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The Ambience Questionnaire: An Exploratory Study of Ambience in Urban Places

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ABSTRACT

Ambience is often related to architecture and urban planning but is also a subject of study in relation to Interaction Design and Human Computer Interaction (HCI). Having a tool that can measure the ambience of a place could offer new opportunities in the field of HCI. This is the reason why our interest is focused on the creation of the *Ambience Questionnaire.*We generated our *Ambience Questionnaire* inspired by the literature of Interaction Design, environmental psychology and architecture. Moreover, from the study of the literature, we have derived our personal interpretation of the elements that contribute to the transition to ambience. These concepts inspired us for the creation of our *Ambience Questionnaire* and were a useful resource because during the phase of brainstorming, they gave us more insights on how to generate the questions for our questionnaire. We defined these elements as: situatedness (the impact of places and cultures) sociality (the influence of other people in the context) and experience (intended as a continuum of knowledge that the subject collects).

Author Keywords

Ambience, questionnaire, perception, place, space, environment, atmosphere, experience.

INTRODUCTION

Ambience is the perception of an experienced atmosphere that affects people in the environment, playing an important role in the perception of the design of the space. Furthermore, the ambience contributes to derive positive or negative perception on places. In the Human Computer Interaction field of study, there have been attempts to investigate ambience from a theoretical and practical point of view, where authors researched how ambience can be used to improve the quality of life of people in different context and situations both indoor and outdoor. Our approach is to develop a tool by using the theory of perception and find a way to measure it. This can be important because it might open new directions for design and evaluation studies and also it could contribute to other domains like usability.

The motivation for quantifying ambience in this study is similar to the reason for quantifying usability. In relation to usability, tools have been developed both to measure the objective usability and subjective usability. Objective usability collects tangible data such as the number of errors and the time used to complete a task. The subjective usability is more focused on the personal experience gained from using an artifact. Tools to collect objective data of the environment are already in use to measure air pollution, temperature and more. Therefore, we argue that a tool, that can measure ambience, could provide opportunities to address issues that people experience and interpret from their perception of an environment.

To have an understanding of ambience and how it is perceived, can be considered useful in the research and design phases of interaction design and urban planing studies to identify if there are issues with the perceived ambience of a place. Consequently, we decided to create a questionnaire with the purpose to facilitate an understanding of ambience. This understanding of ambience can provide opportunities to improve peoples experience of places from a subjective point of view.

In this study we aim to unfold an understanding of ambience through the literature to create questions that can help understand how the ambience of a place is perceived. This understanding will used to elaborate questions for the creation of our Ambience Questionnaire. Moreover, the process to achieve the final results include the use of SPSS as tool for the statistical analysis. The exploration phase during which we explorer which factors define ambience will be presented shown in two separated iterations of Exploratory Factor Analysis (EFA). A description of the participants and the process of data collection, including the distribution of questionnaires, will also be provided.

The results of our study and the Ambience Questionnaire are presented and discussed in relation to the possible contributions and suggestions for future works. More details about the process, analysis and application will be shown in the corresponding sections. Furthermore, we will discuss the limitations of this study and suggest solutions towards these limitations.

WHAT IS AMBIENCE

In order to understand what constitutes and defines ambience we will unfold the theory of Piga and Morello. According to Piga and Morello, the environment can be divided in two categerories: *Physical environment* (space and atmosphere) and *Perceived environment* (place and ambience). (Piga and Morello, 2015)

PHYSICAL ENVIRONMENT ←⋯→ PERCEIVED ENVIRONMENT

        space ←→ place

    atmosphere ←→ ambiance

               sensing

Figure 1. Representation of the physical and perceived environment. (Piga and Morello, 2015)

The model in figure 1 presented by Piga and Morello, shows the relation between the physical and perceived environment. The physical environment is shown on the left side of the model. Under the physical environment there is the space that is represented by features like water, soil, trees and people. In fact, the word *features* refers to people, animals and objects that exist in the space. The interaction with these elements form the atmosphere. "(...) we define the atmosphere as the complex interaction of the physical features of the environment(...)" (Piga and Morello, 2015). The information that derives from the environment is collected by the individuals sensory receptors: eyes, ears, nose and touch. After a person perceives through the senses a space, becomes a place and an atmosphere becomes ambience as shown on the right side of figure 1.

