THE EFFECT OF AMBIENT ODOUR AND SOUND ON ENVIRONMENTAL EVALUATIONS

Ruth Dryden

Thesis submitted as part-fulfilment for the requirements of the degree of Master of Philosophy in Psychology

Department of Psychology
School of Human Sciences
University of Surrey
August 2004

© Ruth Dryden 2004
ABSTRACT

As part of research on the effects of the environment on behaviour, the current thesis reported two studies examining evaluations made of the environment when aspects were changed. The hypothesis derived from Mehrabian and Russell's (1974) theory stated that changes in the environment would only affect evaluations when these changes influence the emotional (pleasure and arousal) states of the individual. Furthermore, changes in the complexity and familiarity within the environment influence emotional states and consequently evaluations. In contrast, Canter's (1977, 1983) theory predicts that evaluations are affected by the changes in the environment only when the goals of the individual also change simultaneously.

The current thesis examined elements of the theories by asking participants to assess various aspects of their immediate physical environment in relation to their emotional states and goals while the sound and/or the odour were manipulated. Participants in Study 1 were exposed to a “cut-grass” odour and “mower” sound, which were considered as being unidentifiable. During Study 2, a different set of participants was exposed to relatively identifiable stimuli consisting of a “coffee” odour and “cafeteria” sound. The goals were kept constant across the conditions as participants carried out the same tasks across the conditions. In both studies participants were required to identify the sound and the odour and given a list of words to rate in terms of their relationship to the sound and odour in their environment.

The studies revealed that the evaluations corresponding to the emotional states were a function of the whether the sound could be identified. The manipulation of the unidentifiable sound influenced the extent to which the environment was considered as being pleasant and making participants to feel ill whereas the manipulation of the identifiable sound did not change these evaluations. However the evaluations were not a function of whether the odour could be identified. Although the data from the studies provided support for some of the elements of Mehrabian and Russell’s (1974), and Canter’s (1983) theories, these theories do not adequately account for the differential effect of the sound and the odour manipulation. It was concluded that future research into the effects of the environment should consider the combined contribution of the emotional and purposive responses within a theoretical framework.
ACKNOWLEDGEMENTS

I would like to first give thanks to the LORD for taking me through this degree and beyond. Sincere thanks to my dad, mum, Christopher and David for their prayers and support. I also wish to extend appreciation to Dr Lyons and my supervisors, Professor Groeger and Dr Simpson.
CONTENTS

Abstract ii
Acknowledgements iii
List of Figures ix
List of Tables xii

1. Evaluations of the Physical Environment 1

1.1 Overview 1
1.2 Brief Historical Exposition 5
1.3 Emotional (Affective) Response to the Environment (Mehrabian & Russell, 1974) 10
  1.3.1 Development of the Theory 10
  1.3.2 Further Developments and Application of the Theory 16
  1.3.3 Summary of the Theory 22
1.4 The Purposive Evaluation of Places (Canter, 1983) 23
  1.4.1 Development of the Theory 23
  1.4.2 Further Developments and Application of the Theory 30
  1.4.3 Summary of the Theory 36

2. Study 1: The Effects of a Cut-Grass Odour and Mower Sound on Evaluations 38

2.1 Introduction 39
  2.1.1 Review of the Two Main Theories 39
  2.1.2 The Role of Identification 41
  2.1.3 Word-Environment Relationship 44
  2.1.4 The Present Study 48
2.2 Method 51
  2.2.1 Participants and Design 51
  2.2.2 Environmental Manipulations and Evaluation Measures 52
    2.2.2.1 Stimuli 53
2.2.2.2 Rooms
2.2.2.3 The Room Environmental Questionnaire (REQ)
2.2.2.4 Wordlist
2.2.3 Procedure
2.2.4 Data Analyses and Scoring Procedures
2.2.4.1 Identifications
2.2.4.2 Environmental Ratings
2.2.4.3 Word-Environment Relationship Ratings

2.3 Results

2.3.1 Identifications
2.3.1.1 Cut-grass Odour
2.3.1.2 Mower Sound
2.3.2 Environmental Ratings
2.3.2.1 Temperature
2.3.2.1.1 Temperature Intensity
2.3.2.1.2 Temperature Positive
2.3.2.1.3 Temperature Negative
2.3.2.1.4 Temperature Cognitive
2.3.2.2 Lighting
2.3.2.2.1 Lighting Intensity
2.3.2.2.2 Lighting Positive
2.3.2.2.3 Lighting Negative
2.3.2.2.4 Lighting Cognitive
2.3.2.3 Spaciousness
2.3.2.3.1 Spaciousness Intensity
2.3.2.3.2 Spaciousness Positive
2.3.2.3.3 Spaciousness Negative
2.3.2.3.4 Spaciousness Cognitive
2.3.2.4 Noise
2.3.2.4.1 Noise Intensity
2.3.2.4.2 Noise Positive
2.3.2.4.3 Noise Negative
2.3.2.4.4 Noise Cognitive
2.3.2.5 Smell
2.3.2.5.1 Smell Intensity
2.3.2.5.2 Smell Positive
2.3.2.5.3 Smell Negative
2.3.2.5.4 Smell Cognitive
2.3.3 Word-Environment Relationship Ratings
2.3.3.1 Mean Ratings of the Words' relatedness to the Predominant Smell
2.3.3.2 Mean Ratings of the Words' relatedness to the Predominant Noise
2.4 Discussion

3. Study 2: The Effect of a Coffee Odour and Cafeteria Sound on Evaluations

3.1 Introduction
3.2 Method
3.2.1 Participants and Design
3.2.2 Environmental Manipulations and Evaluation Measures
3.2.3 Procedure
3.2.4 Data Analyses and Scoring Procedures
3.2.4.1 Identifications
3.2.4.2 Environmental Ratings
3.2.4.3 Word-Environment Relationship Ratings
3.3 Results
3.3.1 Identifications
3.3.1.1 Coffee Odour
3.3.1.2 Cafeteria Sound
3.3.2 Environmental Ratings
3.3.2.1 Temperature
3.3.2.1.1 Temperature Intensity
3.3.2.1.2 Temperature Positive
3.3.2.1.3 Temperature Negative
3.3.2.1.4 Temperature Cognitive 117
3.3.2.2 Lighting 117
3.3.2.2.1 Lighting Intensity 118
3.3.2.2.2 Lighting Positive 118
3.3.2.2.3 Lighting Negative 119
3.3.2.2.4 Lighting Cognitive 119
3.3.2.3 Spaciousness 120
3.3.2.3.1 Spaciousness Intensity 120
3.3.2.3.2 Spaciousness Positive 122
3.3.2.3.3 Spaciousness Negative 123
3.3.2.3.4 Spaciousness Cognitive 124
3.3.2.4 Noise 126
3.3.2.4.1 Noise Intensity 126
3.3.2.4.2 Noise Positive 128
3.3.2.4.3 Noise Negative 128
3.3.2.4.4 Noise Cognitive 129
3.3.2.5 Smell 130
3.3.2.5.1 Smell Intensity 131
3.3.2.5.2 Smell Positive 132
3.3.2.5.3 Smell Negative 134
3.3.2.5.4 Smell Cognitive 135
3.3.3 Word-Environment Relationship Ratings 138
3.3.3.1 Mean Ratings of the Words' relatedness to the Predominant Smell 138
3.3.3.2 Mean Ratings of the Words' relatedness to the Predominant Noise 139
3.4 Discussion 144

4. General Discussion 148

4.1 Emotional (Affective) Response to the Environment (Mehrabian & Russell, 1974) 148
4.2 The Purposive Evaluation of Places (Canter, 1983) 150
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3</td>
<td>4.3 Practical Implications and Proposals for Future Research</td>
<td>152</td>
</tr>
<tr>
<td>4.4</td>
<td>4.4 Conclusion</td>
<td>155</td>
</tr>
<tr>
<td>References</td>
<td>References</td>
<td>157</td>
</tr>
<tr>
<td>Appendices</td>
<td>Appendices</td>
<td>171</td>
</tr>
<tr>
<td>Appendix 1</td>
<td>Appendix 1 Semantic Differential Measures of Emotional State or Characteristic (Trait) Emotions</td>
<td>171</td>
</tr>
<tr>
<td>Appendix 2</td>
<td>Appendix 2 A General Measure of Information Rate</td>
<td>173</td>
</tr>
<tr>
<td>Appendix 3</td>
<td>Appendix 3 Booklet used in Studies</td>
<td>174</td>
</tr>
<tr>
<td>Appendix 4</td>
<td>Appendix 4 Wordlists (with all word categories)</td>
<td>184</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

1. Evaluations of the Physical Environment

Figure 1.1 Outline of Mehrabian and Russell’s framework (modified from Mehrabian and Russell 1974). 11
Figure 1.2. Proposed Two-Dimensional Representation of the Affective Quality Attributed to Environments (Taken from Russell and Pratt, 1980). 20
Figure 1.3. Formal statement of the theory of place (Modified from Canter, 1983). 25
Figure 1.4. Schematic Representation of the Cylindrex of Place Evaluation (Modified from Donald, 1985) 29
Figure 1.5. Mapping Sentence for Office Evaluation (Modified from Donald, 1994) 34

2. Study 1: The Effects of a Cut-Grass Odour and Mower Sound on Evaluations

Figure 2.1 The Mean and Standard Error Intensity Ratings of the Temperature for each group across the four conditions 68
Figure 2.2 The Mean and Standard Error Positive Ratings of the Temperature for each group across the four conditions 70
Figure 2.3 The Mean and Standard Error Negative Ratings of the Temperature for each group across the four conditions 71
Figure 2.4 The Mean and Standard Error Intensity Ratings of the Lighting for each group across the four conditions 73
Figure 2.5 The Mean and Standard Error Positive Ratings of the Lighting for each group across the four conditions 74
Figure 2.6 The Mean and Standard Error Intensity Ratings of the Spaciousness for each condition 76
Figure 2.7 The Mean and Standard Error Positive Ratings of the Spaciousness for each condition 77
Figure 2.8  The Mean and Standard Error Intensity Ratings of the Noise for each group across the four conditions 79
Figure 2.9  The Mean and Standard Error Positive Ratings of the Noise for each group across the four conditions 81
Figure 2.10 The Mean and Standard Error Negative Ratings of the Noise for each condition 82
Figure 2.11 The Mean and Standard Error Cognitive Ratings of the Noise for each condition 83
Figure 2.12 The Mean and Standard Error Intensity Ratings of the Smell for each group across the four conditions 85
Figure 2.13 The Mean and Standard Error Positive Ratings of the Smell for each group across the four conditions 86
Figure 2.14 The Mean and Standard Error Negative Ratings of the Smell for each group across the four conditions 87
Figure 2.15 The Mean and Standard Error Cognitive Ratings of the Smell for each condition 89
Figure 2.16 The Mean and Standard Error Cognitive Ratings of the Smell for each group 89

3. Study 2: The Effect of a Coffee Odour and Cafeteria Sound on Evaluations

Figure 3.1  The Mean and Standard Error Intensity Ratings of the Temperature for each condition 113
Figure 3.2  The Mean and Standard Error Intensity Ratings of the Temperature for each group 114
Figure 3.3  The Mean and Standard Error Positive Ratings of the Temperature for each group across the four conditions 115
Figure 3.4  The Mean and Standard Error Negative Ratings of the Temperature for each condition 117
Figure 3.5  The Mean and Standard Error Positive Ratings of the Lighting for each group across the four conditions 119
Figure 3.6  The Mean and Standard Error Intensity Ratings of the Spaciousness for each group across the four conditions  

Figure 3.7  The Mean and Standard Error Positive Ratings of the Spaciousness for each condition  

Figure 3.8  The Mean and Standard Error Negative Ratings of the Spaciousness for each condition  

Figure 3.9  The Mean and Standard Error Cognitive Ratings of the Spaciousness for each condition  

Figure 3.10  The Mean and Standard Error Cognitive Ratings of the Spaciousness for each group  

Figure 3.11  The Mean and Standard Error Intensity Ratings of the Noise for each group across the four conditions  

Figure 3.12  The Mean and Standard Error Positive Ratings of the Noise for each condition  

Figure 3.13  The Mean and Standard Error Cognitive Ratings of the Noise for each group across the four conditions  

Figure 3.14  The Mean and Standard Error Intensity Ratings of the Smell for each condition  

Figure 3.15  The Mean and Standard Error Positive Ratings of the Smell for each condition  

Figure 3.16  The Mean and Standard Error Positive Ratings of the Smell for each group  

Figure 3.17  The Mean and Standard Error Negative Ratings of the Smell for each condition  

Figure 3.18  The Mean and Standard Error Cognitive Ratings of the Smell for each condition  

Figure 3.19  The Mean and Standard Error Cognitive Ratings of the Smell for each group
LIST OF TABLES

2. Study 1: The Effects of a Cut-Grass Odour and Mower Sound on Evaluations

- Table 2.1: Frequency of Smell Identification made in each condition
- Table 2.2: Frequency of Hits, Near Hits and Misses in each condition for the Cut-Grass Odour (N = 64)
- Table 2.3: Frequency of Sound Identification made in each condition
- Table 2.4: Frequency of Hits, Near Hits and Misses in each condition for the Mower Sound (N = 64)
- Table 2.5: Mean (and Standard error) rating of the Temperature for each scale in each condition.
- Table 2.6: Mean (and Standard error) rating of the Lighting for each scale in each condition.
- Table 2.7: Mean (and Standard error) rating of the Spaciousness for each scale in each condition.
- Table 2.8: Mean (and Standard error) rating of the Noise for each scale in each condition.
- Table 2.9: Mean (and Standard error) rating of the Smell for each scale in each condition.
- Table 2.10: Mean (and Standard deviation) rating of the words' relationship to the predominant smell for each category in each condition.
- Table 2.11: Mean (and Standard deviation) rating of the words' relationship to the predominant noise for each category in each condition.
- Table 2.12: Summary of the Effects of the Cut-Grass Odour and the Mower Sound on the Identification Accuracy, Environmental Evaluations and Word-Environment Relationship Ratings.
3. Study 2: The Effect of a Coffee Odour and Cafeteria Sound on Evaluations

Table 3.1 Frequency of Smell Identification made in each condition 108
Table 3.2 Frequency of Hits, Near Hits and Misses in each condition for the Coffee Odour (N = 61) 109
Table 3.3 Frequency of Sound Identification made in each condition 110
Table 3.4 Frequency of Hits, Near Hits and Misses in each condition for the Cafeteria Sound (N = 61) 110
Table 3.5 Mean (and Standard error) rating of the Temperature for each scale in each condition. 112
Table 3.6 Mean (and Standard error) rating of the Lighting for each scale in each condition. 118
Table 3.7 Mean (and Standard error) rating of the Spaciousness for each scale in each condition. 120
Table 3.8 Mean (and Standard error) rating of the Noise for each scale in each condition. 126
Table 3.9 Mean (and Standard error) rating of the Smell for each scale in each condition. 130
Table 3.10 Mean (and Standard deviation) rating of the words’ relationship to the predominant smell for each category in each condition. 138
Table 3.11 Mean (and Standard deviation) rating of the words’ relationship to the predominant noise for each category in each condition 140
Table 3.12 Summary of the Effects of the Odour and Sound on the Identification Accuracy, Environmental Evaluations and Word-Environment Relationship Ratings during Study 1 and Study 2. 142
1. Evaluation of the Physical Environment

1.1 Overview

On average people spend more than 90 percent of their time inside buildings (Ott & Roberts, 1998; Evans & McCoy, 1998). It is therefore important to understand how people evaluate this environment. Environmental evaluation is defined as the process of deciding whether one environment is preferred over another. Evaluations are important predictors of behaviours within the environment. Understanding environmental evaluations has practical implications in terms of the diagnosis and remediation of environment-related stress and illnesses affecting performance, productivity and absenteeism at work (Raw, Roys, Whitehead, & Tong, 1996). Its implications also extend to retail and other industries where the perception of the environment has been found to influence behaviour (e.g. purchasing, Turley & Milliman, 2000).

