At the end of my first year as a master student at the TU/e, is strong the feeling of having far exceeded the boundaries of the designer's "craft", stepping into an unexplored field where learning is as fast and deep as variegated. The following reflection describes how dealing with such an untraditional approach, has positively influenced my competencies development and my growth as a designer.

Design (research) process

Developing a design research project by employing a scientific method, requires a special effort as knowledge becomes a priority over any aesthetic ambitions and your creativity serves a different cause from the one you are used to. We have been trained to solve problems, applying our skills and intelligence to the best with that teaching in mind and without ever thinking of how the main watchword of functionalism makes our perspective enslaved to a predetermined role. Doing research means overturning such a paradigm, fighting against the frustration of the uncertainty and dealing with the sense of worthlessness that often takes over, especially when you take the hardest route in spite of all the prejudices, driven by the desire to know, following your idea, no matter the costs. This is a strong learning point I gained from this past semester: how hard is working without clear and defined bearings but still, being rigorous and making use of a systematic approach. Embarking in the enterprise of designing for the annoyance or, more correctly, for transformation through the combination of annoyance and fulfillment, meant for me to put aside all the beliefs developed in years of industrial design education regarding what design is or what it should be, preferring the exploration of a phenomenon over the capitalisation of a design project. To a certain extent, introducing the notion of annoyance in a design project means to question the roots of design itself as from the role of world savior for the good of humanity you are straight away classified as a hateful and crazy killjoy from which to stay away. That made also hard performing the investigation as the accessibility to one's own environment requires trust and designing the strategies to actually carry out the test(s) became part of the project activities.

Therefore, beside the great insight gained about the phenomenon of awareness, this experience trained me how to deal with the arrangement of the research when performed employing a scientific method. From the management of a very intense prototyping phase, every time different as specifically finalised to the performance of the test, to its

arrangement with all the technical and psychological hurdles it implies, design research requires to be multitasking and very flexible in the choice-making process. Having gained such a skilful flexibility and being able to apply it in the next upcoming projects, constitutes my growth as a designer (researcher).

Outcomes

Exploration goals

Upsetting the traditional paradigm most of design builds upon, with the risk of staying misunderstood, was for me consistent with the notion of transformation and a game that was worth playing. However, how to make people feel involved in such a "hard game" is still to be discovered and I believe that my research albeit small, has given a good contribution towards that direction. The understanding of the role of (interaction) design in the phenomenology of awareness, is a complex and hard task, requiring time and much work. The identification of the right means of investigation as well as having acquired the capability to handle the entire research process, are the main outcomes of this project. Means of inquiry such as semi-structured interview and diary, resulted to be powerful for such an exploratory investigation, making it possible to dig into the psychological aspects of the people involved. The insights gained by using these methods, are priceless as the understanding of the multidimensional character of the people's experience is profound. Therefore, from an educational point view, having gained an understanding of the priorities this field of research have and the opportunity to spend such an insight in the development of my FMP, is even more important than the specific findings of the research project.

Learning achievements

Flexibility and multitasking aptitude are the key words of the learning process of this semester. I had to become a psychologist in order to design the set of necessary assessment tools, a plumber and an electrician to install the prototypes, a programmer to make the interaction work, an artist to craft the physical prototypes and a social scientist to gather data and perform the qualitative analysis. In brief, how to cope with the difficulty to change role without compromising the quality of the design/research, is one of the main learning points of this semester. The spectrum of skills research requires in order to successfully develop the project, goes far beyond what the competencies development model includes. However, this research project gave me the opportunity to finally develop my competencies in the scope of Technology and realisation for what concerns the programming skills as well as the integration of technology within the artifacts. In a few weeks I was able to acquire the necessary skills to tackle medium profile prototype challenges and start working to make materiality being interactive. Such a capability of managing the entire realisation process

of interactive artifacts, will be vital in the development of my FMP next year.

Future

Research challenges and FMP

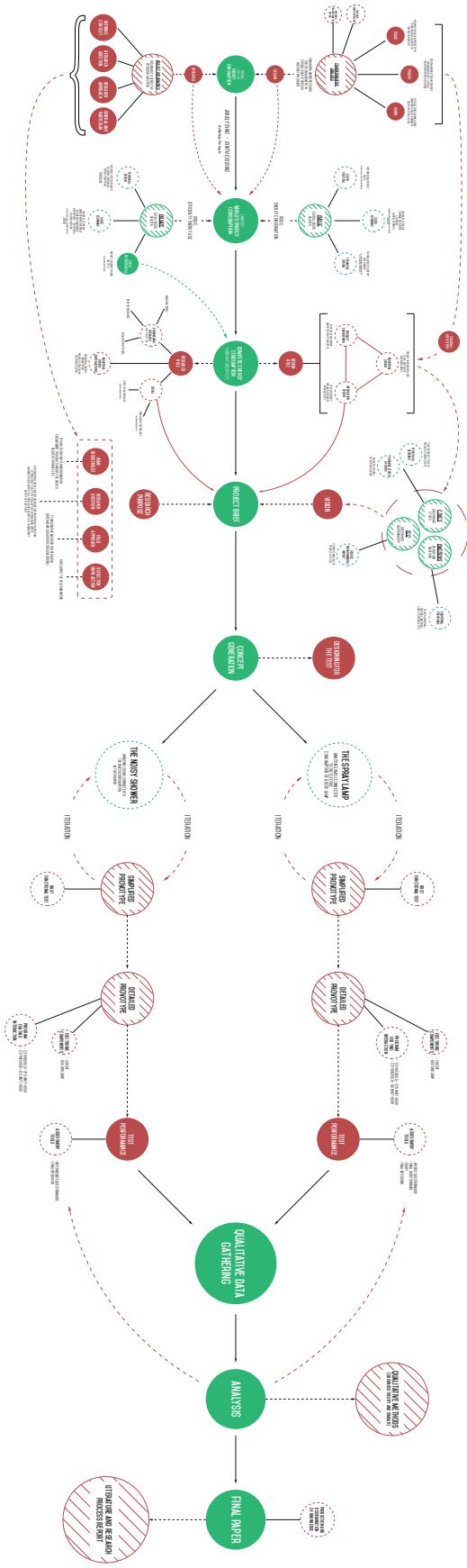
Main challenge for the future is to make a good use of the insights gained throughout the entire research project, re-modulating and re-arranging research question, methodology employed and specific goals for the next upcoming semesters. Looking at the findings, the role of guilt, power and competition in the transformation and awareness process through the interaction with intelligent systems, is a valuable scope of inquiry which deserves to be further investigated. Moreover, the interpretation of such findings, leads to questioning the validity of the assumptions made at the beginning of the semester and prepares the way for setting up a new research project.

In my FMP I want to continue exploring the field of designing for transformation, refining the tools and procedures to investigate such a phenomenon from a more design perspective. From exploratory and abstract to more specific and concrete, the project should address the whole design qualities such as aesthetics, materials, appreciation of details and subtleties and technologies of realisation without sacrificing the research part.

APPENDIX - A

Design research process diagram

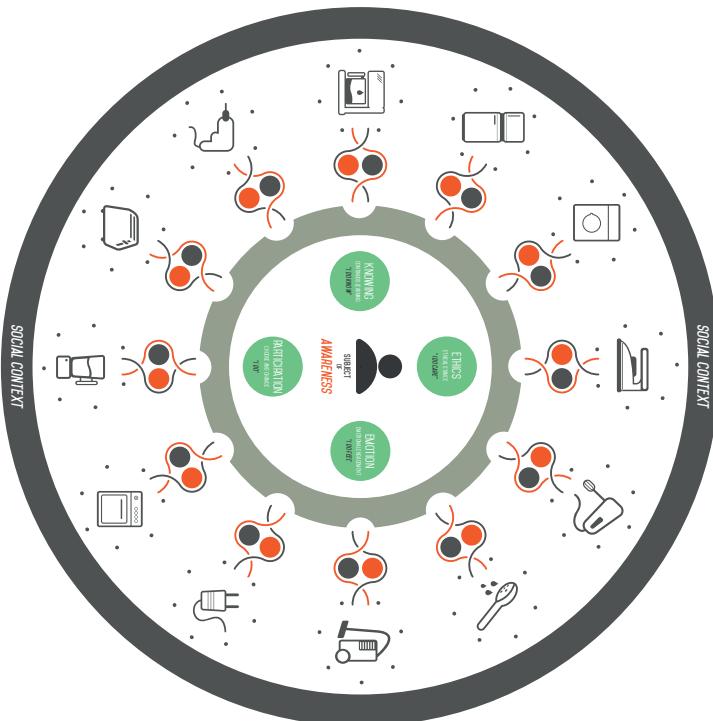
[DESIGN] RESEARCH PROCESS DEVELOPMENT



APPENDIX - B

Design for transformation framework

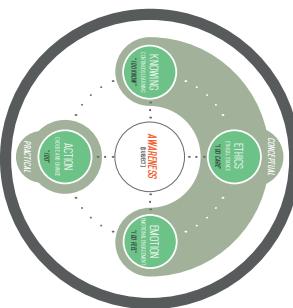
DESIGNING FOR TRANSFORMATION



THE DOUBLE-SIDED INTERACTION

Eliciting ethical reflection in users by combining annoyance and fulfillment

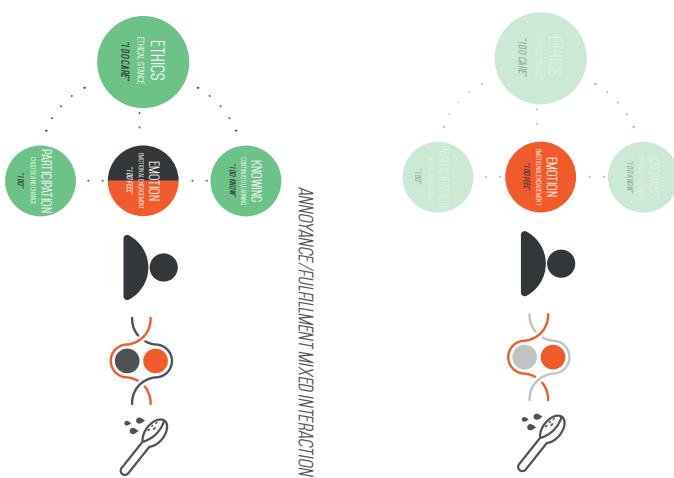
PHENOMENOLOGY OF AWARENESS



DOUBLE-SIDED INTERACTION



ANNOUNCE/FULFILLMENT MIXED INTERACTION



FULFILLMENT FOCUSED INTERACTION

APPENDIX - C

Codings for the interaction(s)

First program

```
#include "EmonLib.h"      // Include Emon Library
EnergyMonitor emon1;      // Create an instance
int loopCounter = 0;

int transistorPin = 9;

int minutesOn;

void setup() {
    // current: input pin, calibration.
    Serial.begin(9600);
    Serial.println("Code Go");
    pinMode(transistorPin, OUTPUT);
    emon1.current(1, 99.9);
    delay(5000);
}

void loop() {

    // Calculate Irms only
    delay(1000);      // (delay)= reading each 60 seconds
    double Irms = (emon1.calcIrms (1480))/2.5;
    Serial.println(Irms);

    if (Irms > 0.70) {
        minutesOn = minutesOn + 1;
    } else {
        Serial.println(minutesOn);
        if (minutesOn > 1800) { // trigger of spray after this
many minutes
            // spraying
            digitalWrite(transistorPin, HIGH);
            delay(1000);
            digitalWrite(transistorPin, LOW);
            minutesOn = 0;
        }
    }
}
```

APPENDIX - D

Codings for the interaction(s)

Second program

```
#include "EmonLib.h"      // Include Emon Library
EnergyMonitor emon1;      // Create an instance
int loopCounter = 0;

int transistorPin = 9;

int minutesOn;

void setup() {
    // current: input pin, calibration.
    Serial.begin(9600);
    Serial.println("Code Go");
    pinMode(transistorPin, OUTPUT);
    emon1.current(1, 99.9);
    delay(5000);
}

void loop() {

    // Calculate Irms only
    delay(1000);      //
    double Irms = (emon1.calcIrms (1480))/2.5;
    Serial.println(Irms);

    if (Irms > 0.70) {
        minutesOn = minutesOn + 1;
    } else {
    }
    Serial.println(minutesOn);

    if ((minutesOn > 1800) && (minutesOn < 1802)) {
        digitalWrite(transistorPin, HIGH);
        delay(1000);
        digitalWrite(transistorPin, LOW);
        minutesOn = 1803;

    } else if ((minutesOn > 2703) && (minutesOn < 2705)) {
        digitalWrite(transistorPin, HIGH);
        delay(1000);
        digitalWrite(transistorPin, LOW);
        minutesOn = 2706;

    } else if ((minutesOn > 3156) && (minutesOn < 3158)) {
        digitalWrite(transistorPin, HIGH);
        delay(1000);
        digitalWrite(transistorPin, LOW);
        minutesOn = 3159;

    } else if ((minutesOn > 3459) && (minutesOn < 3461)) {
        digitalWrite(transistorPin, HIGH);
        delay(1000);
        digitalWrite(transistorPin, LOW);
        minutesOn = 3462;

    } else if ((minutesOn > 3642) && (minutesOn < 3644)) {
        digitalWrite(transistorPin, HIGH);
        delay(1000);
        digitalWrite(transistorPin, LOW);
        minutesOn = 0;
    }

}
```

APPENDIX - E

Context of research (first concept)



APPENDIX - F

Context of research (first concept)



APPENDIX - G

Assessment tools (weekly questionnaire)

The Spray Lamp - weekly experience

Please think carefully of the overall experience of interacting with The Spray Lamp over the last week and answer the following questions.

