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People's perceptions and classifications of sounds heard in urban parks: semantics, affect and restoration.

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ABSTRACT

Sounds have been broadly categorized by researchers into 'human', 'nature' and 'mechanical'. It is less clear if the general public define and classify sounds in the same way and which factors influence their classification process. Establishing people's classification and impression of urban park sounds helps identify their perception and experience of urban parks. This in turn aides the process of defining parks with reference to soundscapes, to produce an appreciated and potentially restorative place. This study involved urban park sounds, identified by park users, being presented in card sorts and survey items. Participants sorted the sounds into similar groups, in reference to a visited park. The terminology, factors involved and classification of the sounds was assessed using multidimensional scaling. Triangulation of the results suggests affect is a key factor in people's classification process. Participants' grouped sounds were labelled by affective terms more often than their perceived physical properties. Affective evaluations of each sound produced a similar classification structure as the card sort results. People's classification structure also varied depending on how restorative they found their urban park. Furthermore schematic recollections played a part with many sounds being 'expected'. Overall similarities and differences with 'human', 'nature' and 'mechanical' classifications were observed.

1 INTRODUCTION

A number of classification systems for environmental sounds have been developed by researchers. These have varied across studies, but often include 'human', 'nature' and 'mechanical' categories (e.g. [1][2]). Only a few studies have actually involved the public's own classification of environmental sounds (such as [3][4]). This is useful to know though if participant's subjective evaluations of the sounds are sought as experts and laypeople's classifications and evaluations can differ e.g. [5]. For example, European Member States agree on the environmental noise classification of transport systems (road; rail; air) [6], yet people's evaluations of these sounds vary within and across these groups (public v private transport [7]). Research into laypeople's perceptions and evaluations of sounds is therefore as important as more objective measures, such as sound pressure level, but it is of little use if these evaluations are then reinterpreted by pre-defined researcher classification systems.

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Knowing how people classify sounds helps the analysis of sound preferences and evaluations of soundscapes. It can also help identify the layperson's own choice of words and terminology used to describe the sounds they encounter in their daily lives [7]. A few studies have classified soundscapes by using participants' subjective evaluations of the soundscapes via semantic scales e.g. [8]. However, it is not clear if the presented adjectives in the scales have any relevance to how the participant would freely evaluate the soundscape and if the scales mean the same thing to each person [9][10]. People's classifications of sounds will also vary across the context they are heard in, not just because there will be different sounds, but the sounds will also mean different things to the individual and evoke different emotions which may influence how the sounds are classified.

This paper therefore seeks to identify how people think about and classify sounds within one particular place: urban parks. The role of peoples' affective evaluations of urban park sounds on their classification system is also studied. Additionally as urban parks, like natural environments, can potentially provide recovery from attentional fatigue [11], the relationship between people's restorative experience of the park and their classification of sounds is noted.

2 SOUNDS PERCEIVED IN URBAN GREEN SPACES

Between August and October of 2005, fieldwork was carried out in 15 urban green spaces in Sheffield, UK (population is roughly half a million). These varied in size, topology, vegetation, typology (e.g. community parks, school playing fields, forests), and location. 312 participants (aged 16 to over 70 years; 54% female) who were resting in or passing through the green spaces were asked to name "*three sounds you hear when you are in this park*". Of the 867 responses, 205 were non-repetitive, linguistically different descriptions of sounds heard in urban green spaces. These descriptions are referred to as 'sounds' as they are how the participants described the sounds.

The named sounds varied from 'trees' to 'souped up cars' to 'building ventilation' and were informative of the wide range of sounds people hear within urban green spaces, as well as how the sounds are described. To discover how people perceive and classify these sounds, a smaller representative sample of the sounds was needed to enable designing a study that participants would not find draining. The list of 205 sounds went through a series of processes to be reduced down to an eventual 31 sounds, see Table 1. Firstly a set of rules was applied which removed slang words, site-specific sounds, and combined similar phrases (e.g. 'talking' and 'chatting'). Affective descriptions and most adjectives were removed as they would hinder other participants classifying the sounds. The resulting list was of sound sources, and ambient sounds, which is similar to [3]. Next, six people (aged 24 to 44 years) were asked to reduce the list down to a smaller representative list of sounds that can be heard in urban parks, by grouping sounds together that they thought were similar. At first inter-rater agreement was low (29%), reflecting the diversity in people's perceptions and agreement of sound similarities. Inter-rater reliability was increased to 69% via discussions and the final resultant list consisted of the sounds that had been agreed on by more than four of the six participants and/or had been originally mentioned by a lot of the participants within the green spaces.