Although there is much research on the effects of the ambient environment on behaviour (e.g. Baron & Bronfen, 1994; Yalch & Spangenber, 2000; Haines, Stansfeld, Job, Berglund, & Head, 2001), few studies report whether the participants’ evaluations are also measured and analysed (e.g. Herz, 1997). In the few studies where participants are asked to rate the environment, detailed analyses of the environmental ratings are rarely published. Understanding environmental evaluation would contribute to knowing how perceptions of the environment influence behaviour. Do people need to be aware of a change in the environment for it to influence their behaviours? Will the perception of change influence behaviour even when no change has occurred? Studies where only the effects on behaviour are reported will not adequately address these and other related questions.

More importantly, most researchers on the effects of the environment on behaviour fail to discuss their findings within a theoretically based framework of how people evaluate their environment. This lack has led to a call for more integration between theory and research within environmental psychology (Sundstrom, Bell, Busby, & Asmus, 1996), especially within the area of evaluation research (Stokols, 1978).
In an attempt to address the issues raised above, the studies presented in this thesis explore how people evaluate environments by using two theories: The Emotional Reaction to Places (Mehrabian & Russell, 1974) and The Purposeful Evaluation of Places (Canter, 1983). Participants are exposed to two rooms for a relatively short period (15-20 minutes) and are required to evaluate their surroundings using theoretically and empirically derived measures.

Post Occupancy Evaluation (POE) research also examines how people assess their surroundings (Bechtel, 1997). Preiser (1994) defined POE as being the process of the actual evaluation of a building’s performance once in use by human occupants. The definition of this term implies that the person has been in the environment for a considerable amount of time. The amount of time spent in an environment has been shown to affect the type of evaluation made (e.g. Pedersen, 1978). Furthermore, the first few moments in an environment may determine how these evaluations develop over time. Therefore it is important to determine the type of evaluations made during initial exposures to environments. As the focus of the present thesis is on evaluations made after relatively short exposures to an environment, research on POE will not be discussed in detail in the remainder of the thesis.

The thesis is organised in the following manner. A brief historical context is initially described consisting of theories explaining how people interact with the environment. The historical exposition is provided to set the stage for later discussion and to show how Mehrabian and Russell’s (1974), and Canter’s (1983) approaches incorporate concepts used in other theories of environmental evaluations. Among these theories are Lewin’s (1936) concept of lifespace, Barker’s (1968) Behaviour Setting theory and more recently Clitheroe, Stokols and Zmuidzinas’ (1998) Contextual Model. Criticisms of some of these models include the fact that they fail to clearly specify how the theoretical concepts can be empirically tested. The ones that do provide operationally defined variables do not do so within a cause-and-effect framework. These problems limit the extent to which researchers can incorporate these theories to study the impact of the environment on evaluations. Mehrabian and Russell’s (1974), and Canter’s (1983) approaches are selected as they suffer less from these shortcomings.
Following the historical exposition, Mehrabian and Russell’s (1974) and Canter’s (1983) theories are individually discussed in more detail. For each theory, the essential features and the evidence supporting it are outlined.

Mehrabian and Russell (1974) proposed that the environment generates pleasure, arousal and dominance responses and these mediate approach/avoidance behaviours. This theory has been widely accepted in retail research (e.g. Donovan & Rossiter, 1982; Babin, Hardesty, & Suter, 2003) and the principles have been implemented in personality research (e.g. Yik & Russell, 2003). Among the criticisms of the theory is that it fails to account for how people’s intentions and goals affect their evaluation.

One approach which accounts for this was proposed by Canter (1983) who argued that evaluations involve the use of cognitive representations to accomplish goals within the environment. This approach has been implemented mainly within office architectural design research (e.g. Donald, 1994), and studies into residential, neighbourhood and housing settings (e.g. Bonaiuto, Boones & Continisio, 2004; Abu-Ghazzeh, 1999). The criticisms of this approach include the fact that it does not define the relationship between the facets of evaluation and variations in the environment.

After the examination of both theories, this chapter concludes by summarising the principle contributions of and differences between the theories. The use of both theories should provide a more comprehensive model of the process underlying evaluation. It is proposed that a way of testing these theories would involve considering what each one would predict should happen to evaluations when aspects of the environment (i.e. sound and odour) are changed. The studies in which these theories are tested are described in second and third chapters.

In the first section of the second chapter it is argued that there are other empirical methods of monitoring evaluations when the ambient sound and odour are changed: identification and word-rating tasks. The ability to identify the stimuli and the relationship between words and the environment are discussed in light of how these tasks could also be used to examine evaluations. It is argued that evaluations may be different between people who can and those who can not identify the stimuli. Also,
evaluations may vary according to how people consider the relationship between the words and the stimuli. A separate scale is also used to measure evaluations of the environment. Although Mehrabian and Russell (1974) and Canter (1983) individually suggest scales to measure evaluation, it is decided to use one scale - The Room Environment Questionnaire (REQ) - which contains key elements from each theory. The added advantage of using the REQ over the other scales is that it has previously been successful in monitoring evaluations across different environments (e.g. Abbott, 2000; Groeger, Croft & Craig, 1999). The participants in the previous studies were from the same population as those used in the studies in this thesis. The results from these studies would further validate the REQ.

The REQ, identification and word rating tasks are used to evaluate two rooms across two studies. During the first study participants are exposed to a mower sound and a cut grass odour (second chapter) and in the second study a different group are exposed to a cafeteria sound and coffee odour (third chapter).

Finally the last chapter contains a reassessment of the two theories in light of the other theories of evaluation initially described in the historical exposition and the findings of the studies presented in the thesis. The practical implications of the findings are then outlined followed by suggestions for further research where evaluations and behaviours can be measured together to determine the effects of the environment.

In summary, the criticisms of past research on the effects of the environment include the failure to publish participants' evaluations and to integrate findings with relevant theories. The failure to address these criticisms limits the extent to which the findings can be used to further understand the mechanisms underlying behaviour-environment interactions. The thesis begins to address these issues by presenting two studies where participants evaluate their surroundings. The methods used to collect their assessments are based on theoretical and empirical issues which are outlined in this chapter and in the first part of the second chapter. Specifically Mehrabian and Russell’s (1974) and Canter’s (1983) theories along with empirically derived methods (identification and word rating tasks) are utilised to determine how evaluations are affected when aspects of the environment (sound and odour) are changed. The
findings of the studies provide a more comprehensive explanation of how people respond to the environment in which they spend 90% of their time (i.e. buildings).

1.2 A Brief Historical Exposition
Before discussing the two main theories (i.e. Mehrabian & Russell (1974); Canter, 1983) that are central to this thesis, a brief historical perspective of other evaluation theories is provided. These theories include Lewin's (1936) concept of lifescape, Barker's (1968) Behaviour Setting theory and Clitheroe, Stokols and Zmuidzinas' (1998) Contextual Model. This exposition will show how these models approach evaluation from various paradigms. The theories also differ with respect to the suggested methodology. This section will conclude by suggesting that one reason for the diversity is that the theories explain the different ways people interact with the environment. Therefore the aim is not to find the best theory, but to conduct research that will integrate the strengths of the theories. The integration will begin to provide a comprehensive model of environmental evaluation. This thesis will begin to accomplish this by using two models, proposed by Mehrabian and Russell (1974), and Canter’s (1983), which share many features with the theories described in this exposition.

The assumption that people only act in accordance with the physical characteristics of the environment was commonly held and developed by the Gestalt school of psychology (Kofka, 1935). Based on this assumption, objective measurements of the properties of the environment should be sufficient to serve as predictors of behaviours within it.

From the early part of the 20th century psychologists have challenged this assumption arguing that people behave in accordance with their perception and cognitive representation (i.e. interpretation) of the environment. For example, in Lewin’s (1936) concept of lifescape it is proposed that the aspects of the environment which are the best predictors of behaviour are those consciously perceived and interpreted by individuals. This theory has provided a starting point for researchers to develop rating scales using lists of adjectives measuring how people use their own natural language.
to describe and appraise their environment such as the Environmental Checklist developed by Domino (1984). An implication of Lewin’s (1936) theory is that aspects of the environment that are not consciously attended to and/or can not be interpreted are unlikely to influence evaluations. This was an important theory, but one of its central claims has been demonstrated not to be true as research shows that people are influenced by aspects of the environment to which they do not consciously perceive (Degel & Koster, 1999).

Barker (1968) offered an alternative explanation commonly referred to as the Behavioural Setting Theory. This theory and subsequent revisions (Wicker, 1987) have been influential within the area of environmental psychology (Garling, 1998). According Barker (1968), environments (or places) are associated with specific behaviours. Interactions with a place are based on a list of behaviours that take place within it. A Behaviour setting (or “setting program”) is an orderly pattern of behaviours within a place, which can be generalised to all individuals. Knowledge of the setting program is obtained by collecting observations of actions in a given place. This makes it possible to determine future behaviours within a specific environment. Barker (1968) argued that members of the setting experience frustration when the setting program is challenged and work hard to maintain the status quo.

Although it is not clearly stated in the theory, its implications are that negative evaluations would be given to places where the status quo is challenged. Positive evaluations would be given when the occupant observes the expected orderly pattern of behaviours. However this view ignores the fact that the consequences of actions are both objective and perceived and this also plays a role in determining future behaviours in the environment. Therefore collecting observations of actions and using this information alone in the way proposed by Barker (1968) is not sufficient to predict behaviours. Furthermore although Barker (1968) addressed how to identify specific environments, no suggestions were provided concerning how evaluations in one setting influence ones made of other settings.

The zeitgeist in which Lewin (1936) and Barker (1968) published their models appeared to heavily influence the development of the two theories. Lewin’s (1936) theory was developed during a period where introspection was a popular approach.
whereas Barker’s (1968) theory was developed at a time where the behaviourist approach was generally accepted. This must be taken into consideration when evaluating the merits of these theories. Both Lewin’s (1936) and Barker’s (1968) provided the basis for later theories to build on.

Wicker (1987), for example, modified Barker’s (1968) Behavioural Setting Theory, adding the importance of motivation, additional social processes beyond maintaining the setting program, and the significance of the context in which the setting occurs. However Behavioural Setting Theory and subsequent revisions of it still relies heavily on the observational method and rarely involves manipulation of experimental variables to explore their effects on various dependent measures. Therefore even if the underlying motivations of behaviour are identified, the question still remains concerning how the environment influences these internal processes.

Kaplan and Kaplan (1982, 1989; Kaplan, 1987, 1995) address this question from an evolutionary perspective by proposing that the perceived resources in the environment influence internal processes. Based on Gibson’s (1979) concept of affordance, Kaplan and Kaplan (1982) proposed that people prefer settings that allow them to find food and shelter and feel safe. People are innately motivated to make sense of their environment through achieving a balance between over-stimulation and boredom. Preferred environments either contain enough challenges to provide stimulation or have sufficient restoration potential to provide recovery of attentional fatigue. This approach is similar to that of various personality theories (e.g. Eysenck, Eysenck, & Barrett, 1985). These theories suggest that people will interact with or select their environment depending on their biological need for arousal.

Kaplan and Kaplan (1982) postulated four criteria on which people make evaluations: Coherence, Complexity, Legibility and Mystery. Coherence corresponds to the ease to which the environment can be organised for comprehension. Complexity refers to the degree to which the environment keeps an individual occupied without leading to boredom or over-stimulation. Legibility corresponds to whether the environment can be explored without getting lost within it. Mystery refers to the extent to which the environment is assessed to provide more for an individual if s/he was to engage more in it. The first two criteria correspond to the immediate judgements whereas the last
two relate to what can be expected from the environment in the future. Any individual differences in evaluation relate to differences in the knowledge and familiarity of the environment. Kaplan and Kaplan’s (1982) approach is one of the few theories which does not only address behaviours, but also explicitly explains how people evaluate their surroundings. However this theory does not provide clear operational definition regarding the assessment of the environment (Garling, Biel & Gustafsson, 1998) making it difficult to test the theory.

The theories presented so far do not explain or predict the effects of different types of environmental changes on evaluations. A recent approach which accounts for how people respond to changing environments is the Contextual Model (Clitheroe, Stokols & Zmuidzinas, 1998). The context is defined as an interdependence of environmental aspects. Within this approach two types of changes are explored: gradual contextual shifts and dramatic contextual transformations. Contextual shifts are slow changes in the environment, which do not substantially inhibit behaviours whereas contextual transformations involve fundamental changes in the environment, which consequently affect behaviour. People are more likely to be aware of dramatic contextual transformations than gradual contextual shifts. Therefore it can be derived from this that evaluations are more likely to be affected by dramatic contextual transformations than gradual contextual shifts. Unlike the theories presented earlier, this approach recognised that contexts are “nested” in more macro contexts, and probably subsume more micro contexts. However this approach is vague because it does not clearly define the relationship between the environmental aspects within the context.

In summary, most of the theories described in this exposition fail to clearly specify how the theoretical concepts upon which they rest can be empirically tested (e.g. Clitheroe et al, 1998). Other theories (e.g. Baker, 1968; Wicker, 1987) only describe behaviour and not predict it. Observing behaviours without utilising experimental manipulation limits the ability to identify any causal relationship between the environment and evaluations, which may influence behaviour.

Theories explaining how people evaluate and respond in their environment differ based on the paradigm from which they approach the area of interest e.g. introspective (Lewin, 1936), behaviourist (Baker, 1968), evolutionary (Kaplan & Kaplan, 1982),
etc. Theories also differ on whether people make generic evaluations based on how the environment affects their feelings (Kaplan & Kaplan, 1982) or specific ones based on how the surroundings facilitate the completion of programs or goals (Wicker, 1987). They also differ in terms of the methodology used ranging from questions on objective judgements of places to interactive ways of using the environment.

An explanation for the diversity in these theories is that they simply capture different ways people respond to their environment. Ward and Russell (1981) suggested that people’s interactions with the environment consist of two main elements: emotional and perceptual/cognitive. The initial evaluation of a building may involve mainly an emotional response of pleasure or displeasure. The emotional response will refer to the building’s connotative characteristics by reference to how specific aspects of the environment influence feelings. After the initial exposure, the type of evaluation may then be the result of mainly a perceptual/cognitive response. This response will consist of the building’s denotative rather than connotative characteristics by reference to how aspects of the environment fulfil an individual’s goal (Stokols, 1978). The diversity in these theories therefore reflects the emotional and perceptual/cognitive elements of evaluation to various degrees.

The theoretical and methodological diversity of the models presented suggest that future efforts to develop a comprehensive understanding of the man-environment interaction should not only encompass, but integrate a wide variety of approaches taking in consideration the limitations of these models. This thesis begins to do this by using two models - Mehrabian and Russell’s (1974), and Canter’s (1983) - which share many features with these models and at the same time avoids most of their criticisms. For example the work of Mehrabian and Russell (1974) largely involves generic evaluations of subjective judgements of how places affect feelings or emotions. In contrast, Canter’s (1983) work concentrates upon the perceptual/cognitive element of evaluation in relation to goal-directed behaviour.

In the following sections of this literature review, Mehrabian and Russell’s (1974) Emotional Reaction to Places framework and The Purposeful Evaluation of Places approach developed by Canter (1983) are individually discussed. For each theory the
essential features and applications are described in terms of their contributions to the understanding of how people evaluate their environment.

1.3 Emotional (Affective) Response to the Environment (Mehrabian & Russell, 1974)

The aim of this section is to describe and discuss Mehrabian and Russell’s (1974) theory and to present subsequent research, which has tested and/or developed this theory. The topics addressed will include Mehrabian and Russell’s (1974) definition of emotion and information rate. Further research by Russell, Ward and Pratt (1981), Donovan and Rossiter (1982) and Amato and Malanes (1983) provide inconsistent support for the relationship between information rate and emotion as predictors of evaluation. It is concluded that there is a need to clearly define this relationship and consider the contribution of cognitive/perceptual responses in evaluation.

1.3.1 Development of the Theory

To illustrate Mehrabian and Russell’s (1974) theory, when entering a brightly lit classroom to sit an exam, the lighting is hypothesised to cause a sensation seeking student (Student A) to feel happy, highly aroused and confident. The behavioural outcome is that Student A will prefer the environment. Another student (Student B) with a timid emotional disposition may encounter the same environment for the same purpose; however the lighting is predicted to make them to feel unhappy, sluggish and oppressed. Student B will not prefer the environment. Conversely, if the room was dimmer, the lighting may cause Student A to feel unhappy, sluggish and oppressed, and desire to leave (or not prefer) the room whereas Student B would feel happy and want to stay in (or prefer) the environment.