- Q1 How did you experience smelling the scent released by the lamp?
- Q2 How would you define the experience of repeatedly smelling the scent?
- Q3 How much?
- Q4 Why?
- Q5 Which emotions connected with the interactive experience did you feel?
- Q6 How intense was it?
- Q7 What was your bodily response at that moment?
- Q8 How many times such an emotional arousal occurred over the 6
- Q9 Please, rate your level of adaptation to the smelling experience over the week.
- Q10 Please, rate the increase of your annoyance over the week.
- Q11 Were the emotions you felt directly related to the interactive experience (smelling)?
- Q12 Please describe which connections were between the emotion arousal and the interactive experience for each single episode.
- Q13 Did the emotion arousal elicit any form of ethical reflection?
- Q14 If you answered YES to the previous question, please briefly describe the dynamics of such an arousal and the matter of the ethical reflection.
- Q15 Did the emotional experience arouse an ethical reflection upon the issue Energy Consumption?
- Q16 If you answered YES to the previous question, please describe more in detail the nature of the ethical reflection (focus on the content).
- Q17 Now think back of the past week, would you link your emotional arousal(s) to the issue Energy Consumption, retrospectively?
- Q18 If you answered YES to previous question, for how many of those arousals you would consider such links appropriate?
- Q19 Did knowing the research purpose influence the link between the emotion felt and the issue Energy Consumption?
- Q20 How much? Please rate it from one to six.
- Q21 How much in depth was the ethical reflection occurred?
- Q22 What was the duration of such a reflection on average?
- Q23 How many times the ethical reflection arousals occurred over the week?
- Q24 Were the ethical reflection aroused by events other than the emotional experience related to the interaction with the lamp?
- Q25 If you answered YES to the previous question, please give some examples of such events.
- Q26 Did the ethical reflection you had itself arouse any emotional state?
- Q27 If you answered YES to the previous question, describe such a dynamics referring to the four basic emotions. In other words, try to describe how the ethical reflection triggered the emotional state.
- Q28 How often the ethical reflection was related to the issue Energy Consumption?
- Q29 Did knowing the research purpose influence the frequency of your reflecting (ethically or not) upon the issue Energy Consumption?
- Q30 How much? Please rate from one to six.

APPENDIX - H

Assessment tools (final questionnaire)

The Spray Lamp - overall experience

Please think carefully of the overall experience (entire test) of interacting with the Spray Lamp and answer the following questions.

- Q1 How would you define the overall experience of living and interacting with the spray-lamp?
- Q2 How would you describe your relationship with the spray-lamp?
- Q3 Please, carefully think of your emotional states while interacting with the lamp throughout the entire experience and answer the following question. How did you feel at the beginning of the interactive experience?
- Q4 How have you felt over the last period of the interaction?
- Q5 How would you describe the change in your emotional response over time?
- Q6 How has getting used to the spray-lamp (overall system) changed the emotional state(s) aroused by the smell?
- Q7 How would you describe the smell itself?
- Q8 How your bodily response to the smell influenced your relation with the lamp?
- Q9 How would have you reacted if the smell were disgusting to the extent to be unbearable?
- Q10 What was your reaction (bodily response and behavior) when the spraying increased (became more frequent)?
- Q11 What was the most annoying, bothering or shocking part of the experience?
- Q12 Please, describe how and to what extent the emotions aroused by the interaction with the lamp, elicited reflection(s).
- Q13 Would you define such a reflective activity as ethical?
- Q14 Why?
- Q15 What is energy consumption for you?
- Q16 How would you describe your awareness about the issue Energy Consumption before the interactive experience (quantitatively and qualitatively)?
- Q17 How changed your point of view on the issue E.C.?
- Q18 How the change in your point of view or the thoughtfulness
- Q19 How have your habits directly related to the domestic energy consumption changed?
- Q20 How and to what extent the overall experience aroused curiosity about the issue E.C.?
- Q21 Do you feel enriched by the overall interactive experience?
- Q22 What will you definitely not do in the future (habits related to domestic energy consumption)?
- Q23 What will you definitely do, instead?
- Q24 How did the different kinds of interaction influence your reflecting upon the issue?
- Q25 How would you define the last interaction (also in comparison to the others)?
- Q26 Do you think the increase in the frequency of the spraying being more effective (considering the purpose of the design)?
- Q27 How did the diary help you in expressing your thoughts?
- Q28 How did the diary influence your ethical reflection arousals?
- Q29 How would have your experience been without the diary?
- Q30 In what do you think the interaction failed to be effective?
- Q31 How would you change the system or the interaction?
- Q32 How do you think a better way to make people aware would be like?
- Q33 Will you miss the lamp?
- Q34 Why?

APPENDIX - I

Diary structure and layout

How to fill out the Event Related Section

Emotion Table

Basic emotions

*assertive-anger
aversion-fear
satisfaction-happiness
disappointment-sadness*

Bodily response

Bodily symptoms

<i>Lump in throat</i>	<i>Heart beating faster</i>
<i>Change in breathing</i>	<i>Muscles tensing, trembling</i>
<i>Stomach troubles</i>	<i>Muscles relaxing, restful</i>
<i>Feeling cold, shivering</i>	<i>Perspiring, moist hands</i>
<i>Feeling warm, pleasant</i>	<i>Other symptoms</i>
<i>Feeling hot, cheeks burning</i>	

Expressive reactions

- Laughing, smiling*
- Crying, sobbing*
- Other changes in facial expression*
- Screaming, yelling*
- Other changes in voice*
- Change in gesturing*

Verbal reactions

<i>Silence</i>	<i>Speech melody change</i>
<i>Short utterance</i>	<i>Speech disturbances</i>
<i>One or two sentences</i>	<i>Speech tempo changes</i>
<i>Lengthy utterance</i>	<i>Other verbal reactions</i>

APPENDIX - J

Questions/answers (weekly questionnaire)

Q7 What was your bodily response at that moment?

ESSAY

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM
heart beating faster

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM
No bodily response

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM
I do not have bodily response to it

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM
feeling warm, pleasant

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM
other reactions, I felt annoyed

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM
feeling warm, pleasant

Q11 Were the emotions you felt directly related to the interactive experience (smelling)?

TRUE / FALSE

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM
Yes

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM
Yes

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM
Yes

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM
No

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM
Yes

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM
Yes

APPENDIX - K

Questions/answers (weekly questionnaire)

Q13 Did the emotion arousal elicit any form of ethical reflection?

TRUE / FALSE

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM

No

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM

Yes

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM

No

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM

Yes

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM

No

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM

No

Q15 Did the emotional experience arouse an ethical reflection upon the issue Energy Consumption?

TRUE / FALSE

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM

Yes

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM

Yes

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM

No

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM

Yes

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM

Yes

APPENDIX - L

Questions/answers (weekly questionnaire)

Q21 How much in depth was the ethical reflection occurred?

RATING

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM

3 : 0

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM

2 : 0

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM

4 : 0

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM

Q22 What was the duration of such a reflection on average?

RATING

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM

3 : 0

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM

3 : 0

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM

4 : 0

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM

APPENDIX - M

Questions/answers (weekly questionnaire)

Q23 How many times the ethical reflection arousals occurred over the week?

RANGE

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM

Low : 6

High : 10

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM

Low : 1

High : 3

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM

Low : 10

High : 30

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM

Q24 Were the ethical reflection aroused by events other than the emotional experience related to the interaction with the lamp?

TRUE / FALSE

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM

No

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM

No

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM

Yes

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM

Yes

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM

Yes

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM

APPENDIX - N

Questions/answers (weekly questionnaire)

Q28 How often the ethical reflection was related to the issue Energy Consumption?

RATING

anonymous - Amsterdam, Netherlands - April 11, 2016 4:15 PM

2 : 0

anonymous - Amsterdam, Netherlands - April 18, 2016 4:16 PM

3 : 0

anonymous - Amsterdam, Netherlands - April 25, 2016 6:16 PM

3 : 0

anonymous - Amsterdam, Netherlands - May 3, 2016 7:55 PM

5 : 0

anonymous - Amsterdam, Netherlands - May 12, 2016 8:15 PM

2 : 0

anonymous - Eindhoven, Netherlands - May 24, 2016 7:01 AM

2 : 0

APPENDIX - O

Analysis of qualitative data (coding phase)

C:\Users\Gabriele\Desktop\TUE_Master\MASTER

Project Edit View Documents

beyond primary function

Code System

Documents

final questionnaire

video.interview

00003

00002

00001

00000

Sets

Multimedia Browser: 00000.mp4

Code System

beyond primary function

pleasure

EXCESS

annoyance

time

EXCESS

private - individual

sensorial

body response

shame

being judged

emotional shock

accustom

lack of references

detachment (non-engagement)

bias

aversion

being judged

context of use

print in memory (permanent association)

pleasure

being judged

context of use

print in memory (permanent association)

0 0 0

A screenshot of a Qualitative Data Analysis (QDA) software interface. The top navigation bar includes 'Project', 'Edit', 'View', 'Documents', and a 'beyond primary function' button. On the left, there's a 'Code System' panel with a tree view of categories like 'final questionnaire', 'video.interview', and several numerical entries (00003, 00002, 00001, 00000). Below it is a 'Sets' panel. The main area features a video player window titled 'Multimedia Browser: 00000.mp4' showing a woman in a black top sitting at a desk. A timeline at the bottom of the video player shows a segment from 00:05:01 to 00:17:13. To the left of the video player is a waveform visualization. The bottom half of the screen displays a detailed code system with various colored bars and labels such as 'EXCESS', 'annoyance', 'time', 'private - individual', 'sensorial', 'body response', 'shame', 'being judged', 'accustom', 'lack of references', 'detachment (non-engagement)', 'bias', 'aversion', 'being judged', 'context of use', and 'print in memory (permanent association)'. A legend on the far left maps colors to concepts like pleasure, aversion, and being judged.

APPENDIX - P

The most frequently occurring codes

Code System	final_questionnaire	video_interview
avoidance		■
beyond primary function		■
bias	■	
detachment (non-engagement)	■	
lack of references	■	
accustom	■	■
pleasure	■	■
being judged		■
context of use		■
print in memory (permanent association)	■	■
acknowledgement (inurement)	■	■
playing	■	■
public collective		■
already aware of		■
knowing and understanding	■	■
private - individual	■	■
excess	■	■
expressive interaction	■	■
sensorial	■	■
effectiveness		■
time		■
learning (being guided)	■	■
reflection - awareness	■	■
behavior change		■
ethical change	■	■
participation (proactive)	■	■
self-reflectiveness	■	■
bodily response		■
predictability and control	■	■
annoyance	■	■

APPENDIX - Q

The most frequently occurring codes in any single document

Code System	final_questionnaire	video_interview
avoidance		■
beyond primary function		■
bias	■	
detachment (non-engagement)	■	
lack of references	■	
accustom	■	■
pleasure	■	■
being judged		■
context of use		■
print in memory (permanent association)	■	■
acknowledgement (inurement)	■	■
playing	■	■
public collective		■
already aware of		■
knowing and understanding	■	■
private - individual	■	■
excess	■	■
expressive interaction	■	■
sensorial	■	■
effectiveness		■
time		■
learning (being guided)	■	■
reflection - awareness	■	■
behavior change		■
ethical change	■	■
participation (proactive)	■	
self-reflectiveness	■	■
bodily response	■	■
predictability and control	■	■
annoyance	■	■

APPENDIX - R

The frequency of any single code in both documents

Code System	final_questionnaire	video_interview
aversion		█
beyond primary function		█
bias	█	
detachment (non-engagement)	█	
lack of references	█	
accustom	█	█
pleasure	█	█
being judged		█
context of use		█
print in memory (permanent association)	█	
acknowledgement (inurement)	█	█
playing	█	
public collective		█
already aware of		█
knowing and understanding	█	
private - individual	█	█
excess	█	█
expressive interaction	█	█
sensorial	█	█
effectiveness		█
time		█
learning (being guided)	█	█
reflection - awareness	█	
behavior change		█
ethical change	█	█
participation (proactive)	█	
self-reflectiveness	█	█
bodily response		█
predictability and control	█	
annoyance	█	

APPENDIX - S

Codes included in categories

Code System	final_questionnaire	video_interview
▲ ACTION		
▢ participation (proactive)	■	■
▲ USE AND ENVIRONMENT		
▢ accustom	■	■
▷ ▢ context of use		■
▲ FEELINGS		
▢ excess	■	■
▢ annoyance	■	■
▢ pleasure	■	■
▲ SOCIAL SPHERE		
▢ private - individual	■	■
▷ ▢ public collective		■
▲ PERSONAL CHARACTER		
▢ playing	■	■
▲ ETHICAL STANCE		
▷ ▢ bias	■	■
▲ RECOGNIZABILITY		
▢ expressive interaction	■	■
▲ THINKING AND REASONING		
▢ acknowledgement (inurement)	■	■
▢ self-reflectiveness	■	■
▢ reflection - awareness	■	
▢ print in memory (permanent association)	■	
▢ knowing and understanding	■	
▲ PHYSICAL		
▢ sensorial	■	■
▷ ▢ bodily response		■
▲ DYNAMICS		
▢ time		■
▢ effectiveness		■
▲ STATIC		
▢ detachment (non-engagement)	■	
▲ UNCERTAINTY		
▷ ▢ being judged		■
▢ lack of references	■	
▲ CONTROL		
▢ avoidance		■
▢ predictability and control	■	■
▷ ▢ learning (being guided)	■	■
▲ TRANSFORMATION		
▷ ▢ behavior change		■
▢ beyond primary function		■
▢ ethical change	■	■