The perceived environment is the perception and interpretation of the physical features experienced in the physical environment. When a person interacts with a space through the senses, the individual perceives and interprets space based on his relations, knowledge and experience in order to transform a place. Similar to the transition from space to place, atmosphere becomes an ambience when it is experienced and interpreted. Therefore, Piga and Morello argue that the perceived environment is the interpretation of the physical environment (Piga and Morello, 2015).

The information that is collected from the environment is analyzed, memorized, experienced and internalized as knowledge (Piga and Morello, 2015). Therefore Piga and Morello state that "(...), the ambiance of a place is here intended as the physical atmosphere processed through human senses, culture and personal experience" (Piga and Morello, 2015) The interaction through the senses results in the perceived environment. As Piga and Morello stated:

> *"(..)we never perceive reality as it is. Even if we can conceive an outer reality, we can only experience it through the interaction of our body and mind, a process that involves the actions of sens-*

ing, perceiving, experiencing and knowing". (Piga and Morello, 2015)

Similar studies that investigate the perceived environment of an urban place can be interesting to examine, in order to understand how others have defined and used the perceived environment. For example Dalsgaard and Kortbek (2009) developed a model "An expanded analytical model of atmosphere" which focused on an atmosphere of an urban environment. The model shows that the perceived atmosphere derives from the experience of elements such as *others* (other people), *space* and *technology*. The implications of these elements, are similar to the understanding we derived from Piga and Morello, where they also claimed, that the social aspects influence the perception of the environment.

The model of Piga and Morello focuses on peoples perception of the environment, whereas Dalsgaard and Kortbek created a model of atmosphere in the field of interaction design where both the subject and the space relation are affected by the technology and the social aspects. The authors focused in particular on the technological dimension and how people perceived the atmosphere once some technological installation were added to the urban environment (Dalsgaard and Kortbek, 2009). Hence, they focused on the atmosphere of the interactions with technology, rather than the ambience of a place. We are not interested in the interaction and alteration of the atmosphere, on the contrary we want to define ambience and collect information on people's perception of an ambience.

The reason why we focus on perception rather than interaction is based on the fact that, we are more interested in understanding how the environment is interpreted, rather than how people interact with the environment and the technology. Therefore, instead of researching what the atmosphere is, we investigate how the atmosphere becomes an ambience, and what influence this transition when people perceive.

Now we are going to focus on the transition from physical to perceived environment. This transition is presented in figure 1, as sensing. Factors that influence the perception have been extracted from the understanding of the literature and are categorized into three elements:

- *situatedness:* the impact of places and cultures

- *sociality:* the influence of other people in the context

- *experience:* intended as a continuum of knowledge that the subject collect

Situatedness can be related to the way the subject relates to the place and the culture that Piga and Morello described as being influenced by the personal background, memory and emotions. *Sociality* is the influence of other people in the ambience perceived by the subjects that Piga and Morello described as collective or individual. *Experience* is the knowledge of the person that is collected through time. Consequently Piga and Morello

stated: *"personal experience leads people to develop their own awareness and meaning of a place. This process contributes to shape our emotions and feelings: from place to the sense of place"* (Piga and Morello, 2015). Moreover, only few studies have focused on how perception of an environment transits a space to place and the atmosphere to ambience. We argue that this is important because it can give valuable insights towards what is perceived, how this is perceived and what this perception means.

To summarize, our definition of ambience in this study aligns with that of Piga and Morello, which states that: *"(...) the ambience of a place is here intended as the physical atmosphere processed through human senses, culture and personal experience."* (Piga and Morello, 2015). With the knowledge gained from both the theory presented by Piga and Morello and our key-terms to indicate the sensing transition, the next section will introduce related works which investigated the subject of ambience and how it has been applied in other studies.

RELATED WORK
The concept of ambience within HCI has been researched, defined and used in different studies. The purpose of the related work is to understand how the concept of ambience is connected to atmosphere and how it is perceived in the field of HCI. Therefore, in this section we present some works from the field of HCI and other related disciplines.

Ishii et al. (1998) conducted a study on integrating ambient medias in architectural spaces. Here they used the ambient information that are properties of the environment such as the sounds volume, light setting and air flow, to determine how these could be exploited and thereby improve the overall experience of that room. One of the main things they concluded in their paper, was that they suggested to further explore the boundaries between attention and awareness. Attention and awareness are derived from the concepts of foreground and background that are introduced by Buxton (1995). Buxton stated that the foreground are activities in focus of the human consciousness, while the background represents the awareness or activities that occur in the background of the environment (Buxton, 1995). Attention and awareness are connected to the atmosphere and ambience because the subjects cannot perceive a place without focusing on it.