Using the Stimulus-Organism-Response (S-O-R) framework, Mehrabian and Russell (1974) proposed an explanatory approach to evaluations. Mehrabian and Russell (1974) posited that emotional states (O) are the key mediators between the physical environment (S) and responses (R) to that environment. Figure 1.1 presents the framework proposed by Mehrabian and Russell (1974).
The approach-avoidance behaviours (R) are proposed to be the dependent measures for the environment and emotional disposition's (S) effect on emotional responses (O). These dependent measures include verbal and non-verbal communication of preference, which can be interpreted to correspond to evaluations i.e. the area of interest of the thesis. Mehrabian and Russell (1974) argued that all emotional states can be reduced to three responses: pleasure, arousal and dominance.

Pleasure is proposed to be a feeling state distinguished from responses such as preference, liking, and positive reinforcement. This distinction is because although the latter responses are positively correlated with pleasure, they are also correlated with the arousal dimension. Mehrabian and Russell (1974) argued that it is important to distinguish these responses from the pleasure dimension as scores on the pleasure dimension are independent from the arousal and dominance dimension. Pleasure is hypothesised to be related to approach-avoidance measures overall.
Mehrabian and Russell (1974) argued that arousal is a feeling state varying along a single dimension ranging from sleep to frantic excitement. Arousal is hypothesised to have an interactive effect with pleasantness. This emotional response is positively related to approach behaviours in pleasant environments and negatively related to approach behaviours in unpleasant environments.

Dominance is the feeling state based on the extent to which an individual feels unrestricted or free to act in a variety of ways. So for example, ambient environmental aspects rated as being more intense, more ordered and more powerful on a semantic differential tasks are associated with a feeling of submissiveness, or in other words, a low feeling of dominance. There is an inverse relationship between the dominant feeling and the potency of the environment. Dominance is hypothesised to be positively related to approach behaviours in pleasant environments.

Mehrabian and Russell’s (1974) definitions are not normally used to describe emotions. Emotions are typically associated with expressions such as sadness or anger. Mehrabian and Russell (1974) use of arousal appears to be more of a physiological response per se as opposed to emotions. For example, Mehrabian and Russell (1974) defined arousal using words such as “sleep” and “frantic excitement”. However when an individual is sleeping, they cannot be accurately considered as experiencing any emotions. Mehrabian and Russell’s (1974) definitions of basic emotional responses have implications on how they are associated with environmental evaluations. For example when someone decides to sleep in a chosen environment, this does not necessarily relate to the evaluation of their surroundings. This suggests that Mehrabian and Russell’s (1974) use of emotions in evaluations is questionable.

Mehrabian and Russell (1974) developed a scale to measure the emotional states elicited in a particular environment. It was hypothesised that pleasure, arousal and dominance would be conceptualised as orthogonal, or share a low inter-correlation. Mehrabian and Russell (1974) stated that they did not intend to select a list of adjectives to exhaustively describe the diversity of human emotions. Rather they aimed to construct a scale that would most directly and uniquely measure each of the three factors. Participants were given either six, eight, or twenty-one randomly selected situations from a list of forty situations and asked to describe each one using
twenty-eight sets of adjective pairs developed by Johnson and Myers (1967). The data from the series of studies confirmed the hypothesis. The results showed that the inter-correlation ranged from -0.07 to 0.26 across the studies. The pleasure dimension accounted for the most variance (average 30%) and was followed by arousal (average 21%) and dominance (average 13%) consistently across the studies.

An 18-item scale (Scales of Emotional Reactions to Places, see Appendix 1) was developed designed in a semantic differential format. Mehrabian and Russell (1974) proposed that the three measures can be used to categorise evaluations of the environment in its entirety as opposed to the traditional method of using separate scales for each sensory modality (e.g. temperature, light intensity). Evaluations are hypothesised to be a direct correlate of the environment's pleasure eliciting qualities. Environments are more likely to be preferred if they elicit moderate levels of arousal than if they elicit extremely high or low levels. There is a complex relationship between dominance and the behavioural responses.

Having established the link between emotion and evaluation, the influence of the stimulus component is considered (see Figure 1.1). Specifically Mehrabian and Russell (1974) proposed a scale based on the information theory to measure the environment. Using this theory, Mehrabian and Russell (1974) argued that the entire environment is perceived in terms of its complexity and novelty and this can be reduced to the concept of information rate i.e. the amount of information elicited from the environment per unit time. The information rate reflects the calculated conditional probabilities of the temporal and spatial distribution for each component within the environment. It is hypothesised that the information rate is directly related to the arousal elicited by the environment.

Mehrabian and Russell (1974) proposed that evaluative judgements were distinct from information rate. So it was important to separate the evaluative response to an environment from the information rate. Mehrabian and Russell (1974) conducted a study to develop a verbal measure of information rate. A set of adjectives were used to test the hypothesis that people are more aroused in environments that elicit high information rate than ones that elicit low information rate. The set contained 21 adjective pairs relating to the concepts described in the information theory e.g.
simple-complex, patterned-random, familiar-novel, etc. Participants were presented with six situations, which were taken from the list of situations used in the previous study on the development of the emotional responses. For each of the six situations participants were asked to report their emotional states using the Scales of Emotional Reactions to Places. They were then asked to rate the situations using the adjective pairs relating to the information rate. The results from the study confirmed the hypothesis. The analyses of the adjective pairs revealed that five factors accounted for 60% of the variance. Of these five factors, two were excluded because they appeared to only reflect an evaluative judgement (e.g. bad-good). The coefficient of the regression equation for the adjective pairs and the items Emotional Response scales showed that arousal was a reliable component of the information rate measure.

Mehrabian and Russell (1974) developed a 14-item scale (General Measure of Information Rate, see Appendix 2) based on the findings of this study. However they do not comment on, or attempt to interpret the three factors. Rather the items from the three remaining factors were put together as if they all measured the same elements of information rate. A reason for not attempting to interpret these factors could be because they were not looking for three factors in the same way that they were looking for the three dimensions for the emotional response scales. However this should not be the reason for not at least publishing the amount of variance accounted for each factor. Reporting this finding would allow the reader to make their own conclusions concerning whether there were really three distinct factors or two major factors and a small one.

On further inspection of Mehrabian and Russell’s (1974) findings it appears that the way that these items loaded on the three factors relate to different aspects of information rate. One factor can be interpreted as relating to familiarity as it contains items such as “common-rare” and “novel-familiar”. Another factor can be interpreted as spaciousness as it contains items such as “small scale-large scale” and “crowded-uncrowded”. The remaining dimension reflects the arrangement of stimuli in terms of their spatial and temporal properties. This dimension included items such as “intermittent-continuous” and “patterned-random”. These factors appear to reflect the different ways that people categorise their surroundings. Controlling and/or manipulating these aspects would determine the extent to which they are used in
evaluations. Although Mehrabian and Russell (1974) do not elaborate on these factors, the scale used in the studies presented in the thesis (the Room Environment Questionnaire) takes into account the uniqueness of these elements of information rate.

The General Measure of Information Rate appears to measure the amount (and not the rate) of information. Recall that Mehrabian and Russell (1974) argued that the information rate is the amount of information elicited from the environment per unit time. However, the scales do not allow for any time measurement. The concept of information rate appears to be an ideal. The scale more accurately measures the information load, which is the usual term used in later research to replace information rate.

The effect of the information rate is modified by the individual's emotional disposition. Specifically, the arousal tendency also determines the emotional response. In general, arousal-eliciting environments are more likely to be approached by high arousal seekers than low arousal seekers. There is relatively more theoretically driven research on the effect on evaluations of personality and emotional dispositions than there is on the environment. Also, although Mehrabian and Russell (1974) proposed that both the environment and the emotional dispositions act on the emotional responses, they did not clarify how both the environment and the emotional dispositions work together to influence emotional states. As the focus of this thesis is on the effects of the environment on evaluations, the role of emotional dispositions is not considered further before the General Discussion of this thesis.

Donovon and Rossiter (1982) argued that Mehrabian and Russell (1974) clearly defined and provided evidence for the emotional and behavioural responses and the links between these two responses. However, Donovon and Rossiter (1982) also noted that the definition of the stimulus is not as developed as the other two variables. This could be due to the complexity within the environment. The environment consists of elaborate combinations of aspects providing stimulation in various sensory modalities. For this reason, the present thesis outlines subsequent studies of the model by other researchers, which focus on examining the link between the environment and evaluations through emotional responses.
1.3.2 **Further Developments and Application of the Theory**

In general, research supports the existence of a relationship between the emotional responses and the environment (e.g. Babin, Hardesty & Suter, 2003; Eroglu, Machleit & Davis, 2003; Biggers & Walker, 1984; Donovan & Rossiter, 1982; Russell, Ward & Pratt, 1981). Empirical evidence suggests that people make their evaluations based on the affective response to the environment. However few studies test specifically how information rate is linked to evaluation (Huang, 2003; Donovan & Rossiter, 1982). In some studies which test this, the hypothesised relationship between arousal and information rate has been rejected. Also no relationship has been found between information rate and evaluation. A possible reason for these findings is that the studies lacked sufficient control over key variables. The lack of control over key variables was demonstrated in a study carried out by Donovan and Rossiter (1982).

Donovan and Rossiter (1982) conducted a correlational study to establish the emotional responses induced by retail environments. Attempts were made to observe whether environments that elicit a high information load led to enhanced arousal. This provided a clear indication of how information load is also related to evaluation where it is predicted that in pleasant settings there is a positive relationship between preference for an environment and arousal. In unpleasant settings there is a negative relationship between preference for an environment and arousal. Participants were randomly allocated to two or three retail environments. The environments selected covered diverse retail settings such as department stores, fast-food restaurants and supermarkets. They were instructed to go to the central point of the store (or the first floor, if the store had two or more levels) and complete a series of questionnaires. The set of questionnaires consisted of Mehrabian and Russell’s (1974) three measures: The Scales of Emotional Reactions to Places (with some of the original items replaced by more context relevant ones), The General Measure of Information Rate (or Load) and The General Measure of Approach-Avoidance Intentions. The latter scale was modified to be contextually appropriate and measured participants’ evaluations of the environment and intentions.
The results from the Scales of Emotional Reactions to Places yielded high reliability coefficients for pleasure (0.90) and arousal (0.86) and a relatively low coefficient for dominance (0.65). This suggested that pleasure and arousal correspond to the affective quality of evaluation whereas dominance did not appear to measure these qualities.

Pleasure accounted for 44% of the variance indicating that this response predicted most of the evaluations and behavioural intentions. More importantly, pleasure elicited from the environment led to positive evaluations of the store. In pleasant environments, there was a positive relationship between arousal and approach intentions. The study could only provide partial support for the hypothesised interaction between arousal and pleasure because there were few unpleasant retail environments. Dominance did not influence any of the behavioural responses.

Information load did not predict any of the behavioural responses. Furthermore the results did not support Mehrabian and Russell’s (1974) predicted relationship between arousal and information load. Recall that it was hypothesised that arousal is directly related to the general measure of information rate. Donovan and Rossiter (1982) found that although arousal was a function of four of the factors of information load (novelty, density and size increased arousal, and variety decreased arousal), information load in general was not related to arousal.

Note that this was only a correlational study and so it can not be concluded that the environment caused the differences in the emotional states. There are other limitations of the study. For example the authors do not report whether the length of time spent in the environment was the same across all evaluations. Donovan and Rossiter (1982) also do not take into consideration participants’ previous experience with the environment evaluated. Recall that familiarity contributes to the information rate from the environment. Information rate is hypothesised to be higher in novel than familiar environments. Also the more time spent in an environment, the less information elicited from the environment. Other studies support this relationship between familiarity, time and evaluations (Pederson, 1978). The complex findings from Donovan and Rossiter’s (1982) study concerning the effect of the environment
(or information load) on the behavioural responses could be due to the lack of control of key variables.

However in another study where there was also a lack in control of key variables (e.g. familiarity), Amato and Malanes (1983) observed people by recording their interpersonal interaction (measured by eye contact, smiling, speaking and nodding) in various environments (e.g. beach, car-park, indoor shopping center). They then took photographs of these settings and asked another set of participants to rate the environment using only the pleasure and arousal items from the Scales of Emotional Reactions to Places. The participants were also required to complete the General Measure of Information Rate scale for each environment. In contrast to Donovan and Rossiter’s (1982) findings, Amato and Malanes (1983) found enhanced arousal ratings were given to environments which were considered to contain high information load.

The inconsistent support for the relationship between arousal and information load suggests that there is a need to test Mehrabian and Russell’s (1982) theory under controlled conditions. This test would determine the influence of the environment on emotional states and evaluations.

Donovan and Rossiter’s (1982) study is consistent with the findings of other research showing that there are only two basic emotional responses: pleasure and arousal. Dominance does not appear to play a role in emotional responses. This was demonstrated in an earlier study by Russell, Ward and Pratt (1981). It was predicted that evaluations using affective adjectives and Mehrabian and Russell’s (1974) scales would both yield the basic emotional components.

Before carrying out the main study, the affective adjectives and the environments were selected in a pilot study. During the pilot study, Russell et al (1981) developed 105 adjectives that were judged by the authors and a sample of undergraduates as describing the emotional quality of an environment. Three hundred and twenty-three places, which were judged to elicit mainly emotional responses, were used including a nudist beach, airport and events such as a wedding and rainstorm.
In the main study, volunteers who had not participated in the pilot study were recruited to evaluate the selected environments. The evaluation procedure required assessing the environment by first using the list of adjectives to indicate how each adjective described their environment on a scale ranging from 1 (extremely inaccurate) to 8 (extremely accurate). After completing the 105 adjectives, the volunteer had to complete the Scales of Emotional Reactions to Places.

The results provided mixed support for their hypothesis. The questions measured pleasure and arousal more reliably than dominance (loading scores for former two responses ranged from 0.86-0.68, compared to 0.72-0.54 from dominance). The analyses of the ratings using the adjective questionnaire revealed three factors, which accounted for 47.7% of the variance. Multiple regression analyses showed that there was a strong relationship between factor 1 on the adjective questionnaire and pleasure (R=0.83). There was also a relationship between factor 2 on the questionnaire and arousal (R=0.73). There was a small relationship between factor 3 and dominance (R=0.37). These results showed that the pleasure and arousal components of the Scales of Emotional Reactions to Places measure the emotional nature of evaluation. The dominance component of the scales does not seem to relate to the affective aspect of evaluation. These conclusions are based on the assumption that the affective adjectives reflect the emotional aspect of evaluations.

As there is more evidence for the pleasure and arousal dimensions than the dominance component of the theory, researchers (Russell, Ward & Pratt, 1981 Russell & Snodgrass, 1987) have modified the model excluding the dominance element of emotional response.

Russell et al (1981) posited that there are two dimensions of emotional responses and that all affective evaluations of the environment are defined by interactions of these two basic responses. This can be represented in a cylinder model such as the one shown in Figure 1.2. Russell et al (1981) proposed that people possess this semantic representation of emotion. This representation is used in evaluating buildings (as well as other environments). Dominance refers to the perceptual/cognitive response to the environment. This is why dominance does not account for much variance in other studies on affective responses.
The original model of emotional response to the environment does not take into account the perceptual/cognitive element. Some research suggests that cognitive factors do not play a key role (e.g. Donovan, Rossiter, Marcoolyn, & Nesdale, 1994), whereas other studies suggest that both cognition and emotions are involved in evaluations (Chebat & Michon, 2003). Russell and Snodgrass (1987) attempt to incorporate this perceptual/cognitive element into the Mehrabian and Russell (1974) framework by proposing that the environment is appraised in relation to an individual’s goal.

In Russell and Snodgrass’s (1987) modification of Mehrabian and Russell’s (1974) theory pleasure and arousal are referred to as mood states. Affective appraisals are judgements concerning the ability of the place to alter mood. In this sense, affective appraisals of a place can be seen as environmental evaluations, implying that this type of evaluations is the assessment of a place to alter moods. Russell and Snodgrass (1987) propose that people enter environments with plans of what they intend to do within it. This involves either remembering moods from previous encounters or making estimates to determine the affective quality of the place. This implies that the environmental evaluations are not only affected by the immediate surroundings and
emotional dispositions, but also the plans and intentions that an individual brings with them as they enter the setting.