APPENDIX - T

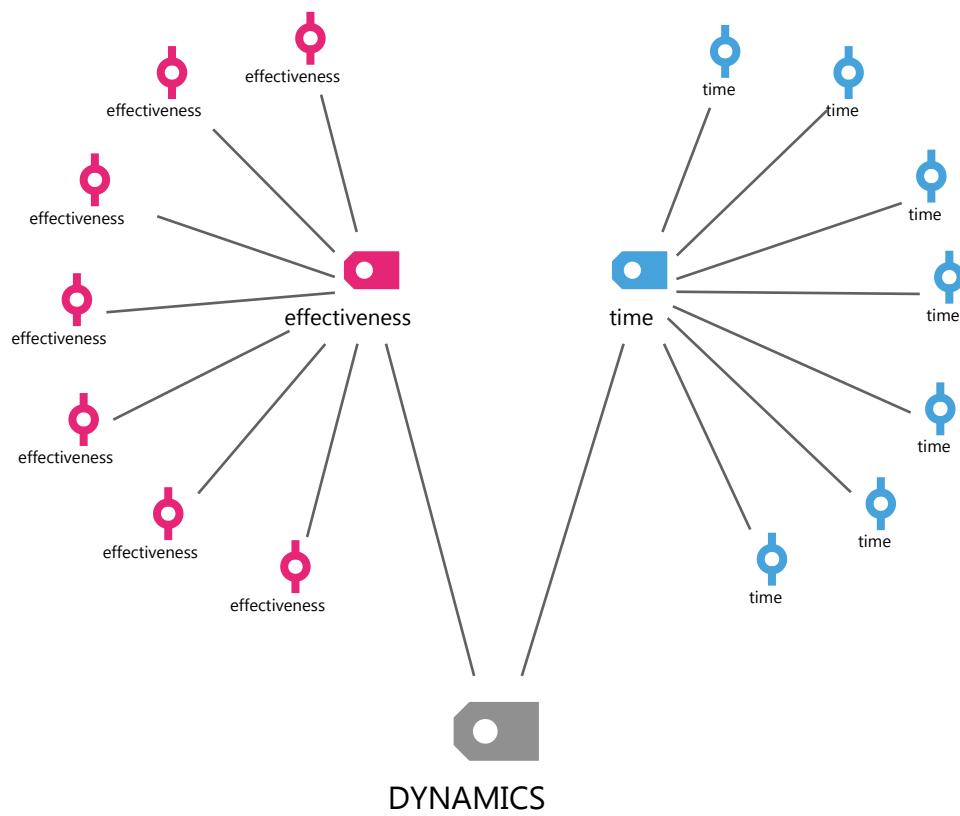
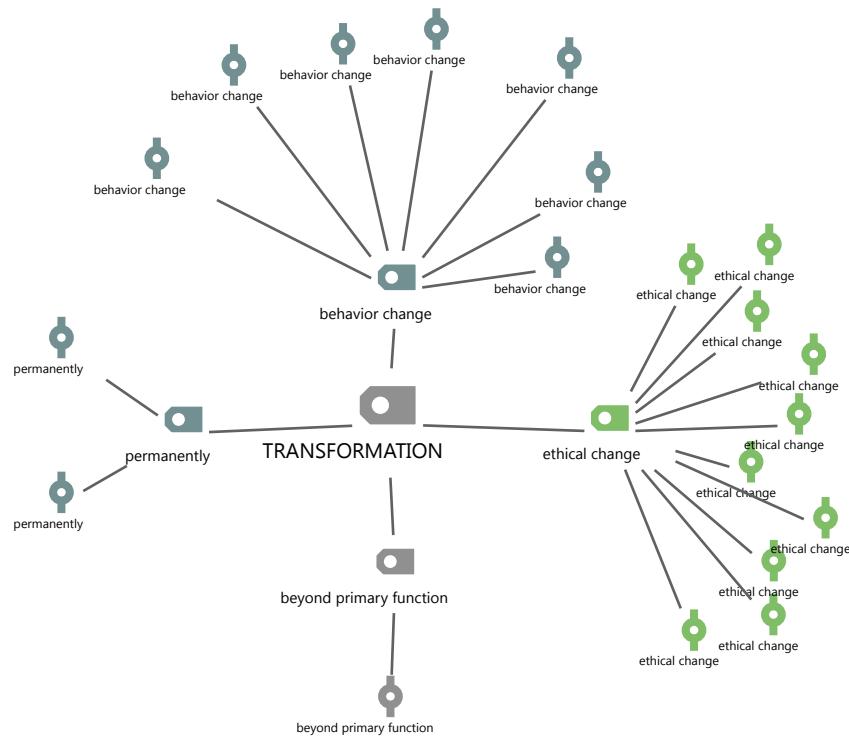
Frequency of occurrence (categories)

Code System	final_questionnaire	video_interview
▷ ⚡ ACTION	■	■
▷ ⚡ USE AND ENVIRONMENT	■	■
▷ ⚡ FEELINGS	■	■
▷ ⚡ SOCIAL SPHERE	■	■
▷ ⚡ PERSONAL CHARACTER	■	■
▷ ⚡ ETHICAL STANCE	■	■
▷ ⚡ RECOGNIZABILITY	■	■
▷ ⚡ THINKING AND REASONING	■	■
▷ ⚡ PHYSICAL	■	■
▷ ⚡ DYNAMICS		■
▷ ⚡ STATIC	■	
▷ ⚡ UNCERTAINTY	■	■
▷ ⚡ CONTROL	■	■
▷ ⚡ TRANSFORMATION	■	■

Code System	final_questionnaire	video_interview
▷ ⚡ ACTION	■	■
▷ ⚡ USE AND ENVIRONMENT	■	■
▷ ⚡ FEELINGS	■	■
▷ ⚡ SOCIAL SPHERE	■	■
▷ ⚡ PERSONAL CHARACTER	■	■
▷ ⚡ ETHICAL STANCE	■	■
▷ ⚡ RECOGNIZABILITY	■	■
▷ ⚡ THINKING AND REASONING	■	■
▷ ⚡ PHYSICAL	■	■
▷ ⚡ DYNAMICS		■
▷ ⚡ STATIC	■	
▷ ⚡ UNCERTAINTY	■	
▷ ⚡ CONTROL	■	■
▷ ⚡ TRANSFORMATION	■	■

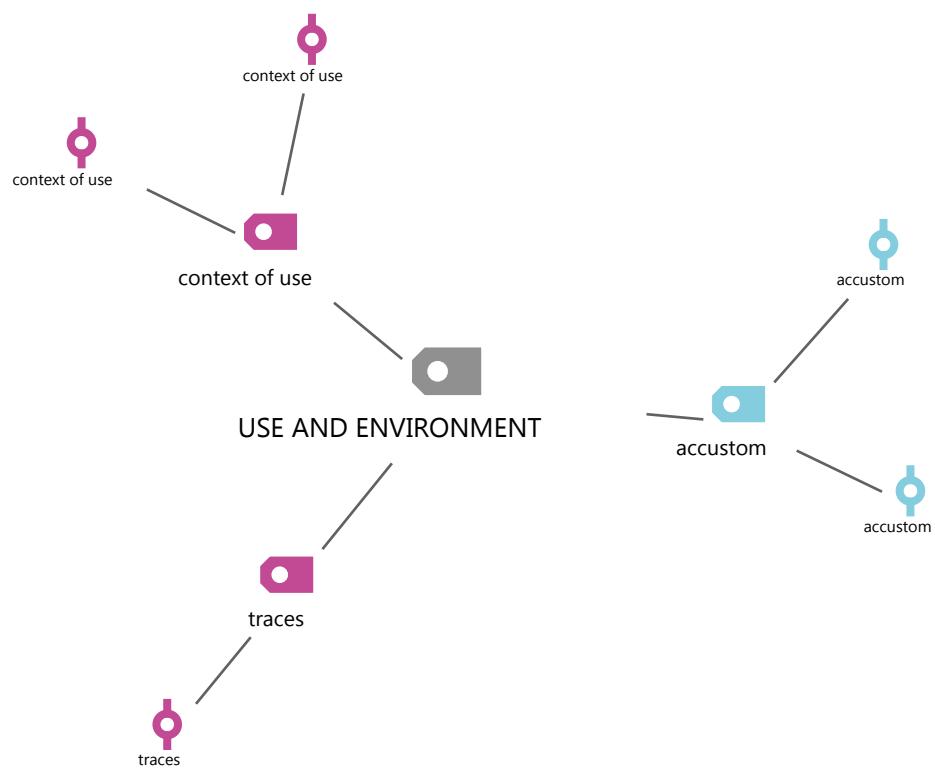
APPENDIX - U

Category map



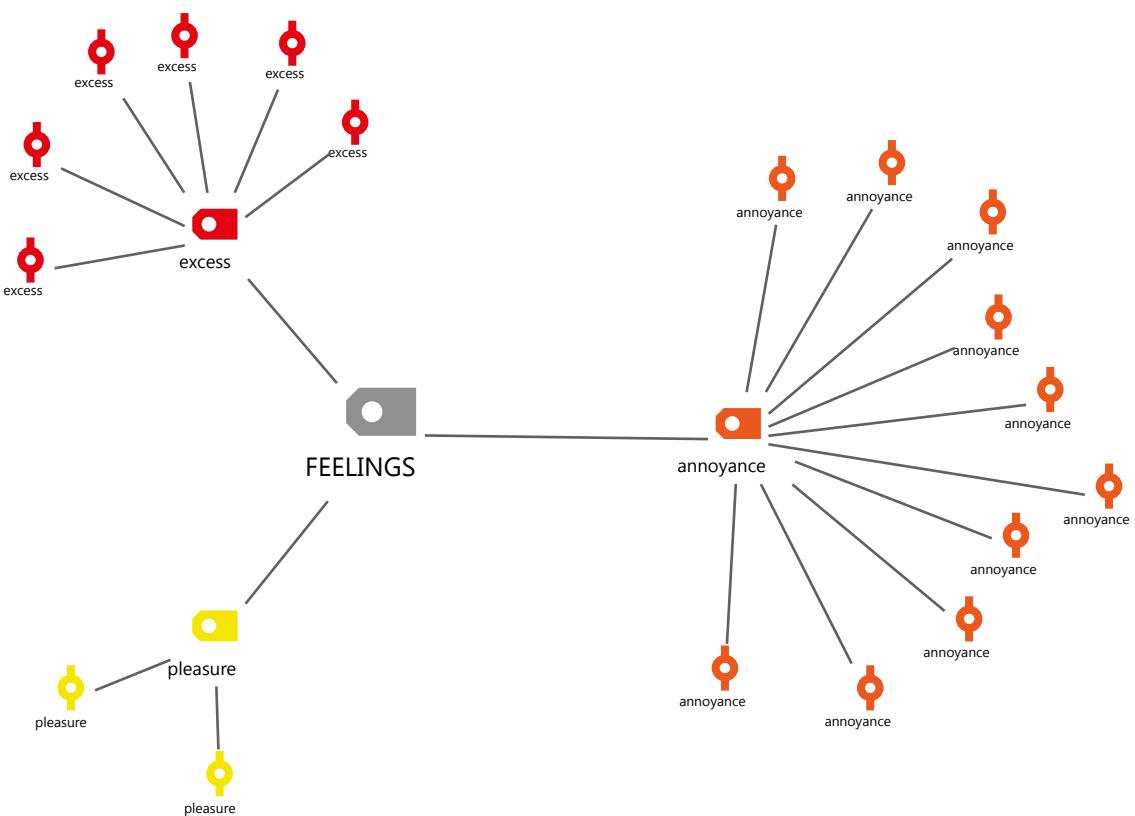
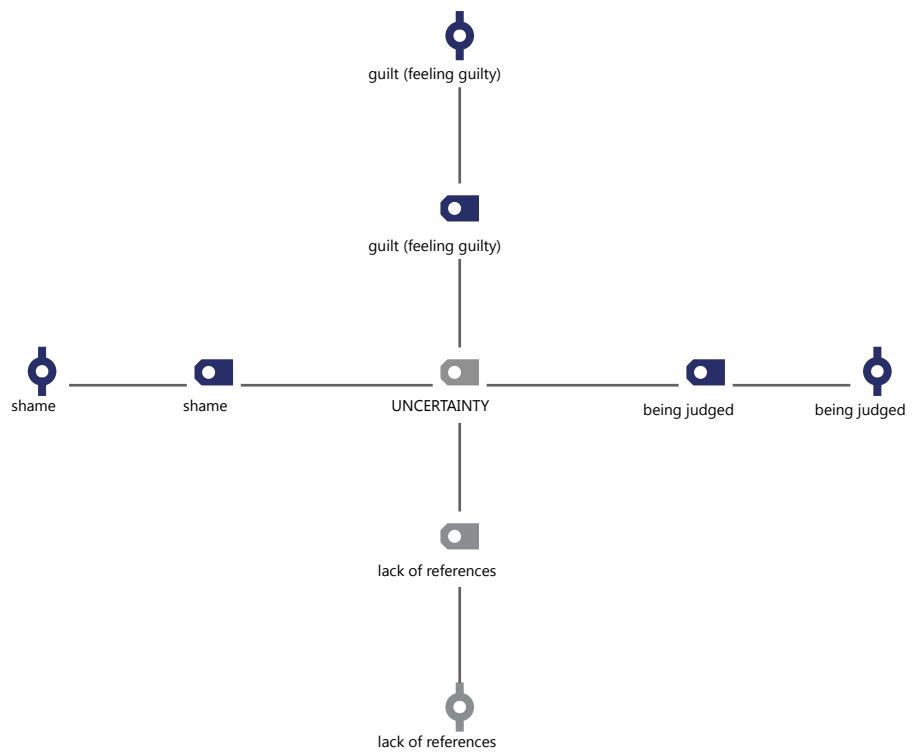
APPENDIX - W