Kinch and Højlund (2012) presented a practical approach to the atmosphere from the perspective of interaction design. The authors designed a device *Kidkit*, a piece of equipment that children can use, when visiting their relatives at the hospital, in an environment that can be stressful for a child. By playing sounds when interacting with the tool, the children adapt to the hospital environment and atmosphere. In their study they addressed the issues of how the information of the atmosphere affects the way children perceive the atmosphere of a hospital. This study is relevant to include, because they investigated how an atmosphere is experienced in

a place and which elements of that atmosphere could be manipulated to improve the quality of the perception.

The literature shows that there are validated tools such as thermometers to measure the tangible data as temperature, air pollution and sun radiation of atmosphere. On the other hand, there are no validated tools for measuring the perceived atmosphere, hence the ambience (Vogels, 2008). In the next section we will unfold the process of developing our Ambience Questionnaire through a quantitative data collection method and statistical analysis.

THE PROCESS OF DEVELOPING THE AMBIENCE QUESTIONNAIRE
The method in the process used to develop the Ambience questionnaire, is Exploratory Factor Analysis (EFA), which identify latent variables that are linear combinations of observed variables. More in detail, the Exploratory Factor Analysis was made by using a statistical analysis process software (SPSS). First, the data collected from a questionnaire that originated from our obtained understanding of what defines an ambience, are imported into the SPSS. Consequently to that, an iterated evaluation of the factors was conducted. As result, only the factors that contributes to the largest extent are selected to the final list of items. The final list of items was chosen according to the "factor loadings" that verifies when one item can be strongly related to a factor. The process was iterative because after the completion of each phase, there was a new set of data to be re-examined and processed in a new phase of analysis. This process continued until an adequate value for each variable was reached. In addition, Kaiser-Meyer-Olkin (KMO) was used to test and ensure the adequacy, Eigenvalue the covariance, and lastly Cronbach's alpha to determine reliability of factors based on the criteria mentioned by Samuels (2015).

A similar process can be found in other studies. For example Bruun et al. (2016) investigated how coolness of interactive products can be measured. Throughout their study they used Exploratory Factor Analysis and Confirmatory Factor Analysis to validate the content of their questionnaire.

Developing the Ambience Questionnaire required three stages: creating questions, first EFA study and second EFA study. The two EFA studies were conducted using the process described above. The following sections will describe each stage of our process and the findings.

Creating questions
For the first stage, we created questions to collect data. The creation of the questions was approached with the understanding of ambience derived from the previous mentioned literature. This resulted in a set of keywords related to the different senses and how they interact with a place. Hence we used traits such as looks, smells, feels and sounds as keywords to formulate as many questions as possible. Furthermore, we included questions relating

to the three elements, that we interpreted from the theory, this resulted in questions, that were not focused on the sensing, but how a person related and interpret a space by interest and social traits, which we define as *sociality*. Questions describing positive and negative situations and settings for a place were included, since we argue *situatedness* is important to include as a context of a situation that influence the perception of a place. The questions were intended for individuals to perceive a place, based on their *experience* of that place. In addition we had to provide the participants with a specific place to perceive, which we were sure that they had experienced before taking the questionnaire. Hence, we chose the street they live in, because we knew that our participants had experienced that place.

Moreover, we added one main criterion which meant that each question had to be applicable for every place. In addition, a class of 25 interaction-design students contributed to this stage as well, as the result of their brainstorm on perceiving ambience of places and their list of questions, was compared to our set of questions. This stage resulted in 159 questions which are shown in appendix 1. Our first questionnaire was distributed in eight international Facebook groups, in order to collect data for our first EFA study. In additions, we asked our participants to base their answers on different environmental contexts. These contexts were changed several times during the process, from rainy night, to sunny day, windy day and lastly cloudy day to include a wider range of possible environmental contexts that could influence the perception and interpretation. The questionnaire is formulated in English to ensure a wider range of participants could be included. In total we collected 170 answers for our first questionnaire.

EFA 1
In the second stage, the first EFA analysis were conducted on our collected data set to identify how our questions could be categorized into a factor structure of ambience. This was done by analyzing three different factors structures containing three, four and five factors. The purpose of introducing different amounts of factors to the dataset is to see how these would differ in the number of variables with high contribution to single factors.