Table 1. Sounds identified in urban green spaces and used to assess people's classification of urban park sounds.

People Playing Games	Birds	People Talking	Aircraft	Buses
Construction Work	Crying	Skateboards	Dogs	Leaves
Children Playing	Twigs	Machinery	Squirrels	Insects
Background Traffic	Cars	Laughing	Swearing	Silence
Gate Closing	Water	Bicycles	Shouting	Wind
Lawn Mower	Music	Motorbikes	Ducks	Sirens
Church Bells				

3 METHOD

Thirty-eight people were surveyed between September and November 2006. The convenience sample ranged in age from 18 to at least 78 years old and consisted of people who were approached in a variety of public places, such as cafés, shops, and pubs within Sheffield. Participants named a park that they had been to, or passed through recently. On average this was a fairly familiar park, (rating 4 on a 5 point scale), which was visited fortnightly (5-10 times) during the summer (May to August). Participants then carried out a multiple card sort and answered questionnaire items and semantic scales as described below. On average the process took 15 minutes.

3.1 Measures

3.1.1 Sound Classification

The multiple card sort involved presenting participants with a card that each had one of the urban park sounds written upon it. Participants were asked to imagine being in the urban park they had identified and think about how they would feel, their moods and activities that are likely to occur there and particularly the sounds they would hear. They were then asked to sort the cards into groups so that similar sounds were placed together. They could make as many groups as they wanted, with each sound only belonging to one group. The instructions were adapted from [12]. Any comments the participant made were noted to help analyse the reasons for the sorts. Participants were then asked to give each group a label; it was presumed this would be a cognitive label to represent that sound category. They were also asked to assign the group a word that best represents their overall impression of hearing that sound in an urban park; this provided an affective label associated with that sound category.

3.1.2 Attention Restoration

Participants assessed their chosen park in terms of how much they agreed that they would be able to achieve various restorative outcomes after having spent some time in the park. Statements for the ability to recover from fatigued cognitive facilities were '*I am able to…*' '*...relax and unwind*' and '*...regain the ability to concentrate after a tiring day/week*'. Reflection was rated by the ability to '*...think about important issues*' and '*...ponder over my daily experiences*'. Responses were made using a five point Likert scale ranging from strongly disagree to strongly agree. These measures were modified from [13] and [14].

3.1.3 Affect Towards the Sounds

A list of the 31 urban park sounds was presented in a random order, each beside a seven point semantic scale where four is neutral. Each sound was first rated in terms of their pleasantness (unpleasant to pleasant scale), and then again with a stressful to relaxing scale. These adjectives were chosen as they have been previously used to affectively rate the environment [15] as well as soundscapes [16][9].

3.2 Analysis

Each participants' sorted card groups were analysed with MDSORT, [17], which produces a plot of each sound's location within a three dimensional (3D) space. The distances between the sounds on the plot represent conceptual differences. The category labels created for each of the participants' groups of sounds were content analysed, to help interpret the 3D plots. This involved collating similar category labels together; the use of a thesaurus helped confirm similarities in meaning. Each participant's original category labels and each category's sounds were then recoded by the new defined system; the most common labels used to categorise each of the 31 sounds could then be assessed. This represented 'cognitive' phrases that were linked to each sound and are referred to as category labels in this paper. The same procedure was conducted with the overall impression responses, which are referred to as affective labels.

Affective semantic scale ratings were analysed individually for each sound and collectively (multidimensional scaling (MDS), using MDPREF). The resultant plots from the affective ratings and the card sorts were compared on a scale of 0 to 1 (1 = identical) using PINDIS. All MDS statistical analyses were carried out with NewMDSX software [17].

4 RESULTS

Participants identified 12 parks on the West of Sheffield, located between 0.2 to 3 miles from the city centre ring road. Some sounds were excluded by half the participants as they did 'Not Relate/ Associate' the sounds with their park; others (less familiar and frequent visitors) quite happily sorted sounds into categories when they can not actually be heard in the park. For example, five people placed Ducks into a category even though no duck pond exists there.

Table 2. Category and Affective labels and the number of participants who used them for their card sorts.

