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VALIDATION OF TRANQUILLITY RATING METHOD

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1 INTRODUCTION

Tranquil spaces are important as they provide respite from the attentional demands of modern city life and can be considered restorative environments[1]. The Tranquillity Rating assessment tool has recently been developed to assist planners and designers to take into account the level of tranquillity that can be attained with the aim of maximising this level to promote well being of visitors to these valuable spaces. In both urban and rural environments 'tranquil space' is predominantly constructed via the sensory information received primarily by the auditory and visual modalities. To capture this information for experimental study it has been necessary to carry out binaural recordings using a binaural head with attached video camera. Recordings of a wide range of spaces from open moorland to crowed city centres were later replayed to subjects in the laboratory and ratings of perceived tranquillity were obtained. From a wide range of factors it was found that the A-weighted sound pressure level combined with the percentage of natural features in the scene could account for much of the variance in these ratings. It was found that improvements could be obtained by adding in contextual features. These include a range of man-made features that directly contributed visually to, or were in context with, the overall natural environment. Examples of such features are: listed buildings, as these have already undergone a value assessment, religious and historic buildings, landmarks, monuments and man-made elements of the landscape that are geographically and aesthetically in keeping with the natural environment of woods, fields, lakes, hills or parkland. A further example would be a fishing community on the coast where the boats and cottages surrounding a harbour could well be counted alongside the area of water in determining *NCF*.

Equation (1) gives the final model, where *TR* = Tranquillity Rating, L_{Aeq} the equivalent continuous sound pressure level and *NCF*, the percentage of natural and contextual features in the scene (excluding the sky).

$$TR = 9.68 - 0.146L_{Aeq} + 0.041NCF \quad (1)$$

The subjective assessments of tranquillity were made using 30 sec video clips taken from 34 different real environments. Subjects were seated in a semi-anechoic chamber with auditory inputs provided via compensated headphones and visual input using a wide plasma screen. The tranquillity rating is dependent on many factors but it has been found that approximately 85% of the variance is accounted for by the two independent factors in equation (1). Note that for practical application the A-weighted level could be the L_{day} (0700-1900) value predicted from the major man-made noise source(s)[2].

However, it was necessary to carry out a validation study to determine how well assessments of tranquillity made in the laboratory environment matched those made in the real outdoor environment in order to have greater confidence in the practical application of the rating tool.

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2 METHOD

In order to validate the findings assessment were made at a number of tranquil and non-tranquil locations on the campus at the University of Bradford in Yorkshire, UK. Participants made ratings

on site and at the same time video records were taken. These video clips were then replayed at least 3 months later in the laboratory using the same replay methods as used previously to develop the prediction tool

2.1 Recordings and Assessments Outside

Binaural head recordings were made under 8 different conditions at 6 locations on the University of Bradford campus. A video camera was mounted on top of the head and operated simultaneously. Figure 1 shows views of the assessment conditions that were videoed and evaluated. The locations are described below:

- Peace Garden: adjacent to a busy road on the edge of the campus. Assessments were made under 3 conditions: “as was”, with litter added, with replayed water sounds
- Great Horton Road: On the pavement next to this busy radial route into Bradford city centre
- Quadrangle: A green in the centre of the campus overlooking a grassed areas with mature trees
- Theatre in the Mill: At the edge of the quadrangle on a bridge over a stream with water sounds
- Library: Fairly narrow space between two university buildings with hedge in foreground
- Construction site: This was close to the busy road and reconstruction work was in progress

Eight subjects (Ss) were recruited to take part. They were asked to complete biographic and contact details before commencing the assessments. They were given a £10 voucher for their time.
Each condition was pesented in a quasi random order. At each location they were asked to stand to the side of the binaural head and video recorder (Canon XM2 camcorder) and look in the same direction as the camera. On a start and stop signal they were asked to assess the tranquillity of the environment during a 30 second timed period and at the end to assess the perceived tranquillity during that period. For this purpose a 0 to 10 point interval scale was used where 0 = not at all tranquil and 10 = most tranquil. Prior to the experiment, the subjects were told that a tranquil environment was one that they considered a quiet, peaceful place to be, i.e. a place to get away from everyday life. They were also informed, that for the purpose of the exercise the environments that they saw should be considered ‘steady state’.

They were also asked to note any factors that they felt improved the tranquillity and those that reduced the level of tranquillity. A score sheet was provided. They were asked not to confer over their assessments. There were 8 separate conditions so that the Peace Garden was visited 3 times during one random order sequence. While Ss were away from the Peace Garden litter was either scattered, collected up or a portable CD player was placed behind the position where Ss were instructed to make assessments.