The reduction process during our first EFA study went as following: The commonality table containing all 159 questions, were reduced by removing all variables with a commonality value < 0.300. This gave same results for all three factor structures and they were reduced to 119 questions. Throughout the reduction process, criteria for removing questions started as multiple contribution to factors and/or a low value of the factor loadings.

The criterion for removing questions was a contribution to all factors, whereas the questions with the lowest contribution towards the main factor of that question were removed. As questions were removed, the criteria of contributing to all factors were lowered until we reached a

certain amount of questions, that only contributed towards multiple factors with a factor loading < 0.250, and have a main contribution > 0.600. The results of the reduction process with three different factor structures showed a repetition of most questions in all three factors. In fact, 44 of the total remaining 55 questions, were present in all three factor structures, whereas 11 of the question were only present in one or two of the factor structures. The adequacy measured by KMO, was for all factor structures > 0.850, with the highest score of >0.905 for the structure with thee factors. The 55 questions were all kept, because of the high adequacy measured with KMO. Furthermore, all remaining variables is only contributing to one factor of the pattern matrix with a primary factor loading > 0.600 and secondaries < 0.200.

To collected data using the new reduced version of the questionnaire, we distributed the new questionnaire in the same Facebook groups, because of the satisfying amount of responses gained for the first data collection through these groups. The questions in the questionnaire of this stage can be found in appendix 2.

EFA 2
The second questionnaire was completed by 75 participants, and the collected data was analyzed in the second EFA study. For the second EFA study, we followed the same process as our first EFA study, by continuing to test our data with a structure of three, four and five, in order to compare the outcome of each structure to explore more possibilities for the final tool. The remaining questions of the second EFA study were also tested with Cronbach's alpha, Eigenvalue and KMO.

We first conducted the reduction with the factor structure with three factors. The questions were reduced from 55 to 49, by removing all the questions with a commonality value < 0.300. Afterward, the 49 remaining questions were removed based on their contribution towards each factor in the pattern matrix. The reduction criteria started by removing factors, that had a low factor loadings or equal contribution towards multiple factors. All of the 20 remaining questions of the three factor structure had a primary factor loading contribution > 0.600 towards a single factor and all secondary contributions were < 0.250. The adequacy of the KMO test, was the highest of the scores we found in the second EFA study, with a value of 0.820. Furthermore, we tested the Eigenvalue of our factors, which resulted in a score of 6.387 for factor one, 4.844 for factors two and 2.901 and Cronbach's alpha which showed a reliability of 0.931 for factor one, 0.909 for factor two and 0.894 for factor three. These are shown in figure 2.

The structure of four factors, were also first reduced by removing questions with a commonality value < 300, which reduced the questions from 55 to 52. Consequently, questions with factor loadings below < 0.600 and/or that had contributions to multiple factors were removed. This resulted in a total of 24 questions, which we tested with

KMO, Eigenvalue and Cronbach's alpha. These did not score as high, as the score of the structure with three factors. The adequacy was measured to be 0.791. Cronbach's alpha was calculated as being 0.875 for factors one, 0.905 for factor two and 0.930 for factor three and 0.828 for factor four.

For the structure of five factors, the same starting criteria for removing questions was also used for the analysis. But because all questions had a commonality value > 0.300 no questions were removed. Subsequently, we applied similar criteria such as those we used during the analysis of the second EFA study, with factor loadings > 0.600. The result was a reduction from 55 question to 25 questions. Most of the questions had a factor loading > 0.600, but what differs from the other factor structures is that more questions were contributing to the second or even the third factors with a value > 0.250. Furthermore, the KMO test for this factor structure gave the score 0.773, therefore this was the lowest score of the second EFA. The reliability of these factors was: 0.887 for factor one, 0.845 for factor two, 0.930 for factor three, 0.814 for factor four and lastly 0.396 for factor five.