Category Label	Number of Participants
Not Related/ Associated to the park	16
Expect → Don't Expect	15
People	15
Negative Emotions	13
Natural	11
Volume (Silence → Loud)	10
Area Related, for that park	8
Positive Emotions and Don't Mind	6
Location (Inside → Outside the park)	6
Hear Anywhere	6
Time Related	5
Frequency (Occasional → Rarely)	5
Attention (Not noticed → Turn head)	5
Activities	4
Animals	4
Machinery/ Manmade	4
Sight	3
Individual sounds	3
Aerial	1
Don't Know	1

Affective Label	Number of Participants
Expect → Don't Expect	15
Not Related to the park/ Excluded	15
Annoying	11
Like → Don't Like	8
Enjoyable	8
Peaceful → Not Peaceful	7
Pleasant → Unpleasant	6
Relaxing → Worrying	6
Background	6
Happy → Sad	5
People	5
Quiet → Noisy	4
Soothing → Irritating	4
Natural	4
Good → Not Good	3
Nice	3
Autumn	3
Satisfying → Frustrating	2
Involving → Disturbing	2
Reassuring → Spooky	2
Love → Horrendous	2
Lively	2
Interesting	2
Alright	2
Everyday	2
Sense of Permanence	1
Accept	1
Well Kept	1
Solitary	1
Cold	1
Distracting	1
Incessant	1
Avoid	1

4.1 Labelling Individual Sounds

Participants created between two and nine categories to sort the sounds, with the mean being five. In total, participants generated 105 differently termed category labels that were reduced down to 20 different category labels using content analysis. Some of the new labels involved a range of items that varied along a scale, such as ‘Volume’ (‘Silence’ to ‘Loud’). Each sound was defined by between 10 to 15 different category labels, with the mean being 12 labels. On average only five of these had frequencies above two (i.e. more than two people referred to that sound by using that category label).

The affective labels produced more variation than the category labels, as shown in Table 2. In total, participants generated 112 differently termed affective labels, which were collated to form 33 different labels (13 involved scales). Each sound was defined by between 14 and 20 different affective labels; the mean was 17. On average only four of these labels were used two or more times. Any sound that had been excluded during the card sort, as it was ‘Not Related/ Associated’ to the park, was not given an affective label. Half of the time that the ‘Expect’ scale was used for Silence, it was actually ‘Not expected’; one participant even referred to Silence as creepy.

There are many similarities between the definitions provided for the category labels and the affective labels. Although the category labels were expected to provide more concrete cognitive labels, often participants used affective labels to describe their categories. This is shown by the most frequently used labels by the different participants; ‘People’ and ‘Don’t/Expect’ were each used by 15 people to define a category; 15 people also used ‘Don’t/ Expect’ as an affective label. The second most frequent category label mentioned by participants were ‘Negative Emotions’ and for affective labels it was ‘Annoying’.

4.2 Classifying the Sounds

The most common category and affective labels for each sound was identified to represent the participants’ description and evaluation of their urban park sounds. These labels were used to define the clusters of sounds identified as similar by the participants. These are shown in a 3D plot (Figure 1), displaying the conceptual relationships between the urban park sounds.

Inspection of the plot shows clear divisions between different types of sounds and how they are described. Category labels and affective labels produced similar divisions. The right hand side of Figure 1 contains the sounds that are ‘Expected’, while the left hand side has sounds that are ‘Not Related to the park’ (bar Background Traffic). The sounds on the right are ‘Peaceful’, ‘Pleasant’, and ‘Enjoyable’, while on the left the sounds produce ‘Negative Emotions’ and are ‘Annoying’. There is also a division between ‘Natural’ sounds on the right, ‘People’ in the middle and more transportation/mechanical sounds on the left. These divisions show that hearing the ‘Expected Natural’ sounds is a positive thing, while more mechanical sounds are not related to urban parks and are therefore negatively rated. ‘People’s vocal sounds are also differentiated by their affective evaluations – positive or negative.

4.3 Affective Evaluations

Many (21%) of the results for the semantic affective scales produced a skewed distribution, suggesting peoples’ affective evaluation of sounds is generally similar. Each sound received the same average rating on the un/pleasant scale and the stressful/ relaxing scale, bar four sounds. The ‘Natural’ sounds were rated more pleasant and relaxing; Water and Birds had an average rating of 7, (the maximum). Ducks, Leaves, Silence, Wind and Laughing were also pleasant and relaxing (rated 6 or 7). The most stressful and unpleasant sounds were Construction Work, Machinery, Sirens and Swearing. The transport orientated sounds were also rated poorly, with an average rating of 2 or 1.