Category map



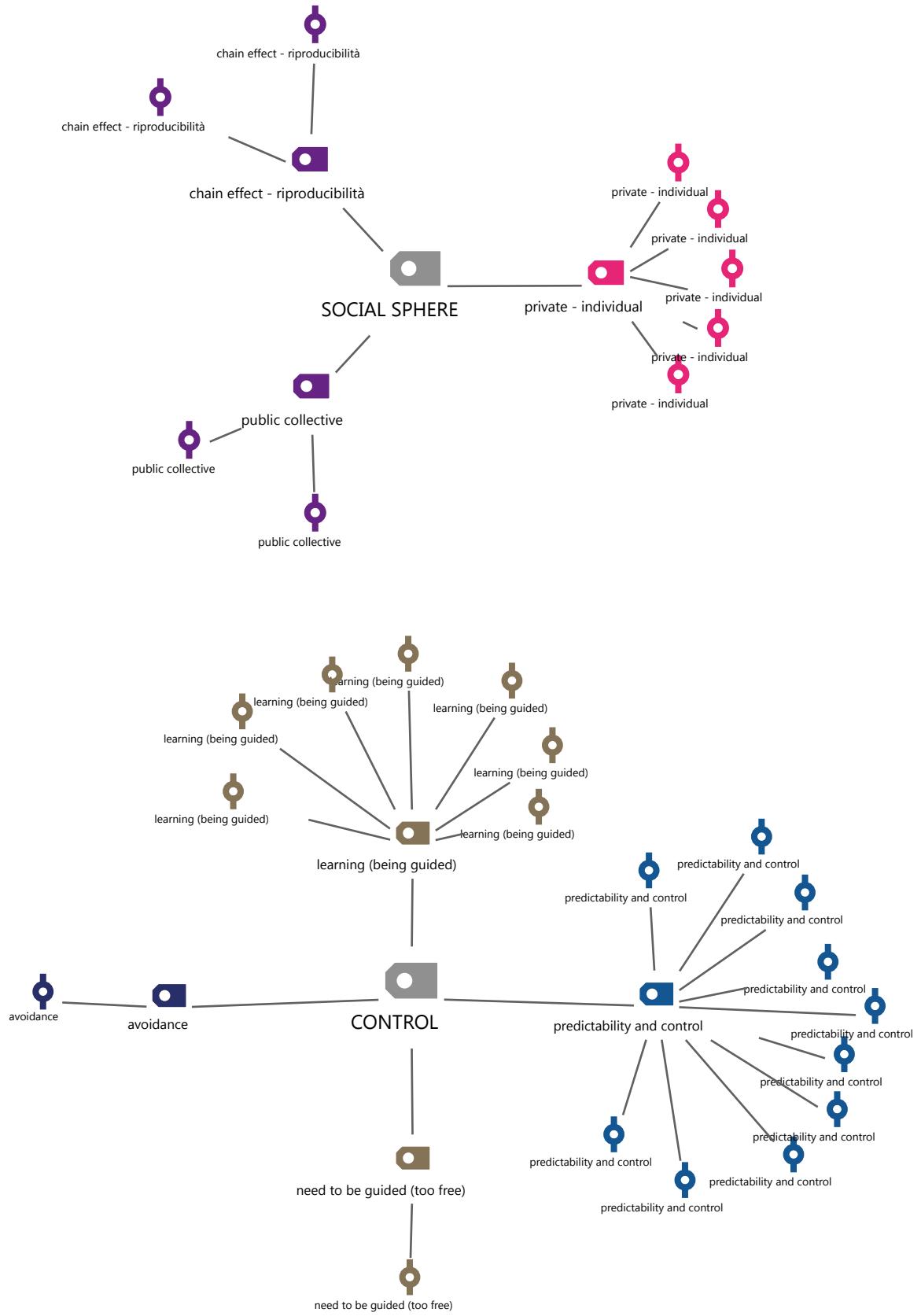
APPENDIX - Y

Category map



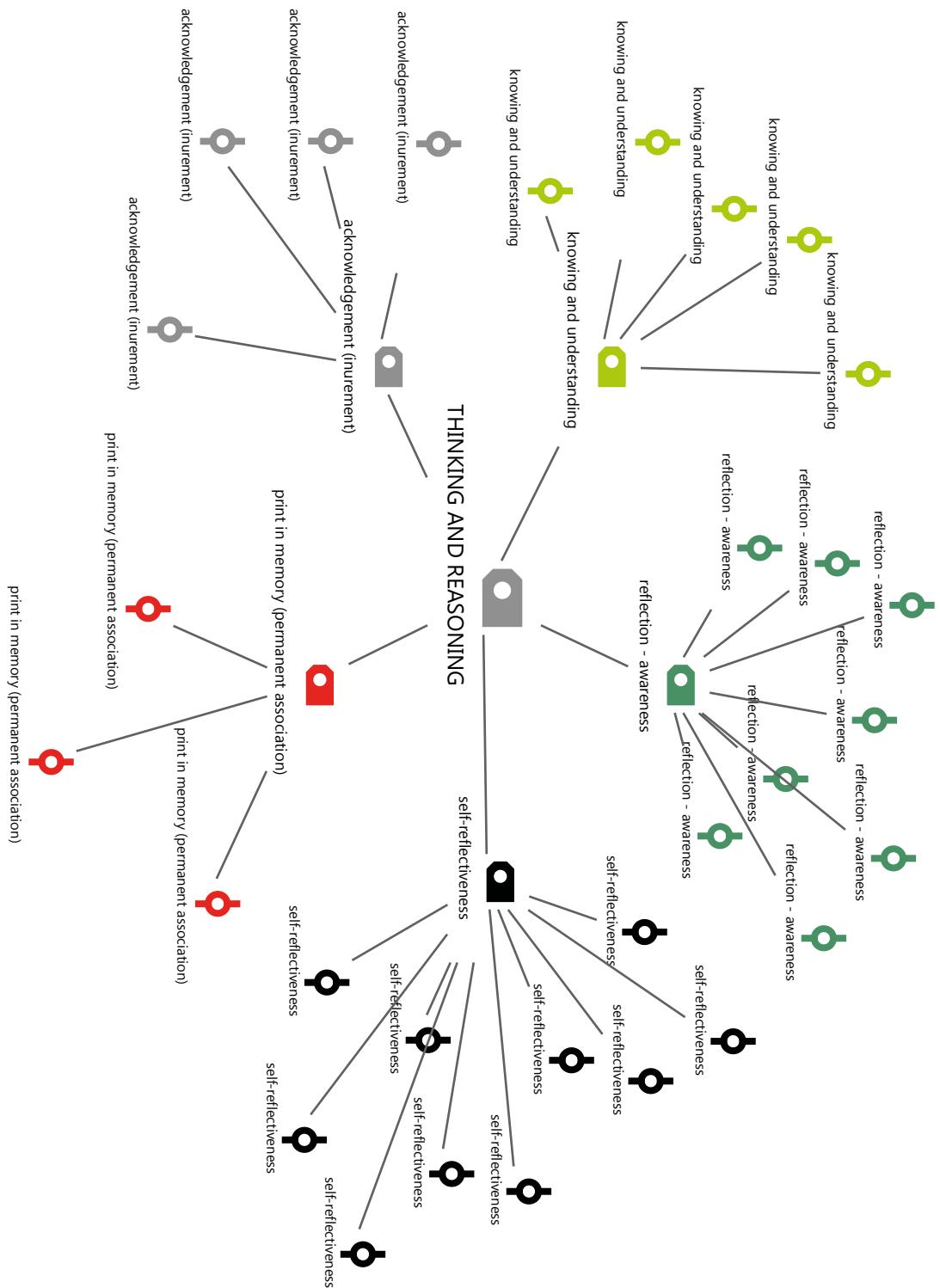
APPENDIX - X

Category map



APPENDIX - Z

Category map



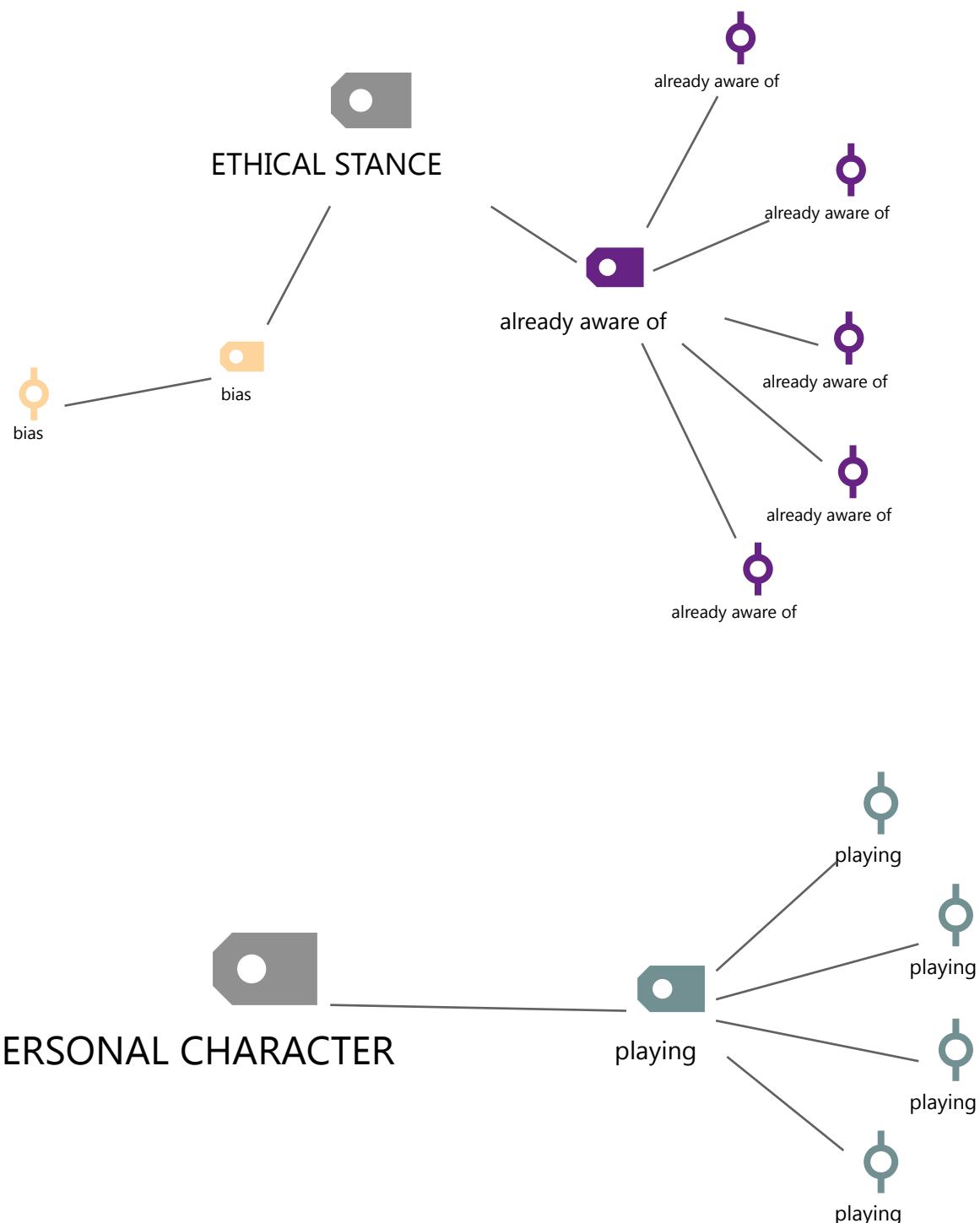
APPENDIX - A.0

Category map



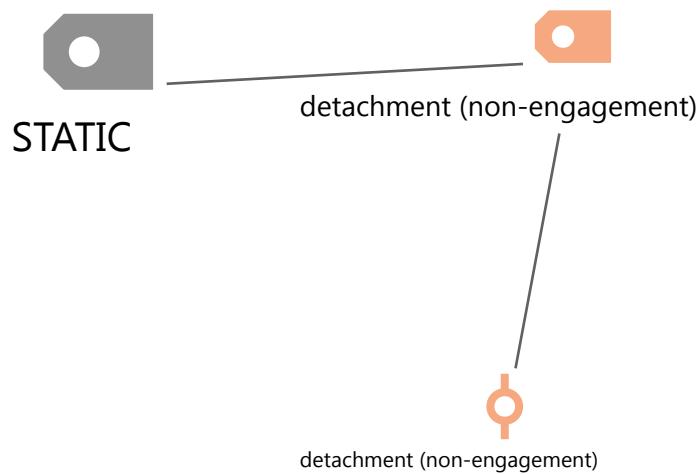
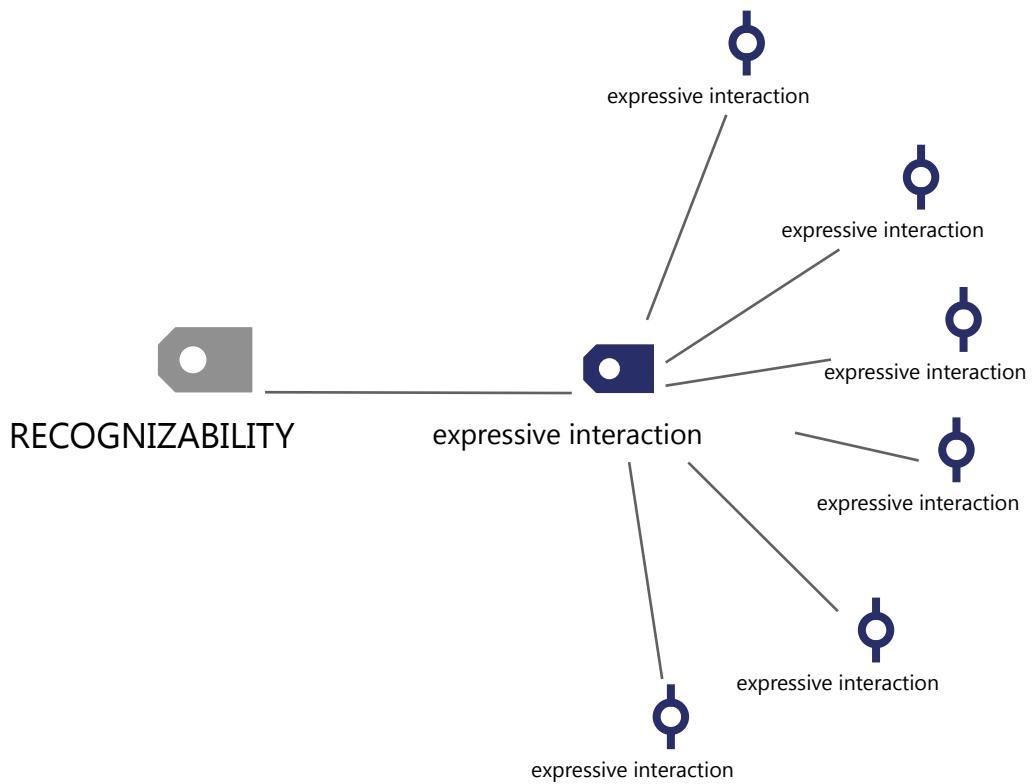
APPENDIX - B.0