	Factors:	1	2	3
	Eigenvalue:	6,414	4,686	2,734
	Cronbach's alpha:	0,931	0,909	0,894
Nature	This place smells of nature	**0,924**	-0,095	0,000
	This place feels like nature	**0,907**	0,018	0,028
	This place feels nature-like	**0,879**	-0,078	0,040
	This place looks natural	**0,838**	0,098	-0,016
	This place has a natural smell	**0,823**	-0,024	-0,078
	This place has natural sounds	**0,777**	0,009	-0,012
	This place has fresh air	**0,668**	0,067	-0,096
Attractiveness	This place is exciting	0,189	**0,867**	0,023
	This place is energetic	-0,139	**0,858**	0,079
	This place is trendy	0,289	**0,808**	0,096
	This place is interesting	0,079	**0,805**	-0,012
	This place is social	-0,093	**0,785**	-0,040
	This place is catchy	-0,055	**0,772**	-0,188
	This place is lively	-0,196	**0,714**	0,142
Unpleasantness	This place is dodgy	0,189	0,023	**0,863**
	This place is creepy	-0,003	-0,022	**0,861**
	This place is terrifying	-0,037	-0,084	**0,835**
	This place is scary	-0,105	-0,048	**0,832**
	This place is unsafe	-0,080	0,042	**0,750**
	This place is intimidating	-0,114	0,111	**0,683**

Figure 2. Pattern matrix with three factors including the Eigenvalue and Cronbach's alpha

Participants
The questionnaire that included 159 questions was completed by 170 participants which were divided in 34% males and 65% females and 1% preferred not to say. They

range from 18-42 in age, with a majority of 22-24 years of age. They are located around the world, however three European cities; Aalborg, London and Amsterdam were mentioned more often as locations of residency by the participants.

A number of 75 participants completed the second questionnaire and were divided in 28% males and 70,7% females and 1,3% preferred not to say. They ranged from 18-59 in age, with a majority of 22-24 years of age. The result of our demographic questions showed that the three European cities mentioned more often were still Aalborg, London and Amsterdam.

Study	Participants	Environmental contexts	Questions
EFA 1	46	Rainy night	159
	38	Sunny day	159
	86	Windy day	159
EFA 2	75	Cloudy day	55
Total	245	Four contexts	

Figure 3. The two EFA Studies

The total number of participants for the study was 245 people. The amount of response to generate datasets for each EFA study, including each of the different environmental contexts can be found in figure 3.

Conclusion of Exploratory Factor Analysis results
In this section of the paper, we present the findings derived from our Exploratory Factor Analysis.

By comparing the three factors in results of our second EFA study, it appears that several questions are present in more than one factor. Furthermore, by comparing the score of the KMO, Eigenvalue and Cronbach's alpha, we can conclude that the structure of three factors achieved the highest score. These scores can be found in figure 2.

As a conclusion to our results, we chose to use a three factor structure that includes 20 questions, factor one and factor two have seven questions and factor three have six questions contributing with a factor loading > 0.600. The result of this research indicates that there are three factors that characterize ambience: *nature*, *attractiveness* and *unpleasantness*, as shown in figure 4. We defined the first factor as *Nature* because the questions included in this factor are related to how natural or nature-like a place is perceived. *attractiveness* as the second factor, contains questions related to how attractive a place is based on the excitement, interest and energy it provides for the individual when perceiving a place. The third factor is defined as *unpleasantness* and it includes questions towards a negative interpretation of the place, that indicate if people perceive a place as unpleasant.

From the results of the analysis seen in figure 2, we can conclude that the content of our Ambience Questionnaire, is relevant in terms of adequacy, reliability and covariance. (Samuels, 2015)
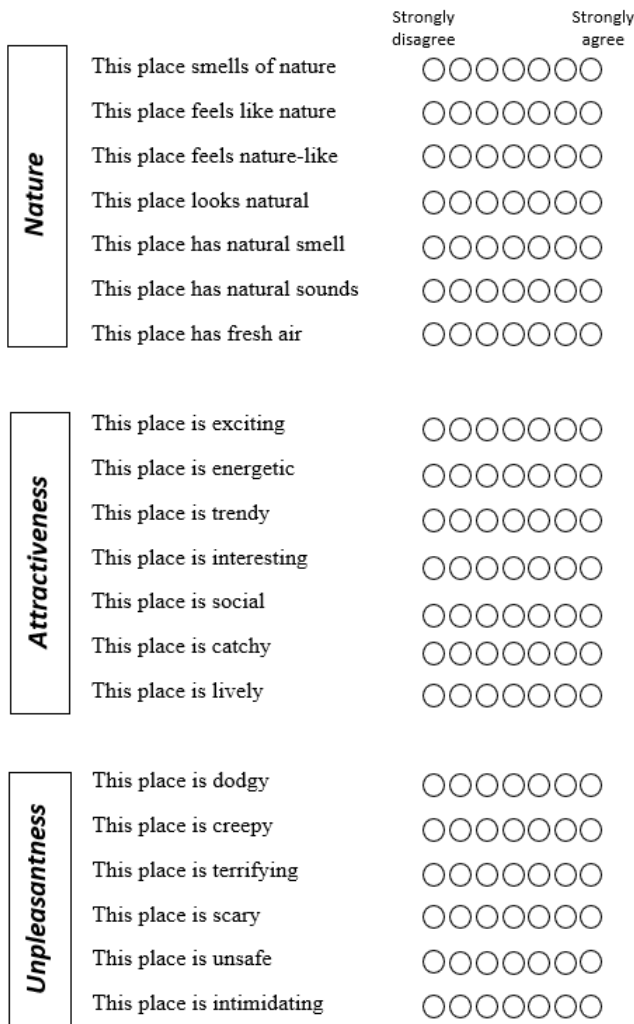
Figure 4. The Ambience questionnaire