Multidimensional plots of the affective ratings for both semantic scales were created, but due to their high similarities [P(0), S(Z, X) = .85], the results were combined to form one

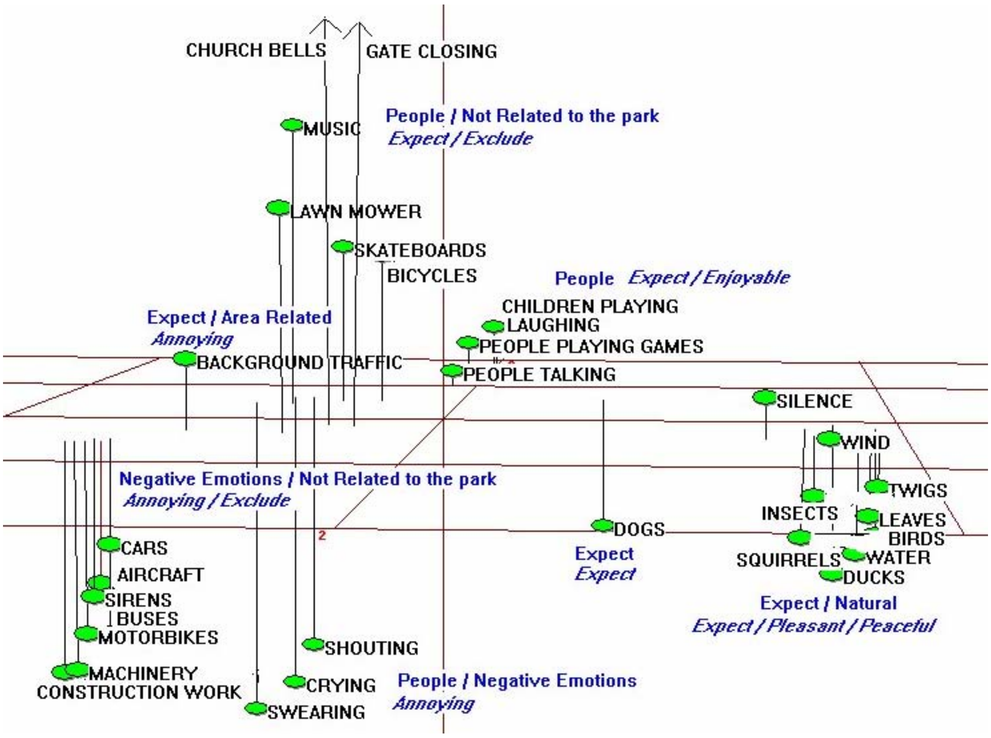

Figure 1. Three Dimensional plot of participants' classification of urban park sounds; results from a card sort. **Category labels** are in blue bold. ***Affective Overall Impression labels*** are in blue bold italics.