Category map



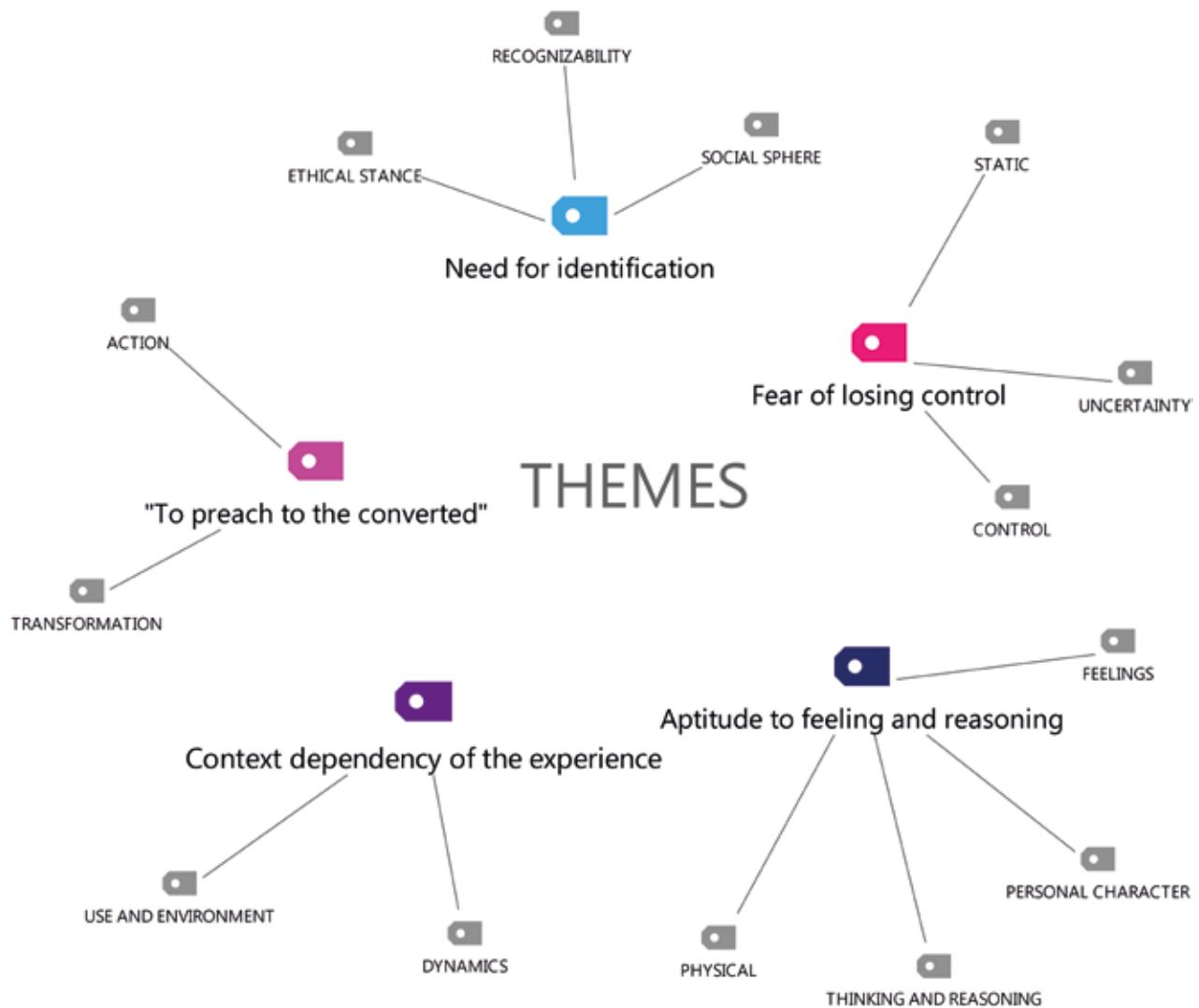
APPENDIX - C.0

Category map



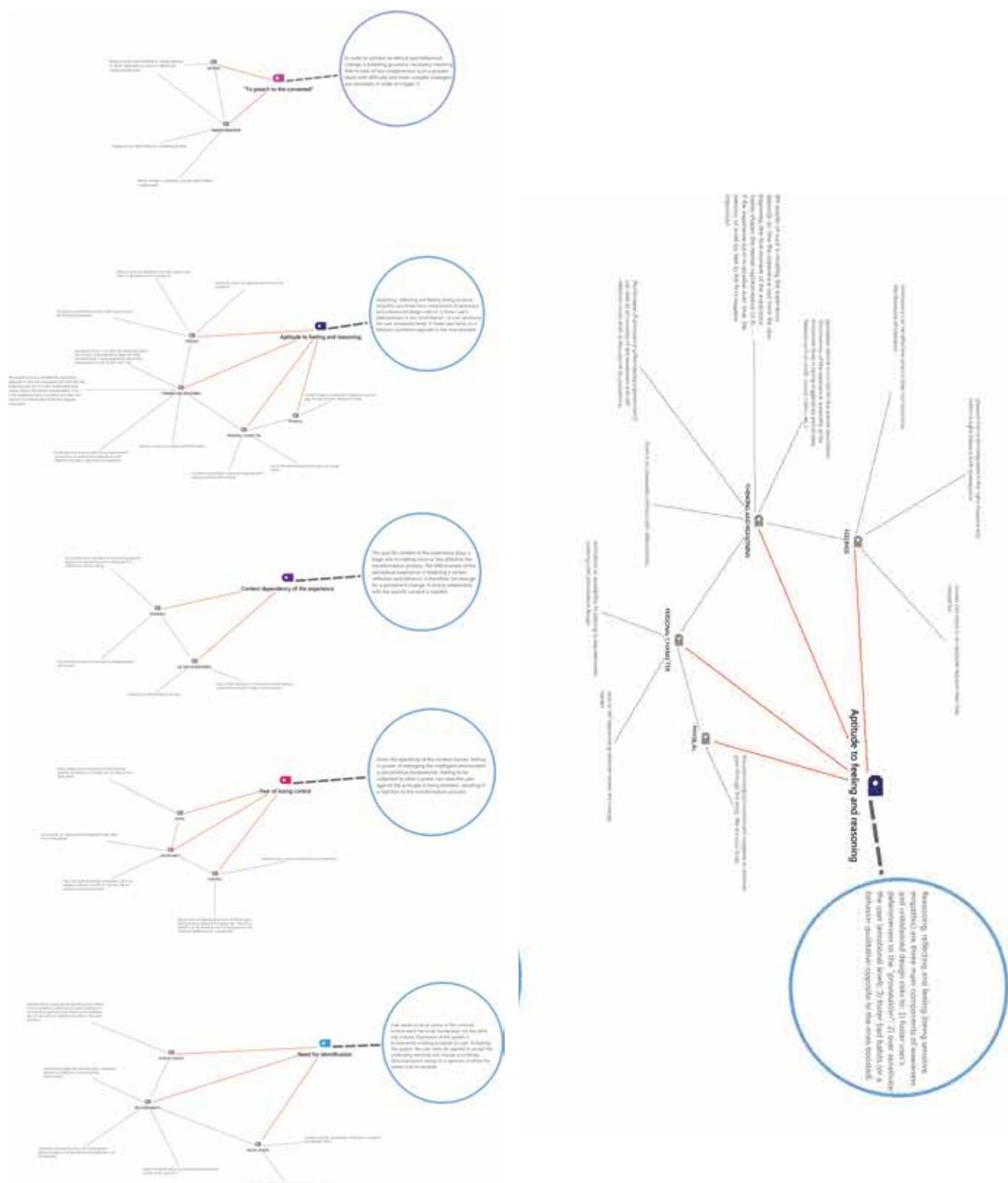
APPENDIX - D.0

Themes map



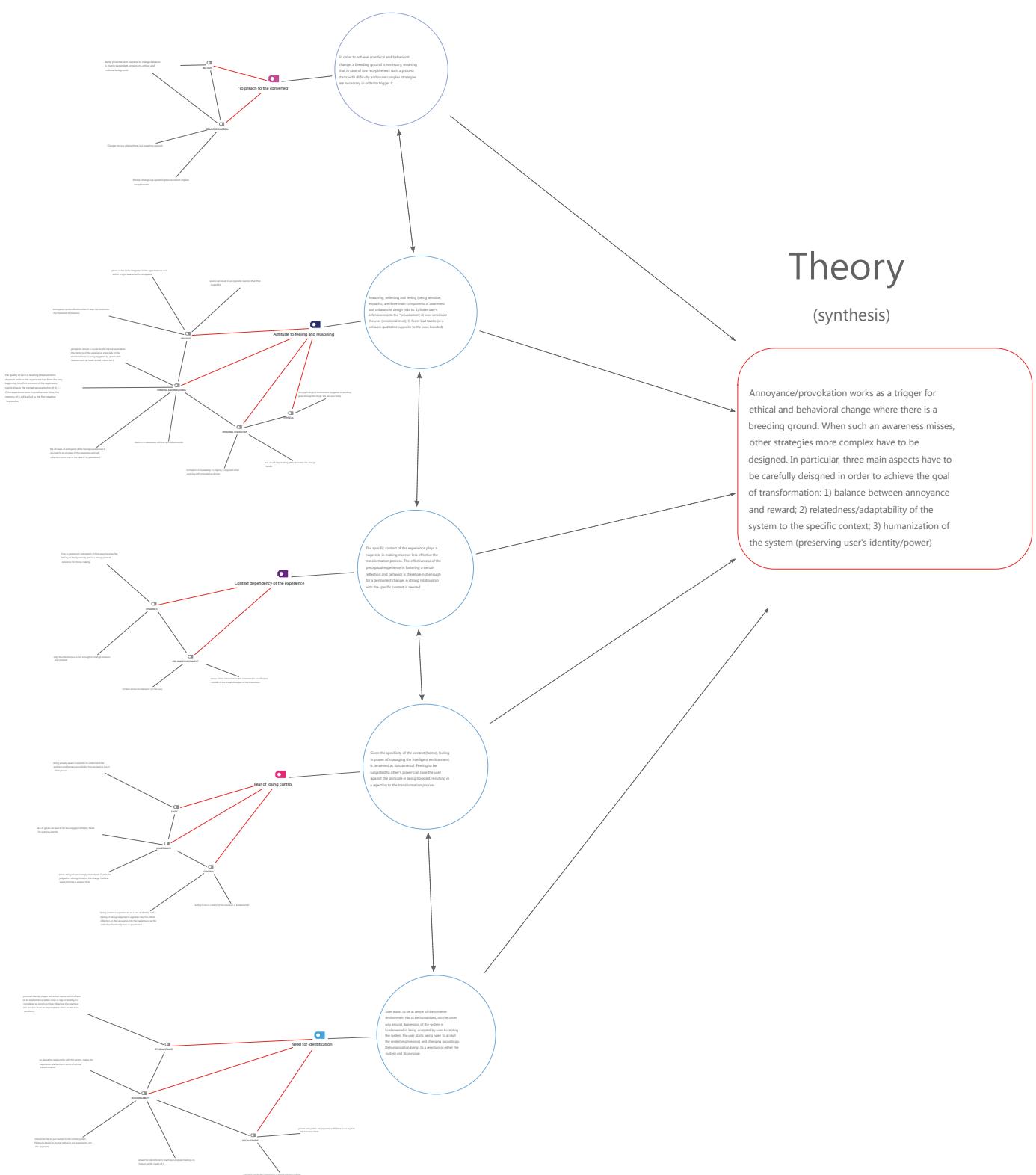
APPENDIX - E.0

From themes to theory



APPENDIX - F.0

Theory construction



APPENDIX - G.0

Polyurethane casting resin



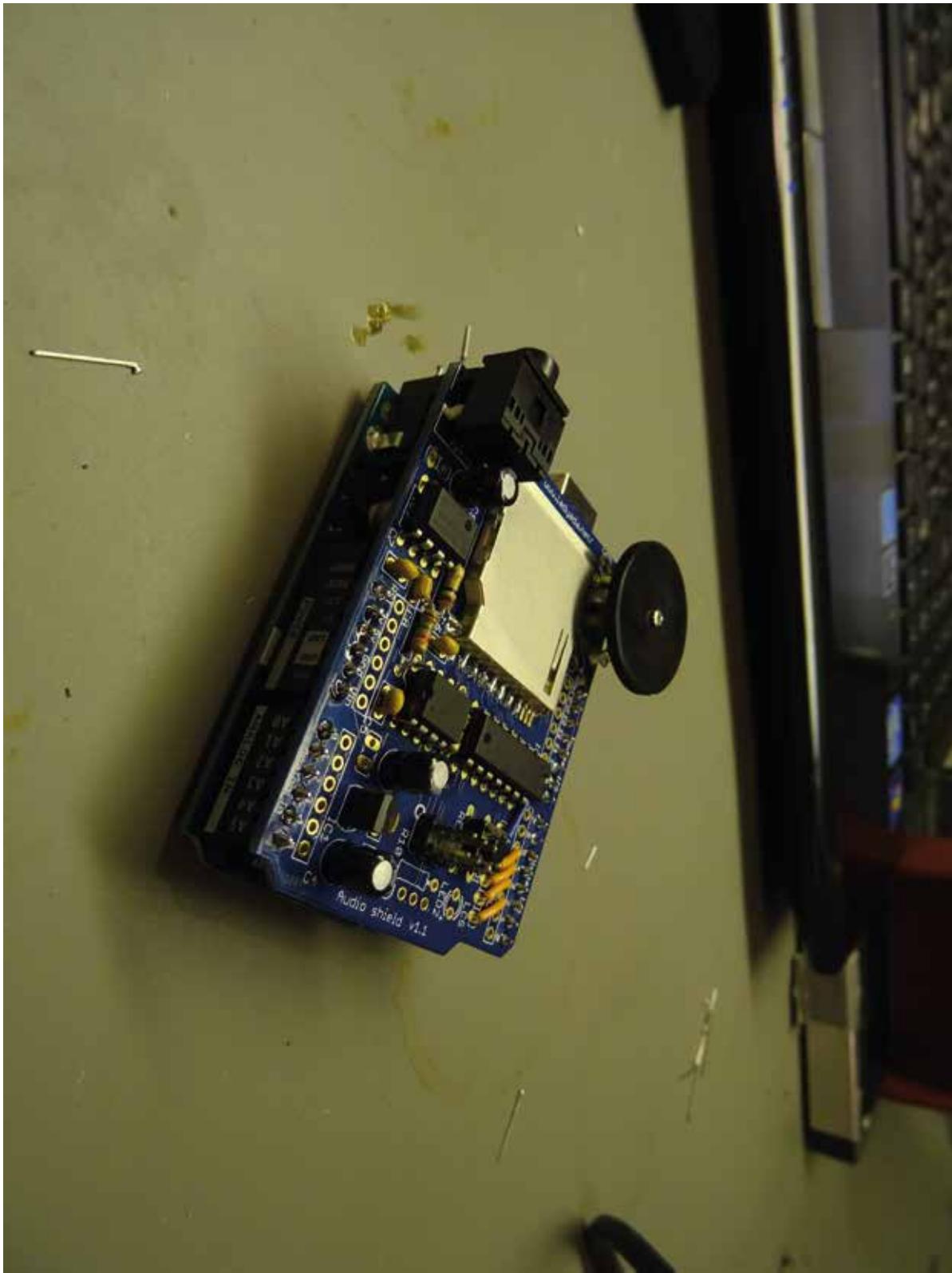
APPENDIX - H.0

Insulated box for the electronics



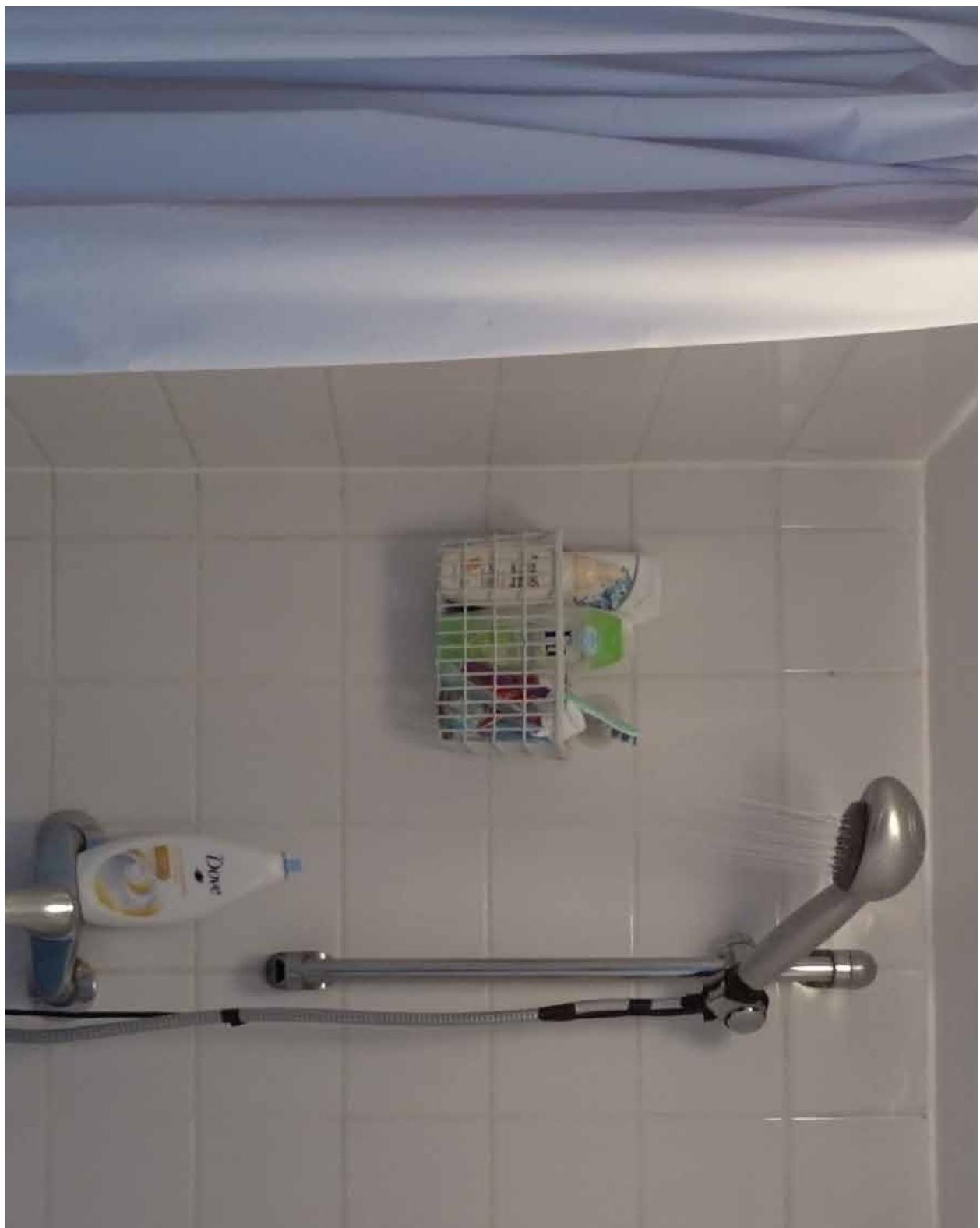
APPENDIX - I.0

Shield for playing music with Arduino



APPENDIX - J.0

Shower faucet within the context



APPENDIX - K.0

Questionnaire between the interactions (shower)

The Noisy Shower - weekly experience

Please think carefully of the overall experience of interacting with the Noisy Shower over the last week and answer the following questions.

- Q1 How did you experience hearing the sounds emitted by the shower faucet?
- Q2 How would you define the experience of repeatedly hearing those sounds?
- Q3 How much?
- Q4 Why?
- Q5 Which emotions connected with the interactive experience did you feel?
- Q6 How intense was it?
- Q7 What was your bodily response at that moment?
- Q8 How long did that feeling last?
- Q9 Please, think of your emotional state after having had the shower; how did you feel?
- Q10 How long did that emotional state last?
- Q11 Please, rate how much the interactive experience influenced your mood in the time span between one shower and the other.
- Q12 Please, rate your level of adaptation to the sound experience over the week.
- Q13 Please, rate the increase of your annoyance over the week.
- Q14 Were the emotions you felt directly related to the interactive experience (hearing)?
- Q15 Please describe which connections were between the emotion arousal and the interactive experience for each single episode.
- Q16 Did the emotion arousal elicit any form of ethical reflection?
- Q17 If you answered YES to the previous question, please briefly describe the dynamics of such an arousal and the matter of the ethical reflection.
- Q18 Did the emotional experience arouse an ethical reflection upon the issue Energy Consumption?
- Q19 If you answered YES to the previous question, please describe more in detail the nature of the ethical reflection (focus on the content).
- Q20 Now think back of the past week, would you link your emotional arousal(s) to the issue Energy Consumption, retrospectively?
- Q21 Did knowing the research purpose influence the link between the emotion felt and the issue Energy Consumption?
- Q22 How much? Please rate it from one to six.
- Q23 How much in depth was the ethical reflection occurred?
- Q24 What was the duration of such a reflection on average?
- Q25 How many times the ethical reflection arousals occurred over the week?
- Q26 Were the ethical reflection aroused by events other than the emotional experience related to the interaction with the lamp?
- Q27 If you answered YES to the previous question, please give some examples of such events.
- Q28 Did the ethical reflection you had itself arouse any emotional state?