DISCUSSION

This section summarizes the findings and contributions of our study on quantifying the perception of ambience. however it is important to reflect upon the limitations of the present study that include the following points shown below:

- *Time:* The main limitation of our study is time, because with more time we could have had more answers, a wider sample size to analyze, therefore higher accuracy in our findings.

- *Methods of collection of data:* Another limitation of this study is the choice of the research methods collection of data. We argue that as a first step in our research, it could have been better to create a small questionnaire where we asked people to answer to the questions: "Please, describe ambience with one adjective". We assume that this single question could have given us valid insights on how people define ambience so that we could have generated the items of the ques-

tionnaire not only from our understanding of ambience but also from the input of people.

- *Settings choice:* As we mentioned in the process section, this study aims to collect as wide an understanding as possible, on how people perceive ambience outdoors. Therefore, the limitation is the lack of variety of settings, so one may ask what would have changed if our study would also have been conducted indoor? Therefore, because of the limited time we decided not to investigate what would happen if our focus would be on indoors perception of ambience, we assume that other settings might led to different outcomes in the questionnaire findings.

The concept of attention and awareness mentioned in the related work by Ishii et al. (1998), was not the focus of our research, since these concepts were not included in the theory of Piga and Morello (2015) on how the environment is perceived. However, we argue that attention and awareness could be interesting to include in further research. In addition, if further works were to explore the ambience of indoor places, we suggest that attention and awareness should be considered, since the focus for attention and awareness, might be implemented in the design of that place and therefore affect the perception (Buxton, 1995). The concept of manipulating the atmosphere of a place as shown by Kinch and Højlund (2012) can be important in order to improve the people's perception of a place.

In conclusion, the three factors that we suggest defines the perception of ambience are *nature*, *attractiveness*, *unpleasantness*. We consider these factors important to include in order to understand what influence the transition from the physical environment to the perceived environment. After interpreting our EFA results, we believe that our participants perceived the ambience of the street they live in according to how closely that place is connected to nature, hence the factor *nature*. We consider this to be induced by the fact, that this study was conducted with a focus on outdoor places, therefore, the presence of nature is more excepted than in indoor places. The factor *attractiveness* includes questions which imply that the interest and excitement of a place are important to consider, as well as how social and trendy a place is perceived, when describing an ambience. The last factor *unpleasantness*, contributes toward the understanding of the negative values of the ambience, such as creepy or terrifying.

The three elements *sitautedness*, *sociality* and *experience* that we unfolded in the beginning, are reflected in the three factors of the final questionnaire. The description of the three factors include questions related to the impact of a place, and what kind of place it is, which in this study were outdoor urban places. The questions "this place is trendy" and "this place is social" from the second factor, indicates that the presence of other people is influencing the perception of the ambience. Experience

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is the element that affects all factors because people experience both nature, the attractiveness and unpleasantness of a place, therefore experience is relevant to include when describing the overall perception of the ambience in a place.

The information collected through the Ambience questionnaire, which describes how ambience is experienced by the respondents, can clarify if that person perceived the place as attractive or unattractive and pleasant and unpleasant, which might indicated if there is an issues with the place. Therefore, We suggest that by using our Ambience Questionnaire it can be possible to improve the quality of a outdoor place, by identifying how the place is perceived. We assume that with a further exploration and wider variety of settings such as indoor, it is possible to investigate if the ambience questionnaire can be extended to consider indoor places or suggest a development of a new tool, that could measure the ambience of an indoor place.