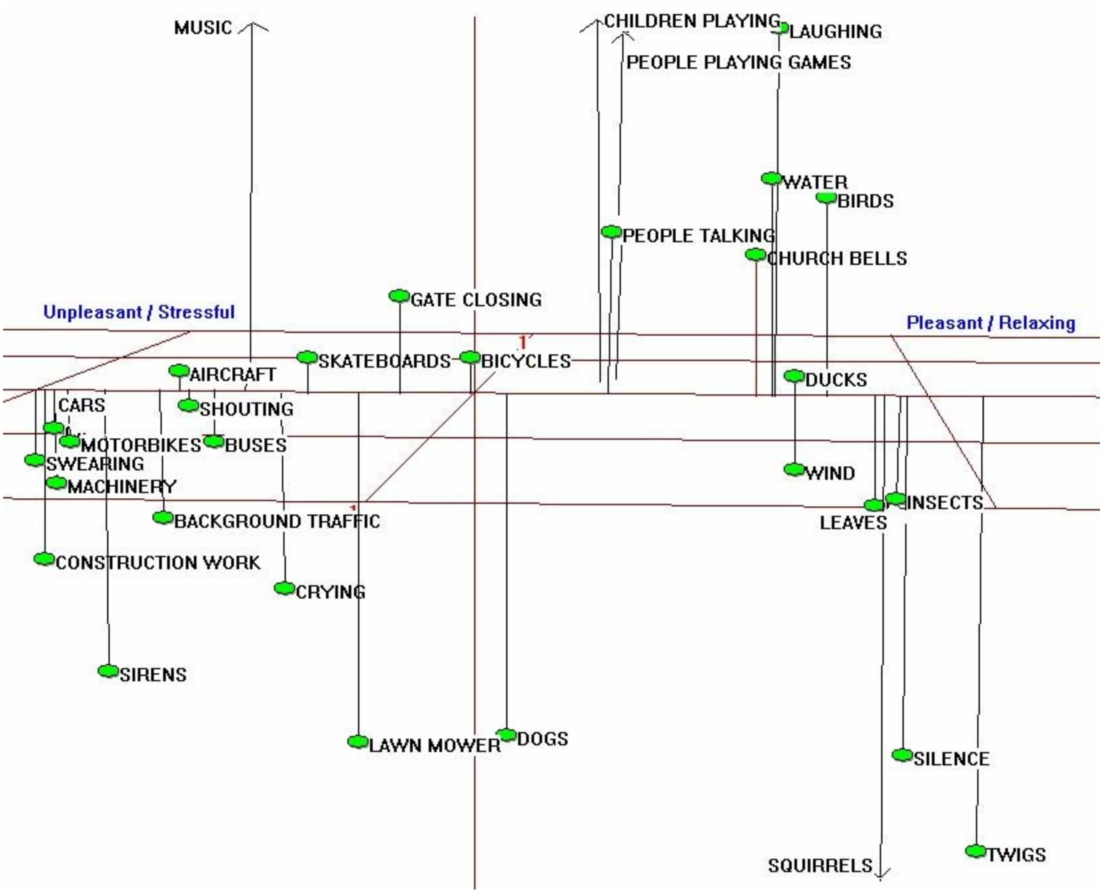

Figure 2. Three Dimensional plot of participants' affective semantic scale ratings of urban park sounds. **Affective dimensions** that sounds were rated on are in blue bold.

affective plot [convergence test in generating the centroid configuration = .96], see Figure 2. The Pleasant/Relaxing and Unpleasant/Stressful scale is noted along dimension one (x axis). More natural sounds and sounds of people enjoying themselves are at one end of the dimension, while more mechanical and people vocal sounds are at the opposite end. The distance between the positively rated natural and people sounds (z axis) represents the number of times an individual gave a natural sound a different rating to a pleasant people sound.

4.4 Classification and Affect

Comparisons between the MDS plots created by the card sort results and the affective ratings were compared visually and statistically (PINDIS). Visual inspection shows similarities between the plots and they have a moderate statistical match [P(0), S(Z, X) = .42]. All the mechanical and transport related sounds cluster together and are located in the same area of the plot. Children Playing, People Playing Games and People Talking are all closely related in both plots although they do vary in distance away from one dimension (z axis). The ‘Natural’ sounds are located at the other end of a dimension to the mechanical/transport orientated sounds in both the semantic scale affect plot and the card sort plot. The conceptual distances in the card sort plot between the ‘Natural’ sounds and ‘Enjoyable People’ vocal sounds, as well as between the positive and negative rated ‘People’ vocal sounds, is similarly reflected in their separation in the semantic scale affect plot. Practically all of the sounds are located within the same area on both plots, although the extreme distances that some sounds are from the other clusters, such as Church Bells, Gate Closing and Music, are not reflected in both plots. Swearing, Crying and Shouting, are also not so closely related in the semantic scale affect plot in comparison to the small cluster they produce in the card sort plot.

4.5 Attention Restoration

Participant’s perceived ability of achieving attention restoration after visiting their identified park was generally good (mean scores >3.5). As the ability to ‘relax and unwind’, had a skewed distribution and correlated poorly with the other items, only three items produced the reliable attention restoration scale (Cronbach’s α= .84). Participants were split into groups, using their scale scores, of lower, medium or higher attention restoration levels.