There were 3 random sequences so that each condition was presented 3 times. The assessments made during the first sequence were counted as a practice round and only the ratings made during the 2nd and 3rd sequences were used in the analysis.

2.2 Replay of Recordings and Assessments in the Laboratory

Approximately 3 months after the outside assessments were completed the Ss were invited to return to take part in a similar study but using the reproduced environments provided by the recordings taken during the assessments outside. The Ss were seated in a quiet room (semi-anechoic chamber) and positioned 2m from a Pioneer PDP-506XDE plasma screen and wearing calibrated headphones (either Technics RP-295 or Roland RH-300). They were instructed to subjectively assess how tranquil they found each environment to be using exactly the same 0-10 tranquillity rating procedure as used outside. Exactly the same instructions were given. The orders of presentations were exactly the same so that results were strictly comparable. As before assessments made during the first sequence were considered as practice results and only the results from the 2nd and 3rd sequences were used in the analysis.

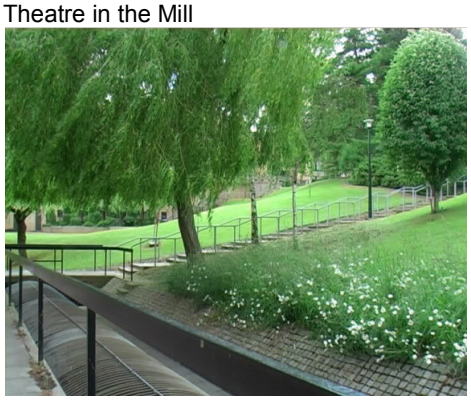
Peace Garden: “as is” and with water sounds

Peace garden with litter

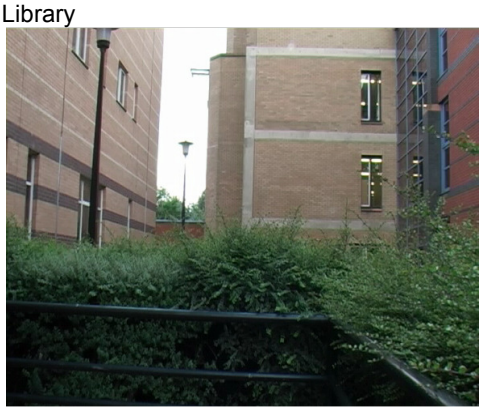
Great Horton Road

Quadrangle

Theatre in the Mill



Library



Construction site

Figure 1: Views of assessment conditions

3 ANALYSIS

The ratings from the 2nd and 3rd sequences outside and in the simulated environment were averaged and compared. Three of the Ss who took part in the original experiment outside did not reply to the invitation to return so that for comparison purposes only the 5 Ss who had completed assessments both outside and indoors were utilised. Figure 2 shows a comparison of these average scores.