FUTURE WORK

The research of ambience in HCI offers new perspectives in relation to design, research and evaluation. It could be important that future research investigate more in depth the participants opinions about the perception of their places by adding more environmental contexts since the limited time was a constraint that did not allowed us to include more contexts. Consequently to the addition of further contexts, we imagine that the answers of the users could be more varied, so that we could have a wider perspective on the perception of ambience under the influence of changing environmental context.

Furthermore, we believe that apart from looking for environmental contexts, future research could focus on changing seasons and different time of the day such as morning, afternoon, night so that for every geographical places it could be possible to include people perception of their area during different seasons and moments of the day. In addition to that, we suggest that future research could further test whether the perception of a bigger and varied number of participants would change the perception of ambience since this study is limited to a certain time span that led to have a number of answers that reflects only part of what can be included in a longer study.

Future research should further develop and confirm these initial findings by asking the participants not only to imagine the scenario but to experience their perception in the field. We point out that our focus was mainly on defining the perception and collect the information of an ambience. But from the theory of Thibaud (2002) who claims that people behaviour change according to the situation, we assume that future investigation could also include to collect data on how people perceive and behave in an environment. (Thibaud, 2002)

The choice to include a real setting may give more insights on how people perceive and interpret the places they live in not only driven by their already acquired knowledge. By experiencing the places they live in, their perception will be actively influenced by new inputs, that consequently generate new information on the perception of ambience. Moreover, it could be interesting to conduct interviews with a group of people to understand, how the idea of ambience as a result of the questionnaire, can be further extended to have additional contributions from the point of view of the subjects perception of ambience. Therefore, the idea of ambience can be further explored by having a discussion with the people that defined the ambience of a place through the questionnaire and whether an issue arise, with the interview it might be possible to have more insight of problems and data on how to develop solutions.

Future research on the application of the Ambience Questionnaire might extend the exploration of the perception of a place. In addition to have a clear understanding of the meaning of perception of places, we suggest that future research on Ambience Questionnaire might be extended in virtual reality and computer simulation domains. Moreover, future research could continue to explore the use of the Ambience Questionnaire to obtain insight for urban planning and tailored solution services. These tailored services are solutions for singular individuals that can be found according to the persons preferences by reproducing the reality through the understanding of the users perception of places. In addition to the already described purposes of the tool, further research could consider the potential use of the Ambience Questionnaire in the domains of Big Data and Machine learning. Similar claims have been stated by Sayegh et al. (2016), who concluded that the understanding of ambience, might allow fields such as machine learning and big data to use this data, to provide new possibilities to perceive a city in a more safe, exciting and comfortable ways.

CONCLUSION

The purpose of this research was to investigate which factors contribute to the perception of ambience and to create a tool that can measure ambience. Consequently, we created the *Ambience Questionnaire.* and applied the statistical techniques of Exploratory Factor Analysis to find the factors that characterize ambience. The results suggested that the perception of an atmosphere of a outdoor place, hence the ambience is defined by: *nature, attractiveness* and *unpleasantness*

However, all the factors that we found contributed to the perception of ambience and they resulted from a process of reduction of the 159 items to eventually 21 items. Moreover, we observed that the respondents associated the ambiance with nature implying that nature is relevant in the process of perceiving ambience of an outdoor place. We assume that the ambience questionnaire can contribute to understand how the ambience of outdoor places are perceived, which can be useful in the phase of designing and evaluating places.

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Appendix 1.

All 159 Questions used for the first EFA study.

1. This place is calm to look at
2. This place feels cozy
3. This place is bright
4. This place is inspiring
5. This place is aesthetically pleasing
6. This place feels open
7. This place is colorful
8. This place is visually pleasing
9. This place is frequently used by other people
10. This place is detailed
11. This place has good natural lighting
12. This place is attractive
13. This place is accessible
14. This place looks natural
15. I have a connection to this place
16. This place appeals to my emotions
17. This place feels empty
18. This place feels relaxing
19. This place has a good social atmosphere
20. I feel protected in this place
21. This place is energetic
22. This place feels comfortable
23. This place is distracting
24. This place is interesting
25. This place is cheerful
26. This place is exciting
27. This place is lively
28. This place has natural sounds
29. The sounds of this place
30. This place has good acoustics
31. This place has a lot of different sounds
32. This place is quiet
33. This place has soothing sounds
34. This place has penetrating sounds
35. This place has resonating sounds
36. This place is affected by external sounds
37. This place has intense sounds
38. This place has clear sounds
39. This place allows personal-space
40. This place breaks social barriers
41. This place has a pleasant smell
42. This place has an attractive smell
43. This place has a covering smell
44. This place has a mix of smell
45. This place has a fresh smell
46. This place has an intense smell
47. This place has an artificial smell
48. This place has a natural smell
49. This place has a penetrating smell
50. This place has a clean smell
51. This place has an overpowering smell
52. This place smells good
53. This place has good physical boundaries