Once the person enters the environment the information rate is only one of a number of features of the immediate surroundings which influence evaluations through mood. Other features of the environment include imperceptible variables, physical presence of another person and most importantly, the blocking or facilitation of the plan.

Russell and Snodgrass (1987) use the term “imperceptible variables” to refer to undetected changes in the environment, but do not consider how such undetected changes might influence affective appraisals. Their definition of affective appraisals implies that an individual’s evaluation should be affected by undetected changes in the environment if s/he is aware of its affect on their mood. This is because it is not the aspect of the environment which is the focal point of evaluations rather it is the mood (or change in emotional response) experienced. However evidence that will be presented in the next chapter suggests that the ability to identify the environmental source of the mood change does influence evaluations.

The effect of the physical presence of another person on environmental evaluations is supported by social facilitation research (e.g. Zajonc, 1965). This research shows that arousal increases with the number of other persons in the environment. Research also shows that spatial density is also negatively correlated with arousal. Worche1 and Teddie’s (1976) studies show that the effect of the spaciousness of the room on arousal is due to the interpersonal space (which was measured by the distance between chairs) rather than the physical size of the room. Based on the original framework (Mehrabian and Russell, 1974), it is hypothesised that environments, which elicit extremely high levels of arousal, are avoided. Negative evaluations would be given to environments that contain small interpersonal space.

Russell and Snodgrass (1987) propose that the environment’s ability to fulfil a goal is the single most important variable affecting evaluations via mood. The research on crowding illustrates this point. As previously stated, it is hypothesised that negative evaluations will be given to places with small interpersonal space. However studies show that negative evaluations are not always given to environments with limited
interpersonal space (Freedman, 1975). One explanation for the inconsistent findings is that spatial density only matters when it blocks the completion of an individual's goal (Saegert, 1981), especially when there are no other resources to compensate. Russell and Snodgrass (1987) argued that the completion or failure of a goal will determine how the person will feel in their environment. These feelings will then influence evaluations of the environment. However Russell and Snodgrass (1987) do not provide any empirical research which directly tests their hypothesis. Nevertheless Russell and Snodgrass (1987) suggest that the role of emotion in evaluation may be overstated in Mehrabian and Russell's (1974) theory. A closer examination of the contribution of cognitive/perceptual element involved in evaluations is necessary.

1.3.3 Summary of the Theory

This section has examined Mehrabian and Russell's (1974) theory of how people evaluate their environment. It is argued that emotional responses elicited from the environment determine the way it is evaluated. The emotional responses are comprised of pleasure, arousal and dominance. This section also explored Mehrabian and Russell's (1974) proposal of how the environment is categorised (by applying the concept of information rate) and how this influences the emotional response. Applications of the theory were then presented including work by Russell, Ward and Pratt (1981), Donovan and Rossiter (1982) and Russell and Snodgrass (1987). It was shown that although most research supports the relationship between emotional responses and evaluations, there is little evidence for how information rate influences evaluation. The evidence also suggests that dominance is not an emotional response. Rather it may refer to the cognitive/perceptual element of evaluation.

It can be concluded from this discussion that there is a need to clearly define the links between the environment and the emotional states. The studies in this thesis proceed to define these links by carefully selecting specific aspects of the environment. These aspects are then manipulated while participants complete an evaluation questionnaire to monitor their emotional states. This is done to determine what environmental stimulus variations produce changes in the intervening variables and hence the predicted changes in the behavioural response.
Mehrabian and Russell’s (1974) theory is a starting point for studying evaluations of the environment. It is just a starting point because it has been shown that emotional responses alone do not sufficiently account for the effects of the environment. Mehrabian and Russell’s (1974) emphasis on the emotional component of evaluations obscures the potential importance of the meaning of the environment (i.e. how people appraise it in relation to their purposes). Canter (1983) proposed the purposive account for evaluation. Canter (1983) argued that evaluations are made purely on extent to which the environment facilitates an individual’s goal. This framework will now be outlined and discussed.

1.4 The Purposive Evaluation of Places (Canter, 1983)
This section describes and evaluates Canter’s (1983) framework as an alternative approach to evaluation. Similar to the structure of the previous section, the key elements of Canter’s (1983) theory are identified and subsequent research is then presented. Canter (1983) used the Theory of Place to argue that environments are evaluated in relation to a person’s objective or goal. However subsequent research suggests that Canter’s (1983) application of the theory of place to evaluation is inadequate. Furthermore Canter (1983) does not clearly specify how variations within the environment are related to the framework. It is concluded that there is a need to clearly identify the goals that people use in evaluations and how this relates to changes in the environment.

1.4.1 Development of the Theory
The purposive model of evaluation, developed by Canter (1983) was an alternative to Mehrabian and Russell’s (1974) theory. The purposive model is based on Canter’s (1977) Theory of Place. Canter (1985) defines “place” as a unit of environmental experience. This definition goes beyond the concept of a stimulus acting on an organism. Rather there is an interaction between the organism (individual) and the stimulus (environment). This approach contrasts with previous theories that emphasise the emotional component of evaluation. It is argued that people do not just encounter environments based on their feelings.
Environmental experience (i.e. place) is a result of the inter-relationship between physical attributes, conceptions (or place rules) and actions (Canter, 1977). The relationship between these components is best illustrated as three overlapping circles. The area in which the physical attributes, actions and conceptions overlap is described as “place”. Canter (1977) briefly mentions that emotion is also inextricably interwoven with places. However no explanation is provided concerning the role of emotion in the experienced environment. The physical constraints and the socially constructed rules dictate the activities that typically take place in the environment. Place is perceived in relation to the goals that are held within the environment and consequently it is argued that evaluations are based on these objectives.

Having established that evaluations are goal defined or purposive, Canter (1983) developed a structure of how people assess their surroundings. The goals of an individual will be shaped by their role and the environment. For example the goals of a student in a classroom, a nurse in a hospital ward and a passenger on a train can all be expected to be different. Therefore, for each role and place, the research focus should be different based on the various goals within each situation. Canter (1983) provided a general template for evaluation research which can be adapted to a specific environment. This general template is shown in Figure 1.3.

In contrast to the process orientated theory suggested by Mehrabian and Russell (1974), Canter’s (1983) model is descriptive because it only outlines the structure and the contents of evaluation. Figure 1.3 shows the three basic components that underlie environmental evaluations: referent, focus and level. These components are called facets and each one has a number of elements, which are conceptually distinct and mutually exclusive.

The relationship between the three facets can be illustrated using the classroom example. Recall that the student’s purpose in the classroom was to sit an exam.

Based on Canter’s (1983) proposal, their evaluations will be based on this goal. The evaluation of the classroom will depend on the object (referent) of the interaction. The classroom can be evaluated in terms of whether the noise in the room facilitates or inhibits the successful completion of the exam. The referent in this case is the
noise. The referent may be more or less important with respect to the student’s goal. The degree of focus is the extent to which a referent is experienced in relation to the goal. The noise may be evaluated to be more central to student’s goal than the lighting in the room. It is also argued that the classroom is not experienced as an environment in a vacuum. Rather it is experienced in relation to the more macro environments such as the university or town in which the classroom is located. Each environment related to a specific environment – classroom, university, town – is referred to as a level of interaction.

![Diagram](image)

Focus (F) | Referent (R) | Level (L) |
---|---|---|
F1, the overall essence | R1, social | L1, local |
F2, the general qualities | R2, spatial | L2, intermediate |
F3, specific aspects | R3, service | L3, greater |

Person (x) evaluates the extent to which being in place (p) facilitates

By stating that it greatly facilitates

to

his/her objectives

interferes with


Where (p) is a place of which person (x) has direct experience

Figure 1.3. Formal statement of the theory of place (Modified from Canter, 1983).

Canter (1983) proposed that the framework of evaluation (refer to Figure 1.3) was only a general template which can be contextualised for different environments. Canter (1983) provided a description of each facet within this template.

Referent of experience (sometimes referred to as referent of interaction) is the object or aspect within the environmental experience e.g. noise. Canter (1983) argues that the experience of a place can be broken down into distinguishable elements: physical referent (e.g. sound) and social referent (e.g. friendliness of the people). (Note: This is not to be confused with the components of place, which is made up of activities,
physical attributes and conceptions. Rather the elements of the referent can be seen as aspects of evaluation.

Canter (1983) argues that both elements of the referent must be present in place evaluation. For example, a study of how a classroom is evaluated should be assessed in terms of how adequate the lighting is (physical referent) along with how friendly the students are (social referent) without implying that they are totally distinct systems or orthogonal dimensions. This point distinguishes this theory from Mehrabian and Russell’s (1974) framework and other approaches which argue that elements of evaluation are completely distinct or independent from each other.

The physical referent is further broken down into two components: spatial aspects (i.e. connotations of enclosure and privacy) and those aspects relating to environmental services (i.e. comfort and convenience). Canter (1983) does not provide any empirical evidence to support the distinction between the spatial and the service aspects environmental evaluation. If the completion of an individual’s goal depends on being comfortable in an isolated area, it is possible that both the spatial and service aspects would be perceived similarly. Canter (1983) also does not define any specific aspects of the environment that would relate to comfort and convenience.

The degree of focus (sometimes referred to as focus of interaction) is the extent to which a referent contributes to the achievement of a goal. The degree of focus is a function of the type of place being evaluated (e.g. classroom or bedroom) and the individual’s goal (e.g. the purpose of being in a classroom could be to sit an exam or hide from a lecturer). There are many referents in the environment and some of these are more readily in focus than others. For example, a student can consider the noise in a classroom in relation to how it contributes to their level of concentration (high focus). At other times the student may evaluate the room as a whole in terms of how the environment facilitates their concentration. In this evaluation, the noise in the room is in low (or indirect) focus. Therefore within environmental evaluation, the degree of focus modulates the referent. The implication of this is that evaluations are more likely to be influenced by referents which are in high focus than ones that are in low focus. Referents exist in distinct categories whereas the degree of focus is measured on a continuous scale.
Although it is not stated in the theory, it is possible that referents can be brought in to high focus by directing attention to it, even if it was not originally perceived as being relevant to the goal. Directing attention to a referent can be achieved by asking people to evaluate the aspect or by increasing its salience (e.g. reducing the temperature in a room).

Environments are said to be experientially and conceptually arranged in a hierarchy (Stokols & Shumaker, 1981; Russell & Ward, 1982). The level of interaction refers to the way a place is assessed in relation to its hierarchical relationship to other places. Canter (1977) posited that the geographical relationships between places are only a part of environmental evaluation. The levels within a hierarchy reflect different ways in which an individual interacts with the place. Based on this argument, the levels of hierarchy are arranged in a linear structure and no level is perceived as more central than another. Each level will have a separate focus which is similar but distinct from that of the other levels. Canter (1983) does not specify the number of levels for a given environment.

Canter (1983) presented evidence from a study by Canter and Rees (1982) where participants were asked to rate their satisfaction of their house, location, and neighbourhood. The findings revealed that the type of evaluations made of the house was different to those made in the other two environments. The relationship between the referent and the focus on one level (e.g. house) is predicted to be different to the relationship between the two facets on other levels (e.g. neighbourhood). This was shown in Canter and Rees' (1982) study where evaluations made of the locations were distinct from the evaluations made of the house and neighbourhood. This demonstrates that satisfaction in one level of the hierarchy is not related to that in the other levels suggesting that evaluations depend on the nature of the environment and goals of the individual.

Canter (1983) proposed that the relationship between the three facets implies a certain complexity, which can only be accessible through the use of the facet approach (developed by Guttman, 1965). Canter (1983) proposed the General Mapping Sentence (GMS) to develop the questions for evaluation research. The GMS is used
to connect the facets using ordinary language (Shye, 1978). The GMS can be used to formulate hypotheses and/or to construct items for people to make place evaluations. Canter (1983) initially proposed the use of the GMS mainly for constructing questionnaire. Besides containing the referent focus and level facets, the GMS also include a common range facet (Borg, 1977; Shye, 1978). This facet describes the possible responses that can be made to the questions constructed by the facets. It is assumed that the direction and range has the same meaning for each question.

Once researchers follow Canter's (1983) suggested methodology, the referent, focus and the level facet is hypothesised to form a structure called the cylindrex (Levy, 1981). Figure 1.4 illustrates the cylindrical structure of evaluations where the referent within any specific environment is modulated by the focus. In other words, the referent of experience will be assessed as being more or less central to the purpose for being within the environment. The relationship between the referent and the focus is independent of the level at which the person interacts with the environment. This structure is consistent across people and places.

One limitation of this explanation is that Canter (1983) fails to describe how the structure of evaluations relates to variation in the environment. For example, how would evaluations be affected by changes in the heating? It is assumed that changes in the heating on one level may not influence place evaluation on other levels. But would it change the focus within each level? These questions can only be addressed through empirical investigations where the specific aspects are carefully manipulated while the goals are controlled.

However, based on Canter's (1983) purposive model of evaluations, this experiment would be conducted under the assumption that these aspects are related. It is likely that these aspects are not related to each other. The facet approach forces them to be evaluated together. However this may not reflect the way people typically assess their surroundings. Therefore it is necessary to first identify the relationship between the aspects of evaluation using techniques other than the facet approach.
Canter’s (1983) framework of place evaluation does not adequately correspond to the theory of place (Canter, 1977) on which it supposed to be based. The theory of place states that a place is always defined as a combination of actions, conceptions (or place rules) and physical attributes within it. Therefore the structure of the evaluation should also reflect these components for a given place. Although the referent facet can correspond to the physical attributes, the actions and conceptions are not clearly identified in Canter’s (1983) framework of place evaluation.

Research suggests that some environments are evaluated purely on the activities within them almost to the exclusion of physical attributes within the place. For example Donald (1983) found that the ability to communicate with other people was central in evaluations of the office environment. This would not be addressed using the general framework of evaluation. Donald’s (1983) work shows either that
Canter's (1983) structure of evaluation may not adequately capture how people assess their environment or that place is not perceived in relation to the combination of the three components as described in the theory of place. Another explanation for Donald's (1983) findings in relation to Canter's proposals is that the way that the office is evaluated may be different to how other environments are evaluated. One way of testing Canter's (1983) framework of evaluations is by clearly identifying the goals and activities in a specific environment. Evaluations can then be compared across different environments where people carry out similar activities.

As previously mentioned Canter (1983) only provided a general template for place evaluation. Subsequent research using Canter's (1983) framework of evaluations demonstrates considerable variations of the model. The next section will discuss some of this research.

1.4.2 Further Developments and Application of the Theory

Although there is some support for the framework (e.g. Hackett & Foxall 1995, 1997), it typically needs to be modified by adding or replacing the facets for it to be appropriate for a particular setting. These modifications tend to result in evaluations being a product of the contextualisation of Canter's (1983) framework and not of the environment under consideration (e.g. GarciaMira, Arce, & Sabucedo, 1997; Bonaiuto, Aiello, Perugini, Bonnes & Ercolani, 1999; Bonaiuto, Bonnes, & Continisio, 2004). It was suggested that research should instead focus on the evaluations of places in general.

Kramer (1995) conducted a study which identified the criteria people use to classify places in general. It was expected that these criteria would be present in evaluations. The criteria (or facets) were hypothesised to be a function of the place, specificity of function, and privacy. The facets were derived from Canter's (1977) theory of place, especially with respect to the activities and the conceptions components of environmental experience. Kramer (1995) argued that an individual must have some knowledge of the function and the shared rules of the place to assess whether their goals are achievable in it. Specifically, an individual must know the activities which are typically associated with the environment. The elements of the function facet (Residential, Service, and Leisure) were derived mainly from a pilot study (Kramer, 1995).
1992). The elements for the specificity of function (low and high degree of specification) and privacy (public, semi-private and private) were directly derived from the theory of place.

Kramer (1995) argued that preference is an appropriate method of accessing evaluations. Preference was defined to be the extent to which the person likes the place. During the main study, Kramer (1995) used preference as the common range on which the places were evaluated. The evaluations were made on a five-point Likert type rating scale ranging from 1 (like it most) to 5 (like it least).