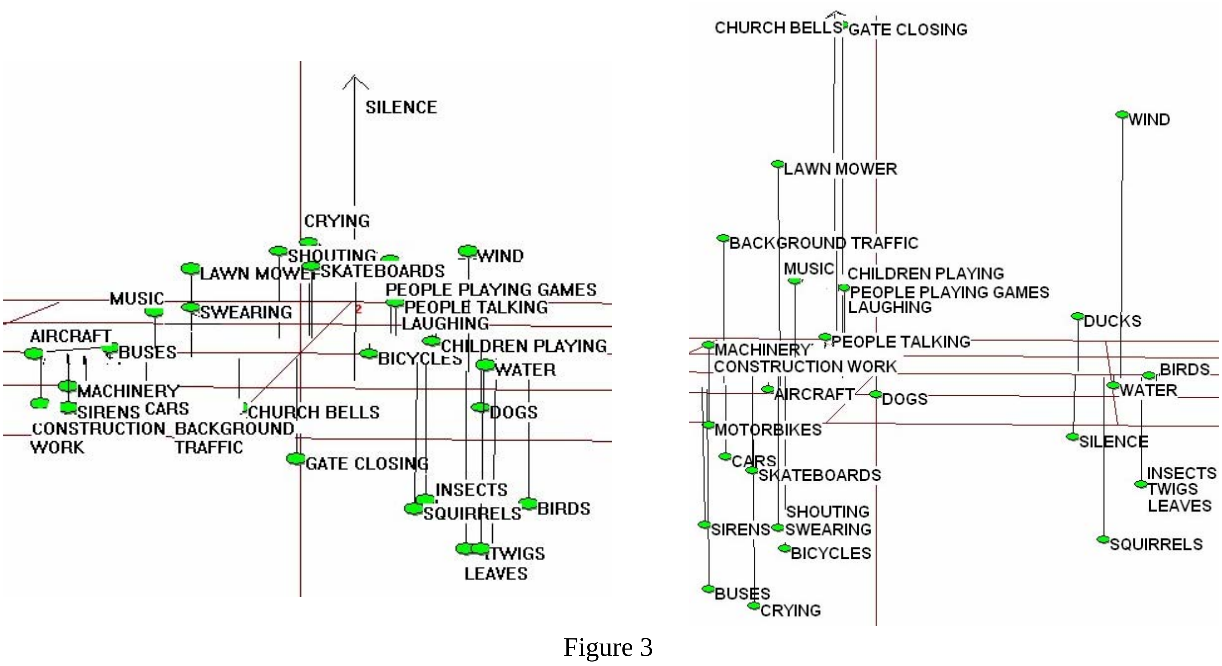

Figure 3

Participants’ classification of urban park sounds dependent on their perceived levels of attention restoration.

Figure 3a (left) are people with lower recovery levels. Figure 3b (right) are people with higher recovery levels.

Separate card sort analyses of participants with lower levels of attention restoration (n=13) and those with higher levels were conducted (n=10). Inspection of the two plots reveals differences, especially in the conceptual distances between the individual sounds, see Figure 3. The low attention restoration plot is very tightly packed around the centroid (Figure 3a). Similar clusters as the participants' universal classification plot (Figure 1) did emerge, but no distinct clusters of sounds are obvious. In particular the ‘People’ sounds that were labelled positive and negative are a lot closer together. Only Silence is substantially separated from all the other sounds. In contrast the individuals who achieved a higher level of attention restoration produced a sound classification plot that is more spread out (Figure 3b) and has more similarities with the universal sound classification plot. The ‘Natural’ sounds, including Silence, are clearly separated from all the other sounds. Statistically, the match between the high and low attention restoration plots is also fairly low [P(0), S(Z, X)= .39].

5 DISCUSSION

This study was able to identify the terminology that urban park visitors use to classify sounds that are perceived within urban green spaces. Compared with labels used by researchers [1][2], both similarities (the use of Natural and People categories), and differences (no Mechanical category), were noted. Affect was an important factor in the classification and labelling of the sounds. A general idea of what an urban park sounds like also seemed to influence the classification structure, this is also known as a schematic representation of an urban park. Differences were also noted in people’s classification structure depending on whether they perceived themselves as achieving lower or higher levels of attention restoration after visiting a park. Each of these results and their implications are discussed in turn.

Urban park users, like researchers differentiate between sounds that are described as Natural and those that are People orientated. In contrast to these commonalities, a researcher derived Mechanical label was hardly ever used by urban park visitors, instead affective labels were used to describe such sounds. A Mechanical label may help describe sounds that consist of certain pitches or are generated from certain objects, but laypeople associate the sounds with the everyday world continuing around them. The perceptions of such sounds are generally perceived as a negative intrusion into the park. Background Traffic is an exception though as it is rated more positively and gives some people the reassuring sense of things still continuing ‘out there’ in the world. This suggests researchers need to be aware of not just the physical attributes of the sound, but also the meaning associated with the sound source, that the everyday listener uses to understand, classify and evaluate their sonic environment.