- Q29 If you answered YES to the previous question, describe such a dynamics referring to the four basic emotions (*). In other words, try to describe how the ethical reflection triggered the emotional state.
- Q30 How often the ethical reflection was related to the issue Energy Consumption?
- Q31 Did knowing the research purpose influence the frequency of your reflecting (ethically or not) upon the issue Energy Consumption?
- Q32 How much? Please rate from one to six.
- Q33 How did you interact with the noisy shower?
- Q34 Did you try to physically interact with the shower faucet in order to modify the sound?
- Q35 Did you realise that you could adjust the volume of the sound by using the shower knob?
- Q36 How long did it take you to realise that?

- Q37 Please, briefly describe the possibility of the interaction, thus how the interactive system works (as far

APPENDIX - L.0

Questions/answers (questionnaire between interactions)

Q1 How did you experience hearing the sounds emitted by the shower faucet?

ESSAY

anonymous - Eindhoven, Netherlands - May 29, 2016 10:08 AM

Well, it was not a pleasing experience by any means. I have a very visual imagination, so the sounds for me were always linked with some horrifying image in my mind, for example one that always came up was the painting The Scream by Edvard Munch, which I have always found to be a very chilling/dark painting for me to see when I was studying arts. Other things that came up were some horrible experiences of being at the dentist with getting my wisdom teeth removed due to the drilling sounds in the shower. Some thriller movies also came to mind with the chainsaw like noises. So the sound experience in the shower for me was actually a very visual, and imaginative experience.

miguel.cabral.guerra@gmail.com - June 4, 2016 6:22 PM

Honestly it was a really unpleasant experience. I take a shower everyday right after I wake up. Most of the time I am still half asleep and waking up to the sound of someone screaming, a power drill and an ambulance is far from being a nice experience.

Q4 Why?

ESSAY

anonymous - Eindhoven, Netherlands - May 29, 2016 10:08 AM

Like I said in the first question, the visual experience for me was very off-putting based on these sounds. As I always shower in the morning, it is not exactly the kind of things I'd like to think about when starting my day and getting fresh. So for me those images and sounds were very disturbing. Thankfully, I didn't find them very loud, so trying to ignore them was a bit easier.

miguel.cabral.guerra@gmail.com - June 4, 2016 6:22 PM

As I mentioned in the first question the sounds you hear are extremely annoying, specially

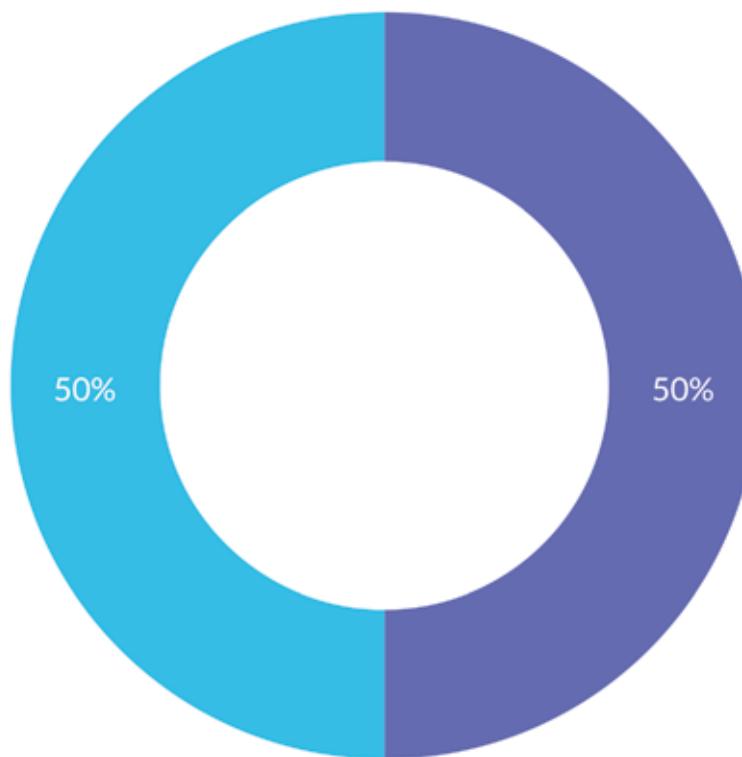
APPENDIX - M .0

Questions/answers (questionnaire between interactions)

Q5

Which emotions connected with the interactive experience did you feel?*

MULTIPLE
CHOICE

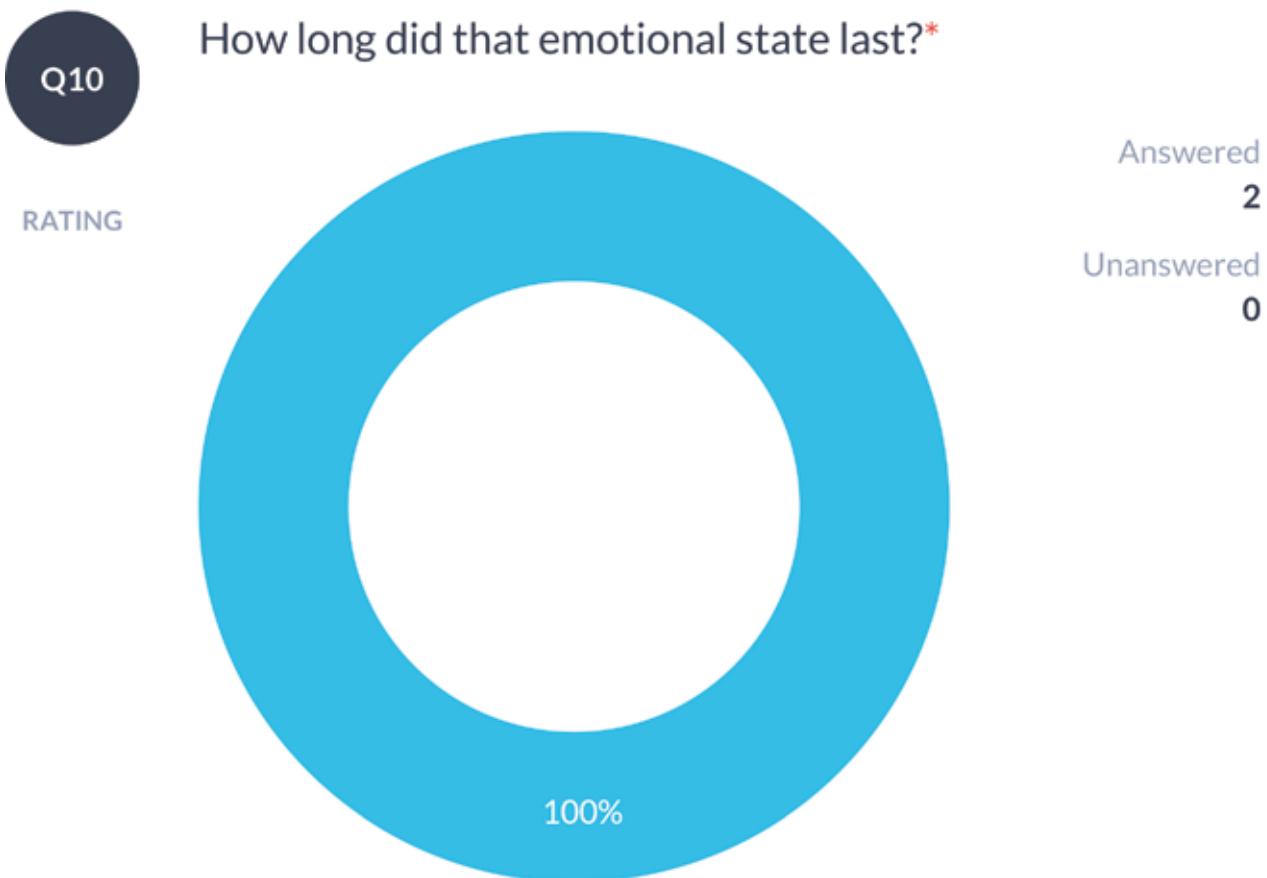


Answered
2
Unanswered
0

Choice	Total
● assertive-anger	1
● aversion-fear	1
● disappointment-sadness	0
● satisfaction-happiness	0