The elements of each facet were combined with the common range to form the General Mapping Sentence (GMS). The GMS served to summarise the aims and hypotheses of the main study. So for example "person (x) classifies generic place (p) as being High specified with respect to its Service function on a Public level by stating that (s)he likes it most...least" (Kramer, 1995 p10). It was hypothesised that if the criteria (function of the place, specificity of function and privacy) were the structure of evaluation, the preference of places should be predicted by the criteria.

During the main study, instead of questionnaire items, Kramer (1995) utilised the structured Sorting Task Procedure to reduce the risk of people mainly using certain categories on the scales. Participants were required to sort the 32 cards (each card consisted of a single name of a generic place) into five categories according to how much they liked each place. There were no restrictions on the number of cards allowed in each category and participants were permitted to reorganise the cards during the classification.

The coefficient of alienation is typically considered acceptable when it is equal to, or less than 0.20. The Smallest Space Analysis (SSA-1) plot in Kramer's (1995) study had a coefficient of alienation of 0.21 suggesting that interpretations of the results should be cautiously considered. To examine whether the criteria (facets) were related to the preference ratings, the mean and median measures for each place were obtained. The preference measures were used to calculate the overall mean and median for each element. A Pearson correlations coefficient was then calculated to determine the overall structure of evaluations based on the preference measures of
each element. The analysis showed that for the function facet, residential places were most preferred and service places were least preferred. With respect to the specificity facet, low specified places were preferred to high specified places. Private places were most preferred and public places were least preferred. The inter-correlations between the elements showed that the residential places on the private level were preferred to all the other places.

Overall, these findings suggest that evaluations involve more than assessing environments on their functional properties. This was illustrated where the Service places were least liked although they fulfil their expected functions. However the conclusions drawn from this study alone are to be taken with caution because there was not a “good fit” between the facets’ inter-correlations and their corresponding spatial representation (coefficient of alienation of 0.21).

In another study, Donald (1994) also found that people use affective goals in their evaluations. Donald (1994) examined how office employees evaluated their working environment. Donald’s (1994) study contrasts with Kramer’s (1995) study as the latter study examined evaluations of places in general. The aim of Donald’s (1994) study was to develop an explanation of office experience by identifying the main components of evaluations. It was hypothesised that evaluation consisted of four facets: referent, focus, level and organisational unit.

The elements within the referent facet were similar to Canter’s (1983) original model, except the social element was replaced by the socio-spatial element. The revised element referred to aspects relating to privacy, communication and isolation. Altogether the referent facet consisted of spatial, service and socio-spatial elements.

The focus facet consisted of two elements: instrumental and affective. Previous research (Hopf, 1931; Goodrich, 1986) suggested that the office environment is evaluated on whether it fulfills the instrumental or affective goals. This is a modification of Canter’s (1983) original model.

Donald (1994) identified three elements of the level of interaction: workstation/immediate work-area, the office/department as a whole and the building.
An additional facet to the original model was proposed called the organisational unit. Donald (1994) suggested that the relationship between the individual and the organisation would also influence how the environment is evaluated. For example, an individual can evaluate the extent to which the environment facilitates their role within the company. Donald (1994) also proposed that the individual can also perceive the environment from the perspective of the organisation. So for example, an individual may evaluate the extent to which the environment facilitates the department/organisation's efficiency as a whole. Individuals therefore evaluate the environment from different perspectives. The elements of the organisational unit facet consisted of individual, department and organisation perspective.

The facets were combined in the form of the GMS as illustrated in Figure 1.5. Some of the questions were excluded resulting in a 41-item questionnaire. Items of the questionnaire included questions such as: How much does the heating throughout the building help make it a comfortable place to talk to each other? (A3:B3:C2:D2) or How much does the amount of space in your office help you store your personal belongings? (A2:B2:C1:D1). The available responses to all the questions were provided on a five-point Likert type rating scale ranging from “helps a great deal” to “hinders a great deal”.

The 41-item questionnaires were randomly distributed throughout the offices at four different organisational sites. The offices were similar in their basic open-plan design. The actual quality of the offices was not considered because the purpose of the study was to examine the structure underlying evaluations.

The ratings were analysed using multidimensional scaling (MDS) procedures. The SSA-1 plot had a coefficient of alienation of 0.19, which is typically considered acceptable. The analysis of all the items did not show any distinction between evaluations of the office and the immediate workspace. However, when only the socio-spatial element items were analysed the analysis revealed a clear distinction between the three elements of the level facet. Donald (1994) remarked that it was not surprising that there was no distinction between the environment of the immediate workspace and the general office because of the nature of open-plan design. If this
The analysis of all the items in terms of the focus facet indicated that the central focus of people's evaluations is the aspects of the environment which facilitate the affective goals. Donald (1994) argued that most research in office settings focus on the role of the environment in terms of its contribution to functional goals such as how the noise facilitates or inhibits the completion of work-related reports. Donald's (1994) study shows that the affective qualities of the environment are likely to have the greatest impact on evaluations.

A way of improving this study would involve comparing the evaluations between organisations or different office designs to determine how the structure would differ. For example, Donald (1994) proposed that open-plan designs would reveal different
types of evaluations compared to private offices. The question is whether the evaluations are a function of the goals, the design of the office or both. A way to determine this would involve comparing the evaluations of workers who are given the same task (therefore the people would have the same goals) in offices with different designs. The findings would begin to show how the model relates to variations in the environment.

In general, Donald’s (1994) study supports Canter’s (1983) argument that the underlying structure of the evaluations is based on the extent to which the environment facilitates the achievement of a goal. However in light of Kramer’s (1995) findings, both studies suggest that evaluations are typically based on both the expected function of a place and affective qualities. The role of the affective quality of the environment is not clearly stated in the Canter’s (1983) framework of evaluation.

In a later paper, Canter (1997) defined place as a “system of experience that incorporates the personal, social and culturally significant aspect of situated activity” (p177). The definition expands on the original one proposed earlier as it takes into account the activities associated with the environment. This is illustrated in how the modified theory addressed the way people deal with conflicting goals. For example, a person may want to use a kitchen for watching TV, cooking and eating. Canter (1997) states that these conditions bring instability. This instability triggers mechanisms that will select one activity as the dominant one. It is hypothesised that the main objective underlying the design of the building will determine the dominant activity. So for example, culture expectations will dictate that kitchens are typically designed for food preparations. Therefore cooking would be the dominant activity of the kitchen. The kitchen would be evaluated differently if activities other than cooking took place in it.

Canter (1997) explicitly states the general objectives of evaluation and incorporates them into the framework. The objectives were derived from Saegert and Winkle’s (1990) review of the different types of paradigms used in evaluation research. It is argued that evaluations consist of three types of objectives – individual, social and cultural – and these influence how the environment is perceived.
The individual objective is to maintain biological and psychological survival. It involves the active management of the environmental interaction in order to maintain personal comfort. It can be argued that individual goals include an emotional component. Although Canter (1997) did not explicitly mention this in his theory, comfort can be extended to issues concerning pleasure. This is based on the assumption that comfort is a correlate of pleasure. Therefore individual objectives include the maintenance of aspects relating to pleasure. The social objective refers to how people select options with the maximum value within a system of socio-physical limitations and opportunities. The aim is to survive within a social setting and to manipulate the environment to achieve the desired relationships with other people. The cultural objective is to manage the environment to define and promote the group and culture identities. It is argued that people act as a social agent to create meaning from the environment. The individual recognises that meanings are not only based on individual interpretations, but also on social construction.

However Canter’s (1997) modified model still does not clearly define the relationship between variations in the physical environment and the proposed structure of evaluation. One way of establishing the links is to clearly identify and control the goals while changes are made to the environment. This method would also test how emotional responses are affected by the changes in the environment. This thesis begins to explore the role of the emotional and cognitive/perceptual elements of evaluation and provides a systematic examination of some elements from the two theories of evaluation.

1.4.3 Summary of the Theory
This section examined Canter’s (1983) theory of how people evaluate their environment. The fundamental features were initially outlined and then elaborated. These features include the notion of place where people experience the environment rather than simply respond to it. Evaluations are defined as a purposive means of completing a goal. It is posited that there are three main components underlying evaluations: referent, focus and level facets. Canter’s (1983) proposed method of collecting and analysing the data were also considered.
Applications of the theory were then presented including work by Donald (1994), Kramer (1995) and Canter (1997). It was shown that although the principle of purposive evaluation is supported, the use of the facets is considerably different to that originally proposed in the model described by Canter (1983). Some research (e.g. Donald, 1994; Kramer, 1995) suggested that the evaluations also consist of affective qualities which are not addressed in Canter's (1983) framework. The evidence indicates that research should focus more on examining evaluations of places in general rather than specific settings. This involves clearly identifying the goals, functions and activities.

Finally a modified framework was described where these aspects are clearly defined in terms of how they are used to evaluate the environment (Canter, 1997). However the relationship between the variations within the environment and the facets is not addressed in the theory. Empirical research is needed to identify the individual goals and the relationship between the facets of evaluation and the environmental variations.
2. Study 1: The Effects of a Cut-Grass Odour and Mower Sound on Evaluations

The studies in this thesis examine the extent to which Mehrabian and Russell’s (1974), and Canter’s (1983) theories account for how people evaluate their environment. Using some of the theories’ predictions of how changes in the environment alter the basis on which it is perceived provides the basis of these empirical investigations of the nature of environmental evaluations.

This chapter will examine environmental evaluations made in the presence and absence of a sound/odour. The Introduction to this chapter summarises the two theories and provides empirical evidence for other ways of monitoring environmental evaluations. Empirical evidence (Distel & Hudson, 2001) suggests that evaluations may vary across people who can and those who cannot identify the stimuli. Also, evaluations may be a function of how people consider the relationship between the words and the stimuli (Van Petten & Rheinfelder, 1995). It is argued that both theoretical and empirical aspects must be considered when examining how people evaluate their environment.

Study 1 is then described which examines people’s assessments of their surroundings in the presence and/or absence of a cut-grass odour and/or mower sound. During this exploratory study evaluations are measured using a scale (the Room Environmental Questionnaire, REQ) which incorporates the essential features of Mehrabian and Russell’s, (1974) and Canter’s (1983) theories. The identifications of the sound and odour, and ratings of the relationship between words and the environment are collected as additional methods of monitoring environmental evaluations. The findings of the study reveal that the cut-grass odour and the mower sound affect evaluations of the environment. Participants considered words from the related (i.e. Plant) category to be more related to the odour when the cut-grass odour was present than when the odour was absent. However the mower sound was rarely identified and participants did not consider the related category to be associated with the sound. In order to provide a clearer explanation of these results it is suggested that another study should be carried out where the odour and sound are likely to be identified.
2.1 Introduction

Taking the two main theories that were discussed in previous chapter, the Introduction to this chapter will consider the essential features of the theories which relate to how people evaluate their environment when changes are made to it. Based on Mehrabian and Russell’s (1974) theory it is predicted that the presentation of the sound/odour will only influence evaluations if they elicit changes in participants’ emotional responses. In contrast, it is predicted from Canter’s (1983) theory that evaluations will only be affected if the sound/odour facilitate or inhibit the completion of the goal. The Introduction then focuses on how the ability to identify the stimuli, and the relationship between words and the environment could also be used to examine evaluations. It is demonstrated that knowledge of the sound/odour’s identity enhances its evaluation. Also evidence from physiological, memory and Stroop studies suggest that people respond differently to words (or events) which are related, compared to those which are unrelated to the sound/odour. The theories proposed by Mehrabian and Russell (1974), and Canter (1983) do not explicitly address how the relationship between events and the environment, and the ability to identify the stimuli affects evaluations. The Introduction concludes by stating the main predictions concerning how the manipulation of the environment influences evaluations and also describes how Study 1 tests these predictions. This study begins to distinguish the basic processes underlying environmental evaluations using the two theories together with empirical evidence regarding identifications and the word environment relationship.

2.1.1 Review of the Two Main Theories.

In the previous chapter, two theories were discussed concerning how people evaluate their environment. Their similarities and differences can be illustrated by considering the main elements of Study 1. In this study participants are arranged in a layout similar to an exam where each person is seated at their individual desk. Participants are required to evaluate their immediate environment while one or two changes are made to it. The changes involve the presentation of a sound and/or odour. The participants are also required to identify the stimuli (sound and/or odour) and rate the relatedness of a set of words to the ambient environment. How would the two theories account for the way that the environment is evaluated during these changes?
According to Mehrabian and Russell (1974), the physical environment is evaluated based on the extent to which it stimulates the emotional states (pleasure, arousal and dominance) of the individual. On the other hand, Canter’s (1983) approach would predict that the physical environment is evaluated based on the extent to which it fulfils goals of the individual. The goal in this setting would be the completion of the various tasks.

Recall from the previous chapter that Mehrabian and Russell (1974) proposed that the environment is measured in terms of the information rate, i.e., the degree of complexity and novelty within it. Mehrabian and Russell (1974) hypothesised that the information rate is directly related to the degree of arousal induced by the environment. Manipulating the arousal induced by the environment would change the evaluations made of the environment. The information rate is differentiated from the amount of information in the environment. Based on Mehrabian and Russell’s (1974) framework, changes in the amount of information from the environment alone will not affect environmental evaluations. So for example, adding a sound alone (e.g. noise of audible conversations in the background) to a classroom will not change evaluations of a classroom. However adding a novel sound (e.g. noise of audible lawn mower in the background) will change the evaluation of the classroom because there is a change in the information rate elicited by the environment. Consequently the degree of arousal induced is enhanced by the presentation of the novel sound. Mehrabian and Russell (1974) argue that this principle can also be applied to other aspects of the physical environment. So for example, evaluations of a classroom are more likely to be affected by adding an unfamiliar odour than adding a familiar odour to the room.

In contrast Canter (1983) proposed three facets underlying environmental evaluation: referent, degree and level of interaction with the environment. Purposive evaluation involves considering the extent to which the referent (e.g. spaciousness) within the level (e.g. of the classroom) fulfils the achievement of the degree of focus (e.g. instrumental) goals (e.g. concentration) of the individual. So in terms of the example, purposive evaluation involves considering whether the spaciousness of a classroom is instrumental in concentration. Canter (1983) further divided the referent of interaction into social and physical components. The physical component consisted of two aspects: spatial aspect and aspects referring to comfort and convenience.
However the theory mainly addresses the spatial aspects while ignoring other physical aspects such as the sound and odour. Although Canter's (1983) theory does not address what happens when changes are made to the environment assumptions can be made based on the theory. When the environment is changed evaluations will only be influenced if the goals are changed simultaneously, or if the changes in the physical environment influence the extent to which the goals can be completed.

In summary, the theories above hypothesise that changes in the environment will only influence evaluations if either the participants’ emotional responses (by changes in the information load elicited from the environment) or when their goals (or the ability to complete these goals) are changed. During Study 1, environmental evaluations of similar but distinct environments are contrasted, while participants goals are systematically changed (i.e. different tasks), and self-reported emotional states are recorded. Thus, since the goals in each environment are similar, it can be tentatively hypothesised that the evaluations of those environments will be similar. However some other aspects of the study must be considered before confirming the hypotheses tested.

2.1.2 The Role of Identification

One factor that may influence evaluations made across different environments, which is not addressed in the above theories, is whether the change can be identified i.e. the odour/sound. Studies show that evaluations such as intensity, pleasantness and familiarity ratings of an odour are influenced by the ability to correctly name the odour (Distel & Hudson, 2001; Distel, Ayebe-Kanamura, Schiker, Martinez-Gomez, Kobayakawa, Saito & Hudson, 1999, Degel & Koster, 1999).