The methodology used within this study identified the nuances and finer classification levels that can be overlooked by the broad categories often used by researchers. Urban park users split People sounds into three subcategories, dependent on expectancy and affect (Expect/Not Related, Expect and Enjoy, Annoying). The equivalent category to Mechanical sounds was also split into three different clusters (Expected, People related, and Annoying sounds). The classification system often used by researchers may well represent a higher classification level to the sublevels identified within this study. Broad definitions of sounds are fine on a general scale, but when actual places are going to be altered, or people’s evaluations of certain sounds are going to be studied, it is important to know the finer classification levels of the users of the place. This study has, in part, identified this, although the results relate only to urban parks, and are based on a relatively small sample size. Different classification structures and evaluations are likely to exist for different places, as well as different groups of people.

Affect was identified as an important factor in people’s classification of urban park sounds via two different methodologies. Firstly, affective terms were used to label individuals’ card sorts when more cognitive descriptive labels had been foreseen. Secondly, individual sounds’ semantic scale affective ratings displayed a similar pattern of results to the clusters of sounds created from the card sorts. Natural sounds' affective ratings and affective labels were all generally positive, supporting the growing body of sound and soundscape research results, regardless of the methodology used [16][18]. However the nuances shown with Background Traffic and Silence suggest caution should be taken with general assumptions that natural sounds are always preferred and transport sounds disliked.

The important role of affect in this study in comparison to other sound classification studies, including [4], may be more apparent due to the emphasis on asking participants to remember real lived experiences rather than an exemplar place presented to them which they may or may not know. Peoples lived experiences and interactions with a place are important in shaping how they think about sounds and their environment. Therefore to gain a fuller understanding of people's perception and evaluation of sounds, the context that the sounds are heard in or to be experienced in is important. The context provides the sound sources with a particular meaning which in turn may influence the affective evaluation, and this plays a role in how the environment is then considered and classified, if need be. Therefore separate analyses of sounds within a particular context and place, by its (potential) users, should be assessed before drastic changes are made to a place. This would also help prevent against making all urban parks similar in style and allow a variety of green spaces to be planned into the urban environment, satisfying a variety of needs and preferences.

A schematic representation of urban park sounds was also implicated as a factor in people's classification structure; nearly a third of the sounds were described as Expected, while other sounds were Not Related to the parks. Comments and the sorting of non-present sounds (e.g. Ducks), suggested some multiple card sorts were carried out in reference to a number of parks, with their chosen park acting as an additional key reference point. The existence of a schematic representation of urban parks sounds is useful for assessing what sounds people want to hear in a park, and those that are not associated with urban parks, and are therefore annoying. This finding is likely to reflect present design practice for urban parks, but it also equates expectations with affect and highlights the importance of designing parks with the involvement of (potential) user's experience of that particular park's soundscape.

Individual variations in how urban park sounds are classified are to be expected, as are similarities and differences between different groups of people. This was shown with researchers and laypeople's classification and labelling of sounds. It was also discovered between people who perceived achieving lower or higher levels of attention restoration after visiting a park. The higher restorative individuals differentiated more between the sounds than the lower restorative group, especially in separating natural sounds apart from all others. This suggests that hearing natural sounds may be important in providing a restorative experience. This result is based on a reduced sample size though, and other co-varying factors, such as a person's social experience within the park, may be influencing this result [13]. Therefore further work needs to be carried out in this important area to help provide and maintain the potential restorative experience of urban parks. A project in this area is currently under way.

6 CONCLUSION

Overall some similarities and differences between laypeople and researcher's classification of sounds are noted. In urban parks, natural sounds are rated positively and are expected to be heard, while transport orientated sounds tend to be annoying. The card sorting procedure and subsequent multidimensional scaling analyses enabled a fuller understanding as to how people remember and classify sounds within their lived experiences, in terms of affect as well as the expected cognitive aspect. Potential sublevels to the researchers' higher order classification level were identified. The close relationship between affect and cognition in people's everyday lives and how they experience environmental sounds was highlighted.

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