APPENDIX - N.0

Questions/answers (questionnaire between interactions)



Choice	Total	Rating
● 1-1 - (few minutes)	0	0
● 2-2	2	4
● 3-3	0	0
● 4-4	0	0
● 5-5	0	0
● 6-6 - (entire day)	0	0

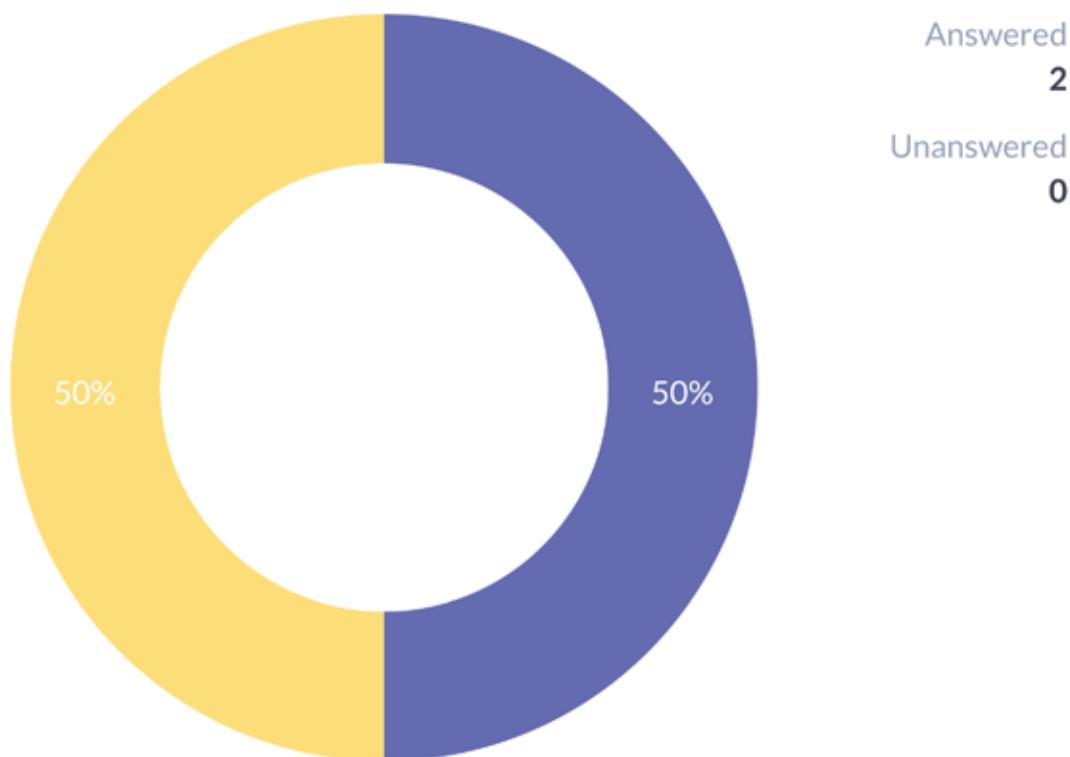
APPENDIX - O.0

Questions/answers (questionnaire between interactions)

Q11

Please, rate how much the interactive experience influenced your mood in the time span between one shower and the other.*

RATING



Choice	Total	Rating
● 1-1 - (very little)	1	1
● 2-2	0	0
● 3-3	0	0
● 4-4	1	4
● 5-5	0	0

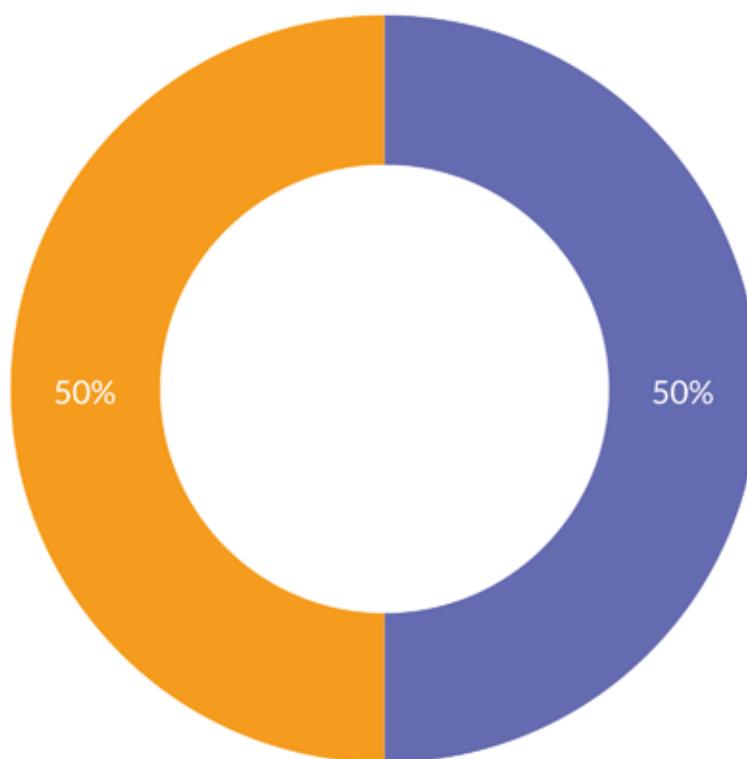
APPENDIX - P.0

Questions/answers (questionnaire between interactions)

Q12

Please, rate your level of adaptation to the sound experience over the week.*

RATING



Answered

2

Unanswered

0

Choice	Total	Rating
● 1-1 - (very little)	1	1
● 2-2	0	0
● 3-3	0	0
● 4-4	0	0
● 5-5	1	5
● 6-6 - (very much)	0	0

APPENDIX - Q.0

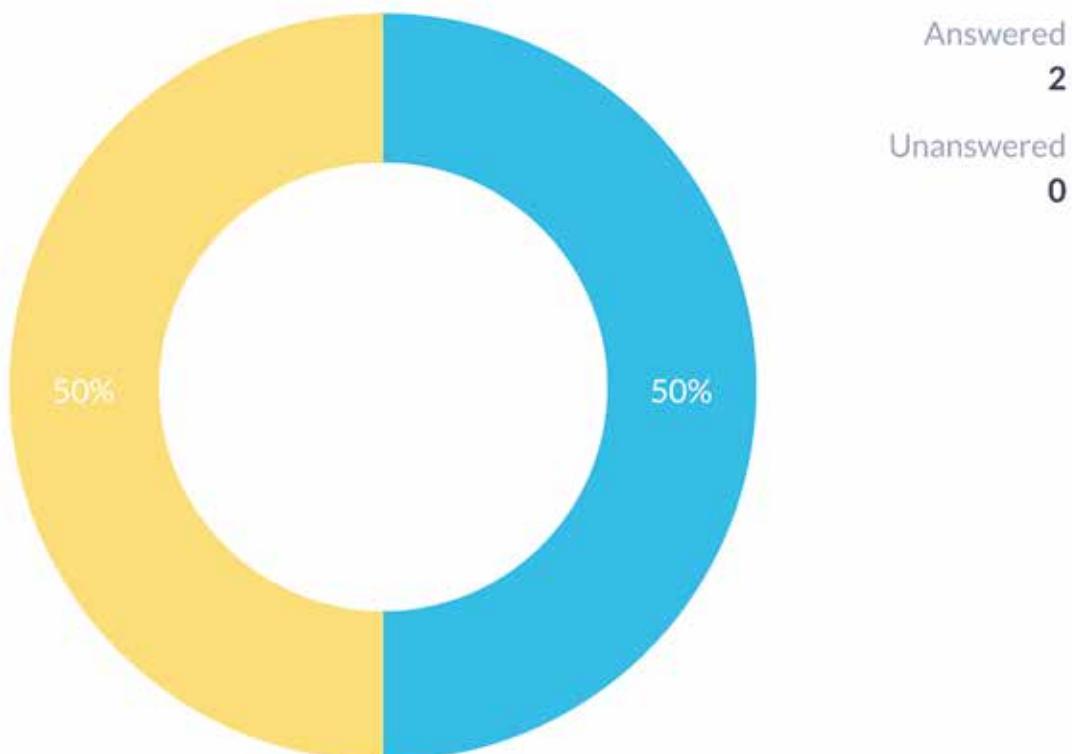
Questions/answers (questionnaire between interactions)

Q13

Please, rate the increase of your annoyance over the week.*

E.g. you can compare the last day of the week to the first one.

RATING



Choice	Total	Rating
0-1 - (very little)	0	0
0-2	1	0
0-3	0	0
0-4	1	0
0-5	0	0

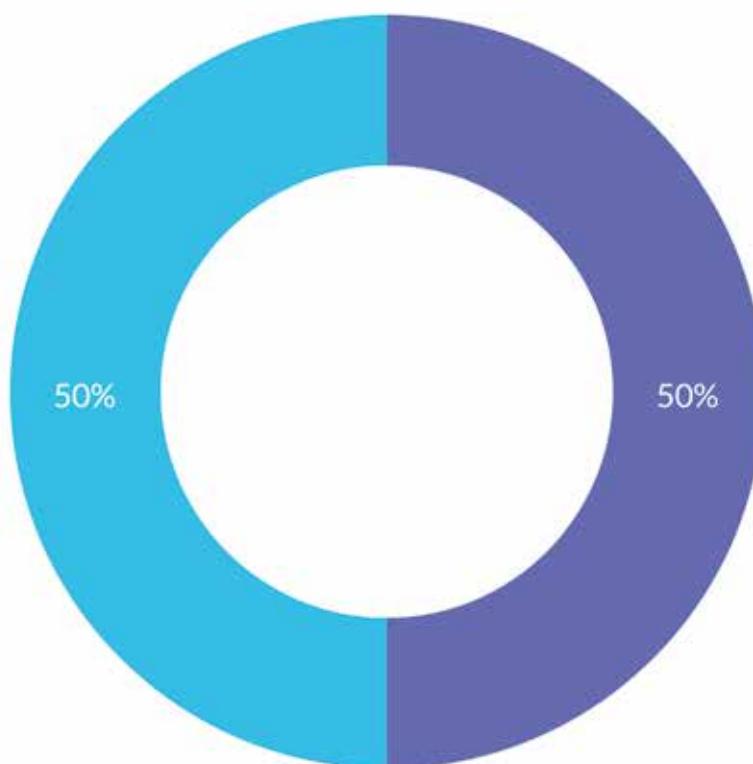
APPENDIX - R.0

Questions/answers (questionnaire between interactions)

Q16

Did the emotion arousal elicit any form of ethical reflection?*

TRUE
FALSE



Answered
2
Unanswered
0

Choice	Total
Yes	1
No	1

- Yes 1
- No 1

APPENDIX - S.0

Questions/answers (questionnaire between interactions)

Q17

ESSAY

If you answered YES to the previous question, please briefly describe the dynamics of such an arousal and the matter of the ethical reflection.

If you answered NO to the previous question, please carry on.

May 29, 2016 10:08 AM

Well I started to think the negative sounds which I assume are to the purpose of changing behavior, did not have to necessarily be these kinds of sounds. The sounds played I feel were really trying to cause a sense of fear and aversion, and gave me very dark thoughts, and was much more emotional and deep. On the other hand I can think of tons of annoying sounds like an alarm clock going off loudly which would have been just as effective in getting me out of the shower more quickly, without needing to create this truly negative emotional experience. I start to think of the psychological work done on classical conditioning, and in this case I think these kinds of dark sounds associated with showering are almost conditioning someone to associate fear and negative thoughts with too much water usage. I am not sure that is a very 'ethical' thing to do. I think for some people hearing these kinds of disturbing sounds could have more long term emotional effects throughout the day, luckily for me it did not have a very lasting impact throughout the day or the whole week.

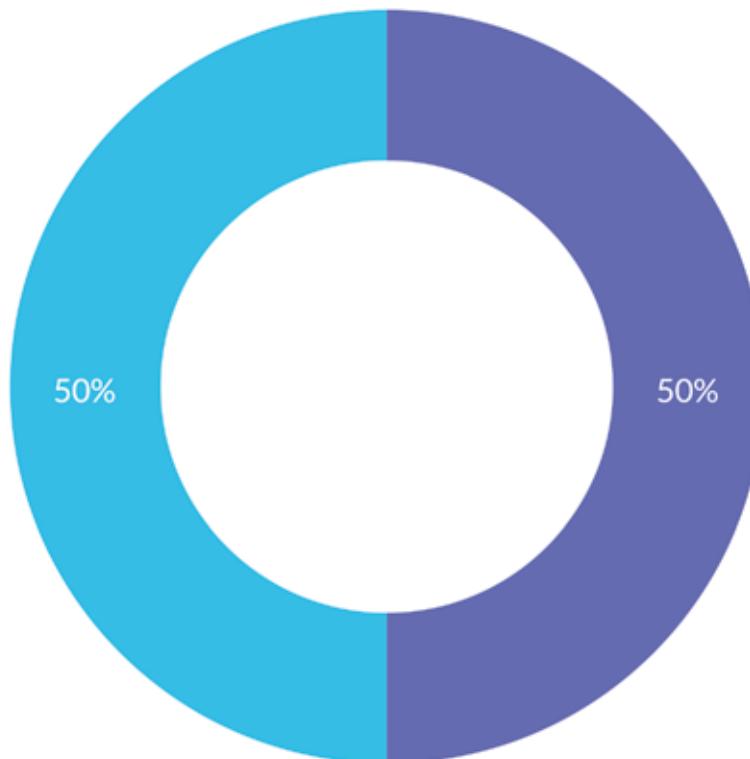
APPENDIX - T.0

Questions/answers (questionnaire between interactions)

Q18

Did the emotional experience arouse an ethical reflection upon the issue Energy Consumption?*