In one study Distel and Hudson (2001) proposed that the previous experience of an odour influences its perception. It was predicted that spontaneous identification of an odour was related to enhanced intensity, pleasantness and familiarity ratings of the odour. The odours were mainly from common food products and each odour was presented on an absorbent paper strip. All the odours were tested equally often and each participant encountered an odour once. Participants rated two sets of twelve odours on a 10cm scale in terms of intensity, pleasantness and familiarity. The scales ranged from minimal (0-2cm) to maximal (8-10cm). After rating the odours, the
participants were asked to provide names or appropriate associations. Each odour was correctly identified on average by 37% of the participants. The results supported Distel and Hudson's (2001) predictions. Higher median ratings of intensity, pleasantness and familiarity were given when the odours were identified than when they were not identified. For those who identified the odour, the median ratings of the intensity, pleasantness and familiarity were 5.0cm, 7.5cm and 7.0cm respectively. In contrast the median ratings for participants who could not identify the odour were 4.3cm, 5.0cm and 3.8cm, respectively for intensity, pleasantness and familiarity.

Distel and Hudson (2001) concluded that the rating differences between the conditions where the odour was presented with and without odour names suggest that knowledge of an odour identity enhances the odour evaluation. Distel and Hudson (2001) also argued that the findings of the whole study indicate that participants match their knowledge of the odour with their immediate olfactory perception. However no comparisons were presented concerning those who incorrectly identified the odours and those who failed to identify the odours. Therefore it is uncertain whether providing a name per se enhances ratings of the odour or whether it is important to provide the correct odour name. To the author's knowledge, there are no published studies that compare evaluations from participants who provide correct identifications with those who provide incorrect identifications. In Study 1, these issues were addressed by asking participants to identify the odour/sound and differentiating participants who correctly named the stimuli from those who did not.

Mehrabian and Russell (1974) and Canter (1983) do not make any explicit predictions concerning how the ability to identify an odour would influence evaluations. However the results from Distel and Hudson's (2001) study show that the ability to name the odour influences evaluations. Studies using physiological measures have also demonstrated that naming the environmental sounds and odours influence evaluation (Cycowicz & Friedman, 1998; Royet, Koenig Gregoire, Cinotti, Lavenne, Le Bars, Costes, Vigouroux, Farget, Sicard, Holley, Mauguiere, Comar & Froment, 1999; Tranel, Damsio, Eichhorn, Grabowski, Ponto & Hichwa, 2003).

When people are asked to identify sounds and odours they tend to provide a name of the stimuli (e.g. car sound or banana odour) rather than describing the olfactory or
acoustic characteristics (e.g. high pitched sound or sweet smell). Based on the assumptions underlying episodic memory, researchers propose that sounds and odours are stored in relation to events. For example, Ballas and Howard (1987) defined an environmental sound as one that is produced by an event, and has meaning by virtue of its causal relation to the event. Similarly, Schab (1991) reports that an odour is referred to by the object which best characterises it. Names generated for sounds and odours reflect idiosyncratic experiences (e.g. identifying the smell of mould as “granddad’s attic”). Furthermore the mapping between sounds/odours and names is not a one-to-one, but a several-to-several relationship. A number of names can be given to one odour (e.g. strawberry odour can be identified as raspberry or blueberry) and similarly a number of odours can be given the same name. This has also been observed in sound, for example the sound *click-click* can be identified as a ballpoint pen, a camera, a light switch to name a few alternatives. Ballas, Sliwinski, and Harding (1987) demonstrated that Hick’s (1952) law was applicable to sound identification where the time taken to identify a common sound was a function of the logarithm of the number of alternatives that were given for the cause of the sound. Some alternative identifications of a target sound (e.g. *click-click*) will carry the correct meaning of the sound (e.g. camera, picture taking) whereas other alternatives identifications will carry different meanings (e.g. ballpoint pen, light switch).

It is possible that different meanings underlying a label may lead to different evaluations, even when the label closely characterises the sound/odour. This raises a question that is not yet addressed in previous research. Does the type of label given to a sound/odour influence evaluations? A way to address this issue would be to contrast the evaluations made by people who made correct identifications with those who made other types of identifications. In Study 1, this issue was addressed by classifying identifications into three categories: correct identifications, identifications that did not refer to the target stimuli but referred to things that smelled/sounded similar to the stimuli (borderline identifications) and incorrect identifications. The identifications made in the presence of the stimuli were also compared with identifications made when the stimuli are absent. This comparison served as a manipulation check to determine whether participants are sensitive to the different environments.
In addition to analysing identifications, there are other ways in which the evaluations can be studied such as by examining how people assess material in relation to the environment. If the sound and odour are perceived or identified in relation to events as proposed above (refer to Balias and Howard, 1987 and Schab, 1991), then asking participants to rate events in relation to the stimuli should indicate the way in which the environment is perceived. When a sound/odour is present, events which are typically associated to the stimuli should be considered more related to the environment than events that are not associated to it. Furthermore, if the sound and the odour are correctly identified, then the corresponding events would be considered to be related to the stimuli. So for example, if the sound of a police siren was correctly identified, then participants should consider events such as an accident or emergency as more related to the sound than a christening or exam. The ratings of the related events should also be influenced by the presence and absence of the sound/odour, whereas unrelated events should not be affected by the stimuli. So for example, accident should only be considered to be related to the environment when the police sound is present, whereas exam should be considered similarly whether the sound was absent or present.

Mehrabian and Russell (1974) do not address how people perceive their environment in relation to external events. However Canter (1983) does account for how people perceive their environment in relation to their purposes. Furthermore it can be implied from Canter's (1977) theory of place that the environment is perceived as an coalescence of activities, or events and the physical surrounding. However Canter's (1983) evaluation framework fails to account for how evaluations are influenced by the perceptions of activities which are related or unrelated to the environment.

The next section will discuss some studies which have compared performance between related and unrelated events in the presence of a sound/odour. These studies typically involve examining performance in tasks using words, which reflect events that vary in the degree of relatedness to the stimuli.

2.1.3 Word-Environment Relationship

The relationship between the material (e.g. words, pictures etc) and the odour/sound influence the processing of both the material and environment. This has been
demonstrated in a number of physiological studies (for example, Grigor, Van Toller, Behan & Richardson, 1999; Sarafirzi, Cave, Richardson, Behan & Sedwisk, 1999; Van Petten & Rheinfelder, 1995).

For example, Van Petten and Rheinfelder (1995) used Event Related Potentials (ERPs, small fluctuations in the EEG which are time locked to sensory, motor, or cognitive events) recorded from the scalp to examine the relationship between words and environmental sounds. They based their studies on evidence that a component of the ERP most closely tied to language processing was a late negative wave peaking at about 400 msec post-stimulus onset otherwise called N400. When word pairs or lists are visually presented, the amplitude of the N400 is smaller if the eliciting word is semantically related to the prior word than if the eliciting word is unrelated to the prior word. This effect is also observed in other sensory modalities such as audition and American Sign Language. Van Petten and Rheinfelder (1995) pointed out that few physiological studies compared words with non-linguistic sounds. They predicted that reaction time would be faster if an eliciting word is semantically related to a prior sound than if it was unrelated to the sound. This would be reflected in smaller N400 amplitudes for related words than for unrelated words.

The sounds consisted of animal vocalisations (e.g. bark), non-speech human sounds (e.g. cough), musical instruments (e.g. piano) and sounds that were described as events (e.g. horses hooves striking a pavement). The extent to which the sounds could be identified, and the relationship between the sound and the words used in the main study was determined in a pilot study. The sounds were converted to a digital card and presented on a PC computer with volume setting at 72 dB.

After demonstrating that reaction time was faster for words that were semantically related to a prior sound than for unrelated word, the stimuli was used to test the second prediction. The second prediction was tested by asking participants to report whether a target stimulus (consisting of portions of sound and words from the first main study) matched or mismatched selected stimuli. Each participant was exposed to one of the two stimulus lists assigned to either the sound/word group or word/sound group. A trial in the sound/word group consisted of a word, followed by a sound, which was then followed by the sound target stimulus. A trial in the word/sound
group consisted of a sound, followed by a word, which was then followed by the word target stimulus. Each sound was presented for approximately 2500msec and the word duration ranged from 352-939msec. Participants were required to listen to all three stimuli and then indicate whether the target stimulus matched or mismatched the second stimuli. For each participant, EEGs were recorded throughout the study from various locations on the scalp. The N400 amplitudes were observed during the presentation of the sound and the word and before the presentation of the target stimulus to avoid a decision related P300 potential, which may occur in the same latency range as the N400. (The reason why P300 potentials were differentiated from N400 was because previous research using P300 amplitudes as the dependent variable (e.g. Lorig, 1991) has found that these amplitudes vary with reaction time and task difficulty. However the variations in the P300 amplitudes only occur when participants are asked to make decisions about the stimuli. Therefore it would be difficult to establish whether the variation in the P300 and/or the N400 was a product of the experimental manipulation or the fact that participants had to make a conscious decision about the relatedness of the stimuli to the target. Differentiating N400 from P300 by observing the N400 before the participants responds made it easier to ascertain whether the manipulation alone affected the N400.)

The results supported Van Petten and Rheinfelder’s (1995) predictions. Smaller N400 amplitudes were elicited for words that were related to the sound than unrelated words. The ERPs were generally more positive in the left than in the right hemisphere, but the effect of word relatedness was observed in both hemispheres. The ERPs elicited when the sound followed the word was also analysed. The relationship to the preceding word also influenced the response to the sounds: related sounds elicited smaller N400 amplitudes than the unrelated sounds. However, in contrast to the results observed for the words, the difference between the related and unrelated sounds was larger in the left than the right hemisphere. The overall N400 amplitude was similar for both sounds and words in terms of general morphology, latency and scalp distribution in the anterior-posterior dimension.

Van Petten and Rheinfelder (1995) concluded that the relationship between the spoken words and environmental sounds influence the processing of both words and sounds. They also argued that the asymmetrical effect of laterality suggests that the
two cerebral hemispheres contribute differentially to the processing of sounds and words. The findings are in accord with previous research (Van Petten & Kutas, 1988) suggesting the processing of words is generally dependent on the left hemisphere dominance on language processing and a greater involvement of the right hemisphere in the processing of environmental sounds than in words. However, the findings demonstrate that words and environmental sounds are processed similarly. This is based on the fact that the effect of the relationship between the sound and the words was observed in throughout the anterior-posterior dimension.

It is uncertain whether the findings can be generalised to sounds with durations long enough to allow for it to be correctly identified. This is because no evidence has been found which extends Van Petten and Rheinfelder's (1995) work to sounds of longer duration. Their study also does not address whether discrete paired stimuli would be processed in the same way as single different words with a single continuous background sound. Also there was only one sound-word combination for each sound so it can not be determined how people will respond to a large sample of words which vary in the degree of relatedness to a specific sound. People normally encounter many things which vary in the degree of relatedness to an ambient environment. A larger sample of words (or other cueing material) would have to be used for studies like Van Petten and Rheinfelder's (1995) to be more comparable to everyday life.

In contrast, Study 1 involved presenting participants with a relatively large sample-of words to obtain single evaluation of different words in the presence of a continuous sound. If Van Petten and Rheinfelder's (1995) results extend to continuous sounds, it can be expected that the evaluation of words which are related to the sound would be influenced by the presence and the absence of the sound. Unrelated words would be unchanged by the sound manipulation. It can be predicted that a similar effect on words which vary in their relationship with the odour would be observed when the odour in the environment is manipulated. Evaluations of words which are related to the odour would be influenced by the presence and the absence of the odour whereas unrelated words would remain unchanged.

Studies investigating the relationship between odour and words using a relatively larger sample of words (or visual cues such as pictures and drawings) for each odour
have also demonstrated differential performance between related and unrelated words (Schab, 1990; Degel & Koster, 1998; Pauli, Bourne, Diekmann, Birbaumer, 1999; Parker, Waterman & Gellatly, 2000). In a context reinstatement study Parker, Waterman and Gellatly (2000) found that in the presence of a lemon odour enhanced memory performance was observed for semantically related words than unrelated words. Pauli et al (1999) used the Stroop Effect to show that the presence of an odour interferes with the performance on odour related words.

These studies clearly show that the relationship between the word and the sound/odour influences performance. However the studies do not report whether participants are asked to name the stimuli. This would be useful in interpreting the results from the studies to determine whether the participants similarly identified the stimuli. The extent to which the words are considered to be related to the environment could be a function of the accuracy of identifying the sound/odour. The theories proposed by Mehrabian and Russell (1974), and Canter (1983) do not adequately account for how the accuracy of identifying an environmental aspect is associated to the way an event (or word) is perceived in relation to the environment. Study 1 begins to examine this relationship. In Study 1, participants were asked to rate words varying in the degree of relatedness to the sound/odour. The ratings were analysed in light of how well participants identified the stimuli. The next section will describe Study 1 in more detail.

2.1.4 The Present Study

In Study 1 participants were exposed to four conditions reflecting four different environments to investigate how evaluations varied across these environments. The conditions varied with respect to whether the environment contained an odour and/or a continuous sound, or neither of the stimuli. In other words, each condition had either a continuous sound, an odour, both or none of the stimuli.

In each condition, the participants were asked to evaluate various dimensions of a classroom: Temperature, Lighting, Spaciousness, Noise and Smell. For practical reasons, the study was carried out in a classroom as opposed to a specially designed soundproof chamber or similar setting.
The scale used to evaluate the environment was a modified version of the Room Environment Questionnaire (REQ). This allowed some of the elements from the theories to be tested in a systematic manner and avoid the limitations associated with using either of the scales suggested by Mehrabian and Russell (1974), and Canter (1983).

The REQ included measures of the emotional aspects of the environment consistent with Mehrabian and Russell’s (1974) theory. The Positive and Negative components of the REQ reflected the emotional responses to the environment, although arousal was not directly measured. These measures were used to monitor the emotional responses experienced across the four conditions. It is hypothesised that the initial presentation of the sound and the odour should influence the information load elicited from the environment and this should be reflected in the questionnaire. When the stimuli are re-presented, then there should be no change in the information load compared to when the stimuli are presented separately as the stimuli are no longer perceived as being novel. Therefore ratings of the Positive and Negative components on the REQ should not change.

The scale also included an item assessing the use of the environment to complete a specific goal i.e. concentration, consistent with Canter’s (1983) theory. The Cognitive component of the REQ reflected the evaluation to which the environment fulfilled a specific goal. Although the environments were different in which the evaluations were made, the tasks completed in each one were the same, and therefore there should be no change in the level of concentration needed to complete the task. However it is possible that the changes in the environment could be so extreme that the participants may be disturbed and the disturbance may be confounded with the effect of the change in the environment per se. Therefore the stimuli was presented above threshold, so that the participants could detect the sound and the odour, but not at a level that caused any harm to the participants.

After completing the questionnaire, participants were asked to rate a list of words varying in the degree of relatedness to the environment. This made it possible to ascertain whether the sound/odour was perceived correctly. In the presence of the sound and/or odour, it was expected that the environment would be considered more
associated to the related words than the unrelated words. This would be reflected in the enhanced ratings of the related words compared to the unrelated words. It was also expected that the presence and the absence of the stimuli should influence the evaluations of the related words whereas the unrelated words should remain unaffected. This would be reflected in the enhanced ratings of the related words when the sound and/or odour was presented compared to when the stimuli were absent. The ratings of the unrelated words should be consistent in the presence and the absence of the stimuli. However this would be dependent on whether the stimuli were correctly identified. Therefore the participants were asked to identify the predominant sound and odour in the environment at the end of each condition. The identifications were completed at the end to reduce the risk of evaluations being based on verbal identifications instead of perceptual experience.

These tasks were repeated in the presence and absence of a mower sound and/or cut-grass odour. Previous research on the ability to identify these stimuli is limited. The available evidence suggests that the mower sound is relatively hard to identify. Marcell, Borella, Greene, Kerr and Rogers (2000) reported that the lawn mower sound used in their study was ranked 89th in a table 120 environmental sounds listed in descending order of naming accuracy. The naming accuracy for mower ranged from 50%-74%. In another study, the naming accuracy for mower was 32% (Ballas, 1993). Although there is no available evidence for the ability to name the cut-grass odour, there is a study which has used cut grass odour to investigate whether the relationship between the ambient odour and magazines affected magazine sales (Schifferstein & Blok, 2002). The findings indicated that the relationship between the odour and the magazine did not influence magazine sales. A reason suggested for the null effect was that the cut-grass smell was not considered to be appropriate or relevant for the magazine. Therefore it would not be likely to influence the evaluation of the product. Study 1, therefore, might in principle provide clearer answers as to why sometime the relationship between words and the ambient environment does not influence evaluations.