54. This place has pleasing surroundings
55. This place is useful
56. I like the changes in this place
57. I feel that other peoples presence affects my perception of this place
58. This place has coherent physical elements
59. This place invites you to action
60. This place is soft
61. This place is new
62. This place is dodgy
63. This place has pleasant colors
64. This place is smooth
65. This place is cold
66. This place is beautiful
67. In this place there is happiness
68. This place has fresh air
69. This place creates the mood that was intended
70. This place feels abandoned
71. This place feels like something new to me
72. This place gives a full experience
73. This place gives the intended experience
74. This place feels like carnival
75. This place feels natural like
76. This place is crowded
77. This place is rough
78. This place is dusty
79. This place has thick air
80. This place is nice to be alone in
81. This is a place I want to stay for a long time
82. This place smells like a Spa
83. This place has a specific theme
84. This place is hyggeligt
85. This place is spikey
86. This place smells funny
87. This place is desirable
88. This place is clean
89. This place is peaceful
90. This place makes me happy
91. This place reminds me of a memory
92. This place is recognizable
93. This place makes me violent
94. This place has music
95. This place is wet
96. This place feels private
97. This place is terrifying
98. This place makes my mind wander
99. This place is dream-like
100. This place is spacious
101. This place is calm
102. This place disconnects me from the real world
103. This place has lovely smells

104. This place makes me feels displaced
105. This place feels nature-like
106. This place is creepy
107. This place is spiritual
108. This place has rounded corners
109. This place is artistic
110. This place makes me think of a season
111. This place makes me hungry
112. This place has suitable sounds
113. This place is old
114. This place has appropriate lighting
115. This place can make me sad
116. This place is hard
117. This place is social
118. This place is expensive
119. This place is unsafe
120. This place smells of nature
121. This place is dry
122. This place has nice climate
123. This place is messy
124. This place feels like death
125. This place is playful
126. This place is dark
127. This place is safe
128. This place is joyful
129. This place is structured
130. This place is warm
131. This place is disturbing
132. This place is intimidating
133. This place is scary
134. This place is inviting
135. This place is dirty
136. This place is unusual
137. This place is restricted
138. This place is luxurious
139. This place is shiny
140. This place is reflecting
141. This place is isolated
142. This place is relatable
143. This place is comprehensive
144. This place is static
145. This place is novel
146. This place is original
147. This place is steady
148. This place is tense
149. This place is seasonal
150. This place is homogeneous
151. This place is appealing
152. This place is terrific
153. This place is vast
154. This place is free
155. This place is classy
156. This place is symmetrical
157. This place is organized
158. This place is catchy
159. This place is trendy

Appendix 2.

This is a list of the 59 Questions used for the second EFA study.

1. This place is peaceful
2. This place is calm
3. This place is calm to look at
4. This place makes me feel displaced
5. This place feels nature-like
6. This place is creepy
7. This place is artistic
8. This place is social
9. This place is unsafe
10. This place smells of nature
11. This place feels like death
12. This place is intimidating
13. This place is scary
14. This place is restricted
15. This place is luxurious
16. This place is shiny
17. This place looks natural
18. This place is catchy
19. This place is trendy
20. This place is frequently used by others
21. This place feels relaxing
22. This place is energetic
23. This place is interesting
24. This place is exciting
25. This place is lively
26. This place has natural sounds
27. The sound of this place makes me feel at peace
28. This place has a lot of different sounds
29. This place is quiet
30. This place has soothing sounds
31. This place has penetrating sounds
32. This place is affected by external sounds
33. This place has intense sounds
34. This place is isolated
35. This place has a covering smell
36. This place is novel
37. This place has an intense smell
38. This place has a natural smell
39. This place has a penetrating smell
40. This place has a clean smell
41. This place has an overpowering smell
42. This place is useful
43. This place invites you to action
44. This place is dodgy
45. This place has fresh air
46. This place feels abandoned
47. This place gives a full experience
48. This place feels like nature
49. This place is nice to be alone with
50. This place has a specific theme
51. This place smells funny
52. This place is clean
53. This place makes me violent
54. This place feels private
55. This place is terrifying