TRUE
FALSE



Answered

2

Unanswered

0

Choice

Total

● Yes

1

● No

1

APPENDIX - U.0

Frequency relationships among codes

Code System	M.	S.
progressive	.	
ritual (value)	.	
public collective	.	■
private-personal	■	■
need to be guided	■	■
uncertainty	■	
anger	■	
awareness	■	■
playing	■	■
competition	■	
being judged		■
participation	■	
conditioning (feeling)	■	
emotions	■	
guilt	■	
individualism	■	
lack of self-esteem	■	
power	■	
expressive interaction	■	
pleasure	■	
need for balance	■	
empowering	■	
unlearn (learn wrong)		■
reward	■	■
defensiveness	■	
refusal (narrowminded)	■	
bias	■	
ethical stance	■	
ethical reflection	■	■
ethical change	■	
visualising (seeing)	■	
understanding	■	
senseless	■	
meaningful	■	
need for association	■	
knowing and reflecting	■	■
time	■	
punishment	■	
violent	■	
predictability and control	■	■
inappropriateness (wrong design)	■	■
avoidance	■	
subjection	■	
accustom	■	
ineffective	■	■
body response	■	
sensitivity (character)	■	
printed in memory	■	
excess		■
oversensitivize	■	
intensity	■	
change behavior	■	■
effectiveness	■	
shock	■	
annoyance		■
fear		■

Code System	M.	S.
progressive	■	
ritual (value)	■	
public collective	■	■
private-personal	■	■
need to be guided	■	■
uncertainty	■	
anger	■	
awareness	■	■
playing	■	
competition	■	
being judged	■	
participation	■	
conditioning (feeling)	■	
emotions	■	■
guilt	■	■
individualism	■	
lack of self-esteem	■	
power	■	
expressive interaction	■	
pleasure	■	
need for balance	■	
empowering	■	
unlearn (learn wrong)	■	
reward	■	■
defensiveness	■	
refusal (narrowminded)	■	
bias	■	■
ethical stance	■	
ethical reflection	■	■
ethical change	■	
visualising (seeing)	■	
understanding	■	■
senseless	■	
meaningful	■	■
need for association	■	
knowing and reflecting	■	■
time	■	
punishment	■	
violent	■	
predictability and control	■	
inappropriateness (wrong design)	■	
avoidance	■	
subjection	■	
accustom	■	
ineffective	■	
body response	■	
sensitivity (character)	■	
printed in memory	■	
excess		■
oversensitivize	■	
intensity	■	
change behavior	■	
effectiveness	■	
shock	■	
annoyance		■
fear		■

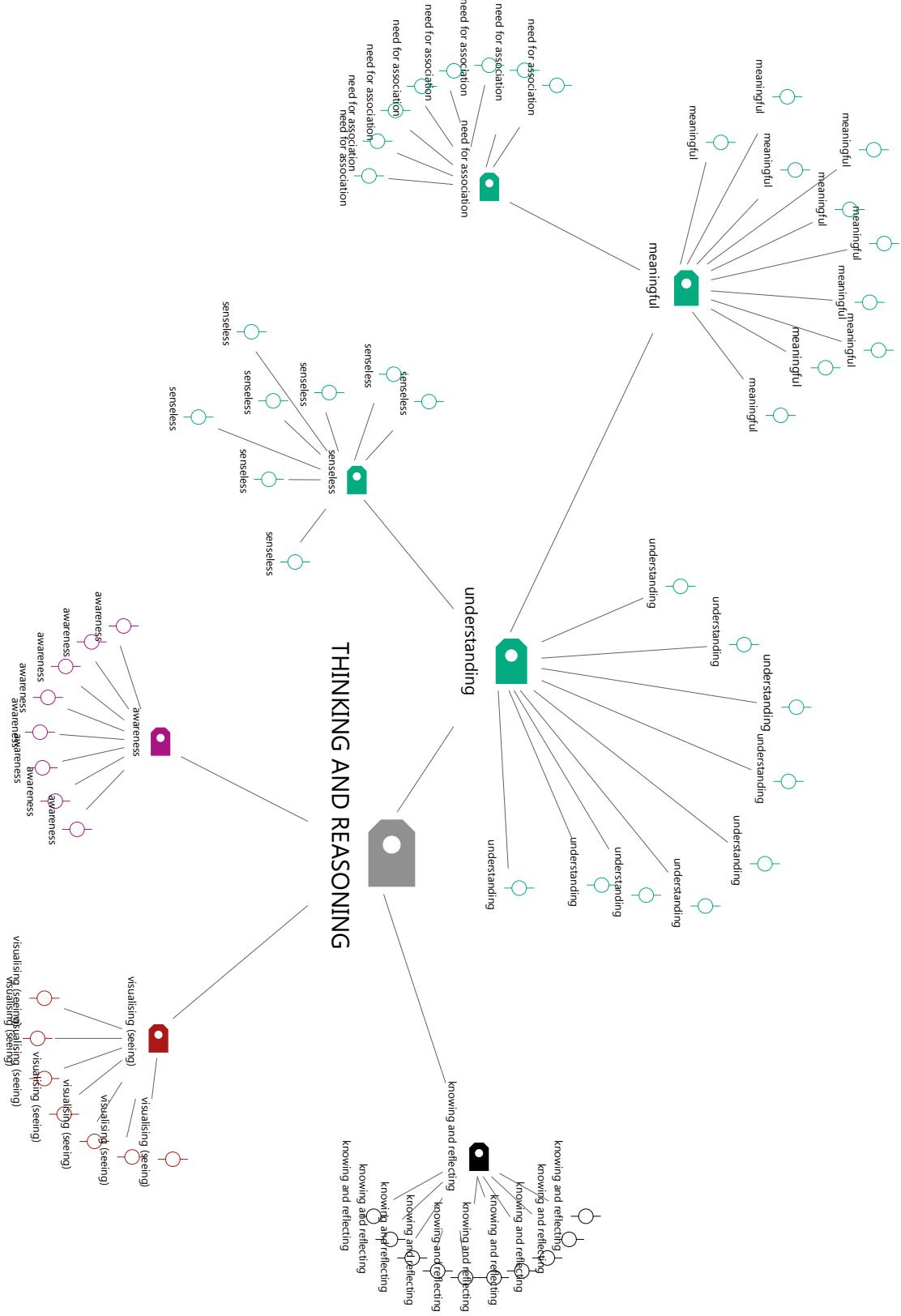
APPENDIX - V.0

Categories and most frequent codes

Code System	M.	S.
▷ ⚡ (UN)BALANCE	■	■
▷ ⚡ ACTION	■	■
▷ ⚡ TRANSFORMATION	■	■
▷ ⚡ ETHICS	■	■
▷ ⚡ VISION	■	■
▷ ⚡ IDENTITY	■	■
▷ ⚡ DYNAMIC	■	■
▷ ⚡ INSECURITY	■	■
▷ ⚡ CONTROL	■	■
▷ ⚡ FEELING and EMOTIONS	■	■
▷ ⚡ POWER AND FREEDOM	■	■
▷ ⚡ THINKING AND REASONING	■	■

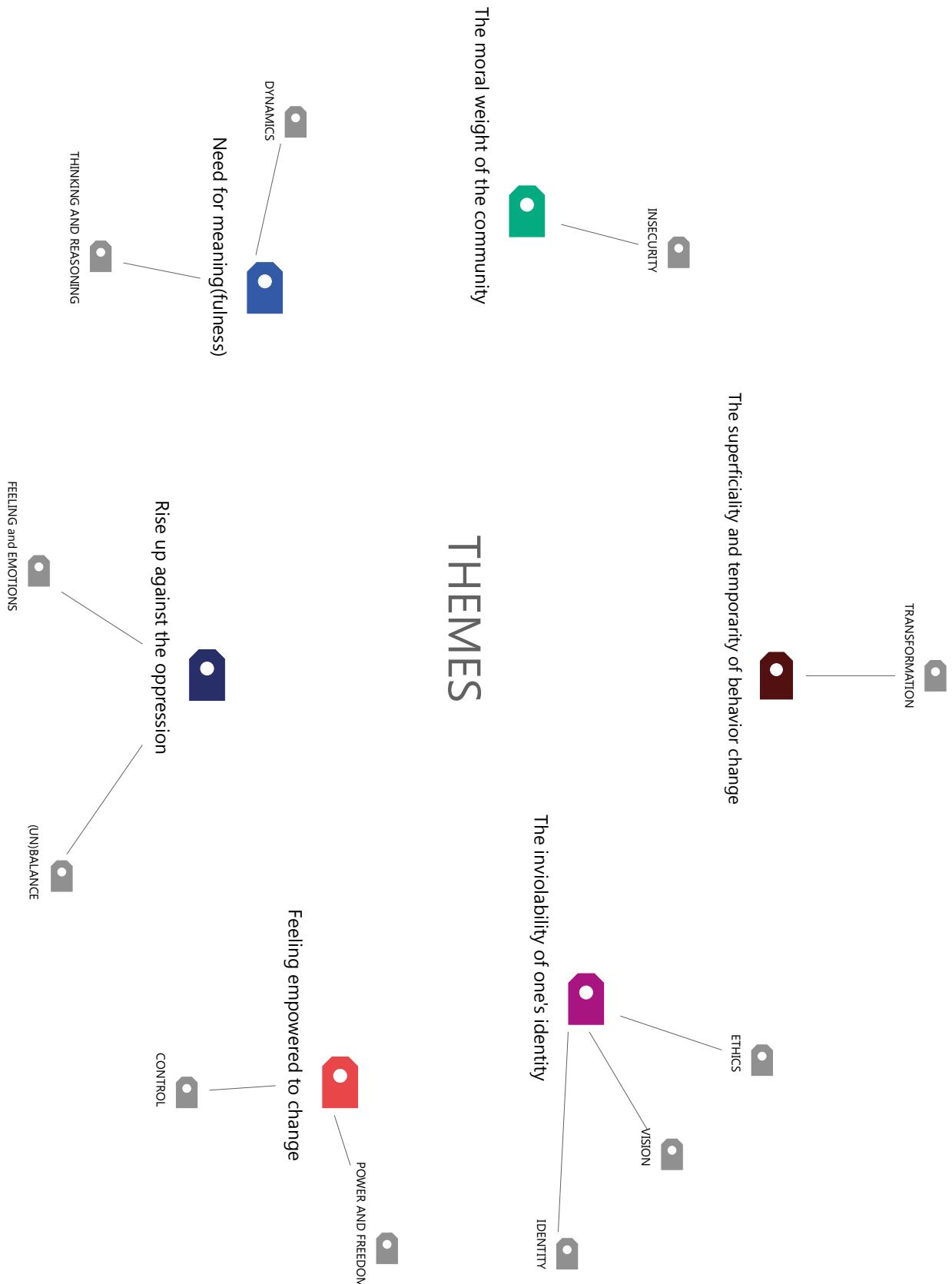
APPENDIX - W.0

Category map



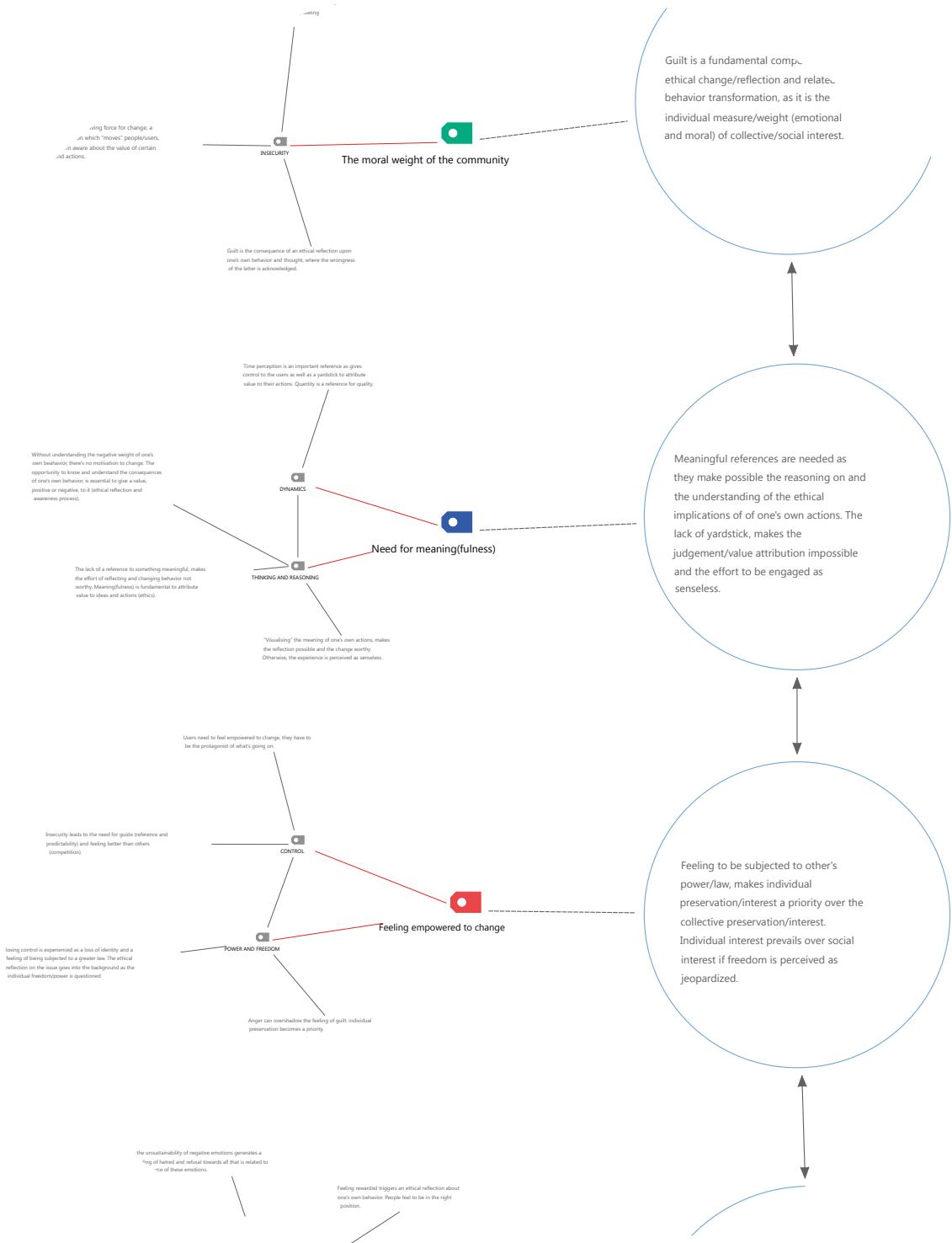
APPENDIX - X.0

Themes map



APPENDIX - Y.0

Theory construction (detail)



APPENDIX - Z.0

Theory construction

Theory (synthesis)