So to summarise, the aim of Study 1 is to determine whether the presentation of the cut-grass odour and the mower sound alter the basis on which the Temperature, Lighting, Spaciousness, Noise and Smell of the environment are evaluated. Based on
the elements from the two theories, the Positive and Negative ratings of the REQ will be affected by the initial presentation of the stimuli. The evaluation of the environment when each stimulus is presented in isolation will be similar to evaluations made when the stimuli are presented together. As the tasks carried out across the study will be the same, it is predicted that the presentation of the cut-grass odour and the mower sound will not change the Cognitive ratings. These evaluations will be based on the fact that participants will correctly identify the cut-grass odour and the mower sound. The extent to which the stimuli can be perceived correctly will be demonstrated by performance on the identification tasks and the ratings of the relationship between the stimuli of a corpus of words. Specifically, it is predicted that the environment would be considered more associated to the related words than the unrelated words. This would be reflected in the enhanced ratings of the related words when the sound and/or odour was presented compared to when the stimuli were absent. The presentation of the stimuli will not change the ratings of the unrelated words.

2.2 Method

2.2.1. Participants and Design
Sixty-four (six males) 1st year psychology undergraduate students of the University of Surrey participated as part of a lab class. The mean age was 19.4 years (range = 18 – 33 years). Participants were divided into four groups and at least one male was in each group. Information about any health conditions that may affect their performance was collected and three participants reported having a cold or any other illnesses that may affect their olfactory abilities. No student reported any hearing difficulties.

The dependent variables were the ratings of the relationship between a set of words and the predominant smell and noise, REQ ratings and identifications of the predominant smell and noise. The independent variables consisted of the presentation and removal of the mower sound and the cut-grass odour, the room in which the environment was rated and the relatedness of the words to the stimuli.
A four-factor mixed design was used. The factors were the environmental ratings, condition, room in which the environment was rated, and the first condition rated in each room.

Two factors were within-subject factors: environmental ratings and condition. The environmental ratings were categorised into four components: Intensity, Positive, Negative and Cognitive. The environment was rated in four conditions: neutral, neutral plus sound, neutral plus odour, and neutral plus sound and odour.

The remaining factors were between-subject factors i.e. the room in which the environment was rated and the first condition rated in each room. The participants made their evaluations in two rooms (Room A or Room B). Approximately equal numbers of participants were assigned to each room. Half of the participants made their evaluations in Room A during the neutral and the neutral plus sound conditions and in Room B during the neutral plus odour and neutral plus sound and odour conditions (AB group). The other participants made their evaluations in Room B during the neutral and neutral plus sound conditions and in Room A during the remaining two conditions (BA group). The remaining factor was the first condition rated in each room. The order of sound presentation was counterbalanced. Within in each room, equal numbers of participants were assigned to the two groups, which determined the condition in which they made their first set of ratings in each room. During the first two conditions, half the participants made their first set of ratings in the neutral condition, whereas the remaining participants made their first set of ratings in the neutral plus sound condition. When the participants moved to their second room, half the participants made their first set of ratings in the neutral plus odour condition, whereas the remaining participants made their first set of ratings in the neutral plus sound and odour condition.

2.2.2. Environmental Manipulations and Evaluation Measures
The environmental manipulations consisted of the presentation of the stimuli and the room in which the evaluation was made. The stimuli consisted of a cut-grass odour and a mower sound. Two distinctly different rooms – A, B - located on different floors were utilised in the study. Within the rooms each participant was given a booklet (containing the evaluation measures) to complete their evaluations during the
study (see Appendix 3). A consent form, four REQs and four wordlists were contained in a booklet. The consent form was the first page of the book and was followed by a REQ. Each REQ was followed by a wordlist. In the following sections the environmental manipulations and the evaluation measures are described in more detail.

2.2.2.1 Stimuli

The cut-grass odour was presented by two wall-mounted canisters (Dale Air Products Odourizer Units), which diffused the odour gradually in the rooms. The odorisers were started fifteen minutes before the odour condition. The sound consisted of a tape recordings of a hand operated grass mower (as opposed to an electric or petrol mower). The mower sound had a cyclic pattern of rattling and mechanical sounds with brief periods of silence between each movement of the mower. The mower sound was presented at 40dB and was measured using a Dawes sound level meter, 1400G. The sound was presented using a Panasonic portable tape player, RQ – L30, through a set of three speakers (Q1 speaker, 2-way Bass reflex, Kef Audio); each speaker was placed in one of the three corners of the rooms. The sound was amplified using the Sony Integrated Stereo Amplifier, TA – FE570.

2.2.2.2 Rooms

The main reasons for using two different rooms was to maintain participants’ involvement in rating the environment, and to assess whether the same sounds and odours would be perceived differently in the different rooms. Neither rooms had windows. Although the actual spaces of the two rooms were in comparable volume, an area of Room A was sectioned and utilised for the present study. The volume of the area used in Room A was 40.4 m$^3$ with the height 2.63m, width 3.2m and length 4.8m. Room A was a square-shaped cluttered room with dark beige walls and fluorescent strip lighting. Participants sat in three rows facing away from the door on chairs that were arranged with an aisle situated half way through the row of chairs. Room B was slightly larger and, on average, 2 °C warmer than Room A. The temperature was measured using the Comark type 2001 electronic thermometer. The volume of Room B was 50m$^3$ with the height 2.62m, width 3.38m and length 5.8m. Room B had white walls with bright fluorescent strip lighting and was brighter than Room A (210Lux and 200 Lux respectively). The lighting was measured using the
Minotta Chrome Meter, CS – 100. Participants sat in two rows with the door to their right. Each room was rated twice using the environmental measures i.e. Room Environmental Questionnaire and the Wordlists.

2.2.2.3 The Room Environmental Questionnaire (REQ)
The REQ required the participant to rate the Temperature, Lighting, Spaciousness, Noise and Smell of the room on seven subjective five-point anchored analogue scales. The seven scales were concentration, pleasantness, comfort, reminder, sickness, oppression and intensity.

The REQ used in the present study was developed from an earlier version of the questionnaire. The earlier version comprised of six aspects of the room (Temperature, Lighting, Appearance, Spaciousness, Noise and Smell) each containing nine subjective scales (alertness, concentration, comfort, claustrophobia, nausea, tolerability, evocativeness, pleasantness, wish to stay or need to leave). Principle Components Analyses revealed three main man-environment interactions: pleasant feelings toward the environment, the extent to which the environment induces ill feelings, and whether the environment facilitates concentration. The subjective scales were revised into 3 components:

1. Pleasantness and Comfort Scales = Positive
2. Sickness and Oppression Scales = Negative
3. Concentration and Reminder Scales = Cognitive

The Positive and Negative components were independent of each other. This can be conceptualised similarly to the relationship between the components in the Positive and Negative Affect Scale (PANAS, Watson, Clark, & Tellegen, 1988). This relationship contrasts to one where the Positive and Negative components are negatively related to other (or being on opposite ends of the same dimension).

The REQ used in the present study was constructed using the six subjective scales (see above) with an additional component called "Intensity", which was included to collect participants' evaluations of the strength of each environmental aspect. The environmental aspects of the REQ were reduced from six to five as the "Appearance"
aspect of the scale was excluded. So the REQ consists of five environmental aspects (Temperature, Lighting, Spaciousness, Noise and Smell). Each environmental aspect contained seven scales (concentration, pleasantness, comfort, reminder, sickness, oppression and intensity). For Study 1, the scales were analysed in terms of the four components: Positive, Negative, Cognitive and Intensity. After the participants completed the REQ, they were asked to use a wordlist to rate the relatedness of a corpus of words to the environment.

2.2.2.4 Wordlists
The wordlists consisted of 96 words (see Appendix 4) from eight categories selected from previous context reinstatement studies and word rating tasks conducted at the University of Surrey. Three words were selected from each category to form a 24-item wordlist. Altogether four wordlists were created from the eight categories so that each word appears only once across the wordlists. Within each wordlist the words were presented in lower case in alphabetical order. The words were presented in a single column in the centre of the page. A five-point anchored analogue scale was located on both sides of each word. The scale to the right of the word required the participant to rate the word in terms of how closely it was related to the predominant sound in the room. On the scale to the left of the word the participant was required to rate the word in terms of how closely it was related to the predominant odour in the room. At the end of each wordlist, the participant was required to identify the predominant odour and sound in the room. The order of the four wordlists was completely counterbalanced using the Latin square design.

2.2.3. Procedure
The first two conditions were conducted without the cut-grass odour and the latter two conditions were conducted in the presence of the odour. The procedure was carried out in this manner because pilot studies revealed that there were problems in evacuating the odour from the room in a short period of time. It was decided to introduce the smell towards the end of the procedure so that sufficient time would be given to de-odourise the rooms.

Participants were assigned to one of the four groups depending on the room and the condition in which they first rated each room: AB (neutral/neutral plus sound and
odour), BA (neutral/neutral plus odour), AB (neutral plus sound/neutral plus odour) or BA (neutral plus sound/neutral plus sound and odour). Participants were not tested individually but in the group in which they were allocated. Each group was tested individually in the allocated room. At the beginning of the first condition, participants were given the booklet and instructed that they were not allowed to turn the page until instructed by the experimenter. They were informed that they would be asked to use the REQ to assess various environmental aspects of the room and also to rate a list of words in terms of their similarity to the environment. The participants were also told that the predominant smell or noise in the room, in which they made the judgements, would be changed and reassured that the changes would not be damaging or injurious.

Participants who made their first set of ratings in the neutral condition were then instructed to turn the page and complete the first REQ. When all the participants had completed the questionnaire, they were instructed to turn the page to complete the word-rating task and attempt to identify the predominant smell and noise in the room. The first condition was completed within 10-15 minutes. When all the participants had completed the word-rating and identification task, the experimenter turned on the tape and then instructed the participants to complete the second REQ, word-rating and identification task in the presence of the sound. The second condition was completed within 9-12 minutes.

For the participants who made their first set of ratings in the neutral plus sound condition, the experimenter turned on the tape immediately after the explaining the procedure of the experiment and then instructed the participants to turn the page and complete the first REQ. When all the participants had completed the questionnaire, they were instructed to turn the page to complete the word-rating and identification task. When all the participants had completed the word-rating and identification task, the experimenter turned off the tape and then instructed the participants to complete the second REQ, word-rating and identification task in silence. These participants completed the first two conditions within approximately the same time as the participants who made their first set of ratings in the neutral condition.

After the first two conditions all the booklets were collected and the groups were taken to a waiting room which was on a different floor situated away from Room A.
and Room B, during which time the odour was introduced into both rooms. After waiting for 15 minutes, the groups were moved to their allocated rooms. The booklets were then returned to each participant. When each participant received their booklet they were instructed to turn the page to the third REQ in the booklet. The participants who made their first set of ratings in the second room during the neutral plus odour condition then completed the third REQ, word-rating and identification task in silence before completing the fourth REQ, word-rating and identification task in the presence of the sound. For the participants who made their first set of ratings in the second room during the neutral plus sound and odour condition, the experimenter turned on the tape immediately after returning the booklets to each participant. The participants were then instructed to complete the third REQ, word-rating and identification task in the presence of the sound before completing the fourth REQ, word-rating and identification task in silence. Both groups completed the last two conditions within 20-25 minutes.

Finally all the booklets were collected and the groups returned to the waiting room where they were thanked for their participation and completely debriefed.

2.2.4. Data Analyses and Scoring Procedures

The ratings were analysed to determine how the environmental evaluations were influenced by the presence/absence of the cut-grass odour and/or the mower sound. The design of the study allowed for pair-wise comparisons to be carried out between the conditions (neutral, neutral plus mower sound, neutral plus cut-grass odour, and neutral plus mower sound and cut-grass odour). The main dependent measures were the identifications of the predominant sound and odour, the environmental ratings from the REQ and the ratings of the relationship between the words and the environmental sound and odour. The data analyses and the scoring procedures for the three main dependent measures were as follows:

2.2.4.1 Identifications

The initial tabulation of the identifications revealed that the odour and the sound were rarely correctly and consistently described as “grass” or “mower”. The identifications frequently consisted of combination of several different but appropriate words (e.g. “flowers/garden” for “cut-grass”) or a combination of the correct word with
extraneous information (e.g. "flowery insect repellent" for "cut-grass"). Therefore it was necessary to develop a set of criteria for evaluating multiple identifications of the stimuli.

The corpus of odour identifications generated during the neutral plus odour, and the neutral plus odour and sound conditions was used to discover consistencies in the odour identifications. Similarly a corpus of sound identifications generated during the neutral plus sound, and the neutral plus sound and odour conditions was used to discover consistencies in the sound identifications. For example, the tabulation of the identifications for the cut-grass odour revealed that a correct identification should include green vegetation (e.g. "forest") because 17 unique identifications made reference to green vegetation during the neutral plus odour condition.

In addition to developing the scoring criteria based on the frequency of the identifications, like Marcell, Borella, Greene, Kerr and Rogers (2000) and Van Derveer (1979), considerations were made regarding whether the identifications adequately described the target stimuli. So for example, the identifications referring to green vegetation were differentiated from identifications referring to household products (e.g. "Floor Clean (pine/lemon)"). Although 15 unique identifications made reference to household products during the neutral plus odour condition, these identifications were not classified as correct. It was appreciated that some cleaning products consist of odours similar to the cut-grass odour used in the study. Identifications referring to green vegetation capture the target odour whereas identifications referring to household products suggest a different (non-target) odour. The difference in the odour referent suggested by the identifications may influence the identifications made when the sound is presented with the odour. The identifications that did not refer to the target odour but smelled similar to the "cut-grass" odour were classified as near hits (borderline identifications).

A similar criterion was used for the identifications made during exposure to the mower sound. The scoring criteria for identifications made during exposure to the mower sound was also based on the frequency of the identifications and whether the identification referred to the target sound i.e. mower. Identifications referring to the sound (e.g. "Cutting Grass/Lawn Cutter") were classified as correct identifications.
The identifications that did not refer to the target sound but sounded similar to cyclic pattern of rattling sounds with brief periods of silence between each movement (e.g. "Sawing") were labelled as borderline identifications.

Other identifications were classified as correct when they fulfilled at least one of the following characteristics:

1. An obvious spelling mistake of the target stimuli (e.g. "laun cutter" for "lawn cutter").
2. A word or phrase containing the correct root word but with a different grammatical ending (e.g. "woods" for "wood" as identifications referring to green vegetation).
3. A correct identification with additional information (e.g. "flowery insect repellent" for "cut-grass").

The remaining identifications were classified as either a near hit (i.e. identifications that did not refer to the stimuli but smelled or sounded similar to the stimuli) or a miss (i.e. incorrect identifications). An identification was classified as incorrect when the identification fulfilled at least one of the following characteristics:

1. An inaccurate description of the stimuli (e.g. "mobile phone" for "mower").
2. Consisting only of an adjective word or phrase (e.g. "strong" or "loud")
3. A broad, ambiguous or generalised description to the extent that it could be applied to a number of odours or sounds (e.g. "Outdoor Smell" for "cut-grass" or "Something moving" for "mower").

Four individuals, two of which were unaware of the purpose of the research, then independently sorted each identification into one of three categories corresponding to the stimuli. For the cut-grass odour, the categories were as follows: (a) Odours associated with Grass/Green Vegetation: (b) Odours associated with Household Products: (c) Other. For the mower sound, the categories were as follows: (a) Sounds associated with hand operated grass mower (as opposed to an electric mower): (b) Sounds associated with a cyclic pattern of rattling sounds with brief periods of silence...
between each movement: (c) Other. A discussion was held with the sorters to settle any disagreements before using the agreed criteria to score the identifications.

The scoring criteria were then applied for the identifications made in all four conditions.

Multiple McNemar tests (p>0.05) were carried out to test whether there were reliable differences in the identifications (hits, near hits and misses) between conditions (e.g. neutral and neutral plus sound conditions, neutral and neutral plus odour conditions etc...). Pair-wise comparisons using the McNemar test were made instead of the Chi Square Test because the study involved related samples and yielded nominal data. The alternative non-parametric (The Chi Square Test) was not used because, in most of the contingency tables, more than 20% of the cells had an expected frequency of less than five and yielded a minimum expected count of 0.31.