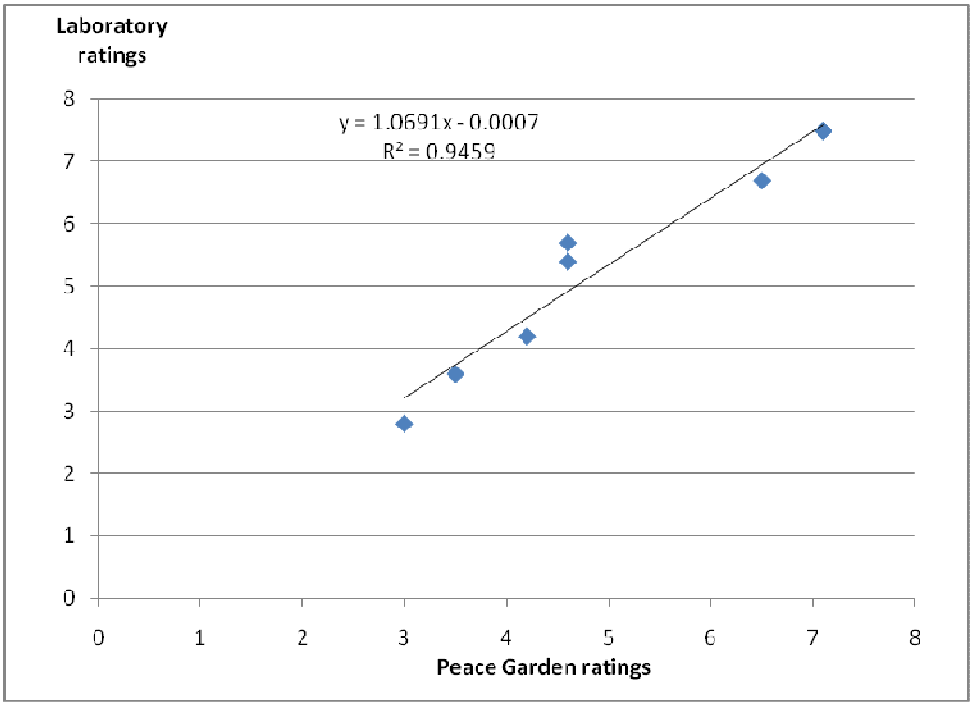


Figure 2: Comparison of ratings made outside and in the laboratory

It can be seen that there is excellent agreement between the two sets of ratings (R^2=0.95) with the regression line passing through the origin. This implies that 95% of the variance could be explained by the direct relationship.

Analysis of variance of the outdoor experiment showed a significant difference between environmental conditions ($p<0.001$)as shown in Table 1 below:

Table 1: Analysis of variance of outdoor ratings

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Subjects	11.10938	7	1.587054	0.929759	0.492221	2.203232
Environments	163.3594	7	23.33705	13.67177	1.19E-09	2.203232
Error	83.64063	49	1.706952			
Total	258.1094	63				

The average ratings ranked in order of tranquillity are given below in Table 2:

Table 2: Average scores for each environmental condition

Option	***Average rating***
Quadrangle	7.65
Theatre in the Mill	6.94
Library	6.56
Peace Garden with water sound	4.94
Peace Garden “as is”	4.63
Construction site	4.31
Peace garden with rubbish	3.63
Great Horton Road	2.75

It can be seen that the presence of the water sound lifted the average rating slightly (from 4.63 to 4.94). However a more noticeable difference was the effect of litter on average ratings. This produced a whole scale reduction in average ratings (from 4.63 to 3.63). The presence of relatively low noise levels and natural features such as trees, grass and shrubs and running water would have lifted the levels of tranquillity in the centre of the campus (Quadrangel, Theatre in the Mill) compared with those near the periphery such as the construction site and edge of busy road.

The frequency of comments made during the outdoor assessments by the 8 Ss concerning both factors thought to improve or reduce perceived tranquillity are summarised in Table 3 below.

Table 3: Positive and negative factors affecting tranquility

Factor	**Number of Ss**	***Auditory***	***Visual***
Positve			
Sound of water	8	x	
Trees, shrubs, flowers, grass	7		x
Quiet, peaceful, low noise	7	x	
Open space, views	3		x
Old buildings	3		x
Wind in trees	3	x	
Sunshine	2		x
Bird song	1	x	
Negative			
Traffic noise	8	x	
Noisy people (including music)	6	x	
Litter	5		x
Sound of water (recorded)	4	x	
Ugly buildings, paths and signs	4		x
Vehicle noise (reversing alarms, ice-cream chimes	4	x	
Building site view	3		x
Dirty conditions (exclude litter)	3		x
Excessive wind noise in trees	3	x	
Sound of water (natural)	2	x	
Construction noise	2	x	

The factors are listed in order of the frequency the factors were mentioned in the questionnaires It can be seen that the presence of water sounds and natural features such as trees grass, shrubs and trees are frequently mentioned as are peaceful surroundings. Notice that old buildings appear to contribute as do open views. On the negative side high noise levels both from traffic and people depress ratings as do litter. Some Ss commented on the poor quality and loudness of the reproduced water sound and for some it was irritating.

4 CONCLUSIONS

The following conclusions can be made:

- There is support for the use of the simulated environment employed for assessing tranquillity. This finding helps to underpin the method used for developing the tranquillity rating prediction tool
- Litter can depress ratings of tranquillity. It could reasonably be assumed from the list of factors reported that ugliness and dirty conditions also have the potential to depress ratings. It was not possible to assess the effects of graffiti but it is conjectured that this would also have a significant detrimental effect
- Some water sounds can improve tranquillity ratings. This is in agreement with a previous study of the effects of water sounds on perceived tranquillity in a simulated balcony setting[3]
- Low noise levels and natural feature combine to elevate the perceived tranquillity

5 REFERENCES

1. S. Kaplan, “The restorative benefits of nature: Towards an integrated framework”, Journal of Environmental Psychology, 15, 169-182 (1995).
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