### 2.2.4.2 Environmental Ratings

Recall that a four-factor (4 x 4 x 2 x 2) mixed design was applied to carry out the study. The factors were the environmental ratings, condition, room in which the environment was rated, and the first condition rated in each room.

Participants were divided into two groups: Group 1 (AB) consisted of participants who rated Room A in their first two sets of ratings before making their remaining ratings in Room B, Group 2 (BA) consisted participants rated the two rooms in the reverse order. Within each room, the order of sound presentation was counterbalanced where participants were assigned to the two groups, which determined the condition in which they made their first set of ratings in each room. The reason for the counterbalancing of the sound presentation was to control for order effects. However as the sound counterbalancing was not the main focus of the present study and for simplicity, the analysis incorporating the sound counterbalancing manipulations are not included in the results section.

A 4 X 2 mixed ANOVA was conducted to analyse the effect of the mower sound and the cut-grass odour on the evaluations for each aspect of the environment: Temperature, Lighting, Spaciousness, Noise and Smell. The within-subject factor was
the condition (neutral, neutral plus mower sound, neutral plus cut-grass odour, and neutral plus mower sound and cut-grass odour). The between-subject factor was the order in which the participants rated the two rooms.

All follow-up analyses to the main effect of conditions (with no reliable interactions) examined whether the mower sound and/or the cut-grass odour affected the environmental evaluations. The follow-up tests consisted of all pair-wise comparisons among the four conditions using Bonferroni adjustments to control for Type 1 error (p<0.05).

For cases where a reliable interaction was found, one-way related ANOVAs were conducted for each group to reveal the cause of reliable interactions. Follow-up analyses to the main effect of conditions within a group examined whether the mower sound and/or the cut-grass odour affected the environmental evaluations. Post-hoc tests using Bonferroni adjustments were conducted to make pair-wise comparisons of the environmental evaluations between the conditions (p<0.05).

Separate analyses were carried out for each scale (Intensity, Positive, Negative, and Cognitive).

2.2.4.3 Word-Environment Relationship Ratings
The mean rating of the word relatedness to the predominant sound and odour was obtained for each category in each condition. Recall that in each condition, participants considered the relationship between the environmental sound and odour, and a list of words. The wordlists consisted of three words taken from the eight categories. The categories varied in the degree to which they were related to the cut-grass odour and the mower sound.

There were two main assumptions underlying the analyses of the mean rating of the word relatedness to the predominant sound and odour. One assumption was that the twelve words from each category were randomly allocated to each wordlist. The other assumption was that the twelve words within each category were similarly related to the environmental stimuli.
With respect to the first assumption, although the words were not randomly allocated to each wordlist, the wordlists were carefully counterbalanced so that each word was evaluated an equal number of times in each condition. Analysing the ratings of each word across all the conditions could verify the efforts made to meet the first assumption. The second assumption could be addressed by analysing the mean standard deviation of the three words for each category across the conditions. This would be done to determine whether the presence and/or absence of the stimuli influenced the similarity in the relationship between the three words in each category and the stimuli. However as this was not the main focus of the study these analyses were not conducted.

A repeated measures two-way ANOVA was used to investigate the interaction between the independent variables of condition (neutral, neutral plus sound, neutral plus odour, and neutral plus sound and odour) and category (Bedroom, Car, Cooking, Health, Kitchen, Plant, Reading and Seaside) on the word-environment relationship ratings.

One-way related ANOVAs were conducted for each category to reveal the cause of any reliable interactions. Follow-up analyses to reliable main effect of conditions within a category examined whether the mower sound and/or the cut-grass odour affected the mean rating of the word relatedness to the predominant sound and odour. Post-hoc tests using Bonferroni adjustments were conducted to make pair-wise comparisons of the word ratings between the conditions (p<0.05).

2.3 Results
This section will present the results that relate directly to evaluations made in the presence/absence of the sound and/or odour. It was discussed in the Introduction that the ability to identify the sound and the odour might influence how the environment is evaluated. It was also suggested that the degree to which the words are considered to be related to the environment are a function of the ability to identify the cut-grass odour and the mower sound. Therefore the findings concerning participants' ability to identify the cut-grass odour and the mower sound identifications will first be reported.
The results pertaining to the environmental evaluations and the ratings of the relationship between the words and the environment will then be presented separately.

2.3.1. **Identifications**

As described in the previous section, the identifications were classified either as correct (hits), borderline (near hits) or incorrect (misses). Multiple pair-wise comparisons using McNemar tests were carried out to test whether there were reliable differences in the identifications between conditions. The findings pertaining to each stimulus (cut-grass odour and mower sound) are presented separately.

2.3.1.1 **Cut-grass Odour**

The identifications given by more than one individual are listed in Table 2.1 with the most frequent identifications listed towards the top of the table. Table 2.2 shows the frequency of hits (correct identifications), near hits (borderline identifications) and misses (incorrect identifications) in each condition for exposures to the cut-grass odour.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut-grass odour</th>
<th>Neutral plus mower sound and cut-grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifications* made by more than 1 person</td>
<td>Frequency</td>
<td>Identifications* made by more than 1 person</td>
<td>Frequency</td>
</tr>
<tr>
<td>Nothing</td>
<td>16</td>
<td>Pine</td>
<td>20</td>
</tr>
<tr>
<td>Air Freshner</td>
<td>2 Sweet(s)</td>
<td>3 Air Freshner</td>
<td>3 Grass</td>
</tr>
<tr>
<td>No Response</td>
<td>2 Hospital</td>
<td>2 Express</td>
<td>3 Air Freshner (Lemon)</td>
</tr>
<tr>
<td>Stale</td>
<td>2 Musty</td>
<td>2 Dead Flowers</td>
<td>2 Air Freshner</td>
</tr>
<tr>
<td>Sweet</td>
<td>2 Stuffy</td>
<td>2 Disinfectant</td>
<td>2 Fresh</td>
</tr>
<tr>
<td>Wood(s)</td>
<td>2 Study</td>
<td>2 No Response</td>
<td>2 No Response</td>
</tr>
<tr>
<td>Suffering from</td>
<td>2 Hating</td>
<td>2 Suffering from</td>
<td>2</td>
</tr>
<tr>
<td>Cold (hating)</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2.1 suggests that more correct odour identifications were made when the odour was present than when the odour was absent. Also Table 2.2 shows that during the
odour-free conditions (neutral and neutral plus sound conditions), correct and borderline identifications of the cut-grass odour were made before the cut-grass odour was presented. A possible reason for this is that traces of cleaning products may have been present in the room before the experiment and consequently identified as the cut-grass odour. Recall that earlier it was mentioned that some cleaning products consist of odours similar to the cut-grass odour used in the experiment.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut-grass odour</th>
<th>Neutral plus mower sound and cut-grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hits</td>
<td>5</td>
<td>4</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>Near Hits</td>
<td>8</td>
<td>6</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>Misses</td>
<td>51</td>
<td>54</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

The McNemar tests revealed that there were no reliable changes in the type of odour identifications made between the neutral and the neutral plus sound conditions. This was expected because there were no changes in the odour environment between these two conditions. The tests also revealed that there were no reliable changes in the type of odour identifications made between the neutral plus odour, and the neutral plus sound and odour conditions. This was also expected because there were no odour manipulations between these two conditions.

Using the McNemar tests, it was found that the changes in the odour environment affected the type of identifications made between the odour-free conditions and the odour conditions. Specifically, identifications in the miss category during the neutral, ($\chi^2 (1) = 17.05, p<0.001$) and the neutral plus sound ($\chi^2 (1) = 18.05, p<0.001$) conditions showed a reliable tendency to move into the hit category during the neutral plus odour condition. Similarly, identifications in the miss category during the neutral, ($\chi^2 (1) = 18.05, p<0.001$) and the neutral plus sound ($\chi^2 (1) = 20.05, p<0.001$) conditions showed a reliable tendency to move into the hit category during the neutral plus sound and odour condition. This indicated that the odour reliably changed the incorrect to correct identifications.
Identifications in the miss category during the neutral ($\chi^2 (1) = 14.45, p<0.001$), and the neutral plus sound ($\chi^2 (1) = 12.19, p<0.001$) conditions showed a reliable tendency to move into the near hit category during the neutral plus odour condition. Identifications in the miss category during the neutral ($\chi^2 (1) = 12.50, p<0.001$), and the neutral plus sound ($\chi^2 (1) = 12.19, p<0.001$) conditions showed a reliable tendency to move into the near hit category during the neutral plus sound and odour conditions. These findings indicated that the odour reliably changed the incorrect identifications to borderline ones.

### 2.3.1.2 Mower sound

The sound identifications given by more than one individual are listed in Table 2.3 with the most frequent identifications listed towards the top of the table.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut-grass odour</th>
<th>Neutral plus mower sound and cut-grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifications* made by more than 1 person</td>
<td>Frequency</td>
<td>Identifications* made by more than 1 person</td>
<td>Frequency</td>
<td>Identifications* made by more than 1 person</td>
</tr>
<tr>
<td>Quiet</td>
<td>10</td>
<td>Annoying</td>
<td>2</td>
<td>Nothing</td>
</tr>
<tr>
<td>Noting</td>
<td>5</td>
<td>Engine</td>
<td>2</td>
<td>Quiet</td>
</tr>
<tr>
<td>Outside voices</td>
<td>4</td>
<td>Grassing</td>
<td>2</td>
<td>Paper</td>
</tr>
<tr>
<td>Pages</td>
<td>2</td>
<td>Object moving on</td>
<td>2</td>
<td>Outside Voices</td>
</tr>
<tr>
<td>Silent</td>
<td>2</td>
<td>Surface</td>
<td>2</td>
<td>Quiet/Frustrating Paper</td>
</tr>
<tr>
<td>Scraping</td>
<td>2</td>
<td>Excreta</td>
<td>2</td>
<td>Excreta (Quiet)</td>
</tr>
<tr>
<td>Screeching Metal</td>
<td>2</td>
<td>Whistle</td>
<td>2</td>
<td>No Response</td>
</tr>
<tr>
<td>Total Number of Unique Identifications = 43</td>
<td>Total Number of Unique Identifications = 58</td>
<td>Total Number of Unique Identifications = 33</td>
<td>Total Number of Unique Identifications = 54</td>
<td></td>
</tr>
</tbody>
</table>

*Italicised identifications were considered near hits. Underlined Identifications were considered as hits. All other identifications were considered as misses.

Table 2.4 shows the frequency of hits, near hits and misses in each condition for exposures to the mower sound.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut-grass odour</th>
<th>Neutral plus mower sound and cut-grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hits</td>
<td>Near Hits</td>
<td>Misses</td>
<td>Hits</td>
<td>Near Hits</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>64</td>
<td>1</td>
<td>34</td>
</tr>
</tbody>
</table>
Table 2.4 suggests that overall more borderline sound identifications were made when the sound was present than when the sound was absent. There was only one correct identification, indicating that the mower was difficult to identify.

Using the McNemar tests, it was found that there were no reliable changes in the type of sound identifications made between the neutral and the neutral plus odour conditions. This was expected because no sound was added during these two conditions. The tests also revealed that there were no reliable changes in the type of sound identifications made between the neutral plus sound, and the neutral plus sound and odour conditions indicating that the cut-grass odour did not change the type of sound identifications made.

The McNemar tests revealed that the changes in the sound environment affected only some types of identifications made between the sound conditions and the silent conditions. Specifically, identifications in the miss category during the neutral, and the neutral plus odour conditions did not show a reliable tendency to move into the hit category during the neutral plus sound, and the neutral plus sound and odour conditions ($\chi^2 (1) = 0, p>0.05$ for all comparisons). This indicated that the presentation of the mower sound did not change the incorrect identifications to correct ones.

However identifications in the miss category during the neutral ($\chi^2 (1) = 32.03, p<0.001$), and the neutral plus odour ($\chi^2 (1) = 30.03, p<0.001$) conditions showed a reliable tendency to move into the near hit category during the neutral plus sound condition. Moreover, identifications in the miss category during the neutral ($\chi^2 (1) = 32.03, p<0.001$), and the neutral plus odour ($\chi^2 (1) = 30.03, p<0.001$) conditions showed a reliable tendency to move into the near hit category during the neutral plus sound and odour condition. This indicated that the mower sound only changed the incorrect to borderline identifications.
In summary, most participants identified cut-grass odour as either green vegetation or a household product such as an air freshener. The mower sound was rarely identified as a mower. Rather the mower sound was frequently described as grating or scraping sounds. The accuracy of the identifications made when the odour and the sound were presented in isolation was similar to the accuracy of the identifications made when the odour and the sound were presented in combination. This indicates that the identification of one stimulus was not aided by the addition of another stimulus. The next section will address how participants evaluate their environment in the presence and absence of the cut-grass odour and/or the mower sound.

2.3.2. Environmental Rating

Recall from the method section that Room B was slightly brighter and, on average, 2°C warmer than Room A. Room B was also slightly larger than Room A. A mixed two-way (4 X 2) ANOVA was carried out to examine the effects of the mower sound and the cut-grass odour on the way the two rooms were evaluated. Follow-up analyses consisted of pair-wise comparisons using Bonferroni adjustments to control for Type 1 error (p<0.05) and/or one-way ANOVAs. One analysis was carried out for each scale (Intensity, Positive, Negative and Cognitive). Refer to the Method section for a detailed description of the analyses. The results pertaining to each aspect of the environment (Temperature, Lighting, Spaciousness, Noise and Smell) will be presented separately.

2.3.2.1 Temperature

The mean environmental ratings of the Temperature across the conditions are listed in Table 2.5.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Condition</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>Neutral plus mower sound</td>
<td>3.31</td>
<td>0.08</td>
</tr>
<tr>
<td>Neutral</td>
<td>Neutral plus cut grass odour</td>
<td>3.27</td>
<td>0.10</td>
</tr>
<tr>
<td>Neutral</td>
<td>Neutral plus mower sound plus cut grass odour</td>
<td>3.22</td>
<td>0.06</td>
</tr>
<tr>
<td>Neutral</td>
<td>Neutral plus cut grass odour</td>
<td>3.29</td>
<td>0.10</td>
</tr>
<tr>
<td>Neutral</td>
<td>Neutral plus cut grass odour</td>
<td>3.29</td>
<td>0.11</td>
</tr>
</tbody>
</table>

(N=64)

*Ratings ranged from 1 to 5*
2.3.2.1.1 Temperature: Intensity
There were no reliable main effects on the Intensity ratings of the Temperature (condition: $F(3, 183) = 0.28, p>0.05$, group: $F(1, 61) = 0.23, p>0.05$). There was a reliable interaction between the condition and the group ($F(3, 183) = 8.75, p<0.001$), indicating that the heat experienced was not similar across the conditions for both groups. The mean Intensity ratings of the Temperature across the conditions for each group are illustrated in Figure 2.1.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Intensity ratings of the Temperature for both groups (Group 1: $F(3, 87) = 6.32, p<0.005$ and Group 2: $F(3, 96) = 3.21, p<0.05$). The post hoc tests revealed that for Group 1, the environment was considered cooler when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than during the neutral condition. Group 1 also considered environment cooler when both the cut-grass odour and the mower sound were
presented and when only the cut-grass odour was presented than when only the mower sound was presented. There were no reliable differences in the remaining comparisons for Group 1. The post hoc tests did not show any reliable differences in the pair-wise comparisons for Group 2.

The results suggest that the mower sound did not influence the evaluations of how warm the room was. However, the presentation of the cut-grass odour caused participants who moved from the cool odour free room (Room A) to the warm odour room (Room B) to consider the warm room as feeling cool. Although all the differences between the odour and the neutral conditions were not reliable, the direction of the data suggested that the participants from Group 2 also experienced a reversed effect in the room temperature. In other words, the presentation of the cut-grass odour affected the evaluations of how warm the room was for participants who moved from cool odour free room (Room A) to the warm odour room (Room B). The reason for this effect is unknown.

2.3.2.1.2 Temperature: Positive

There was a reliable main effect of condition on the Positive ratings of the Temperature (F (3, 183) = 4.42, p<0.01), however the main effect of group on the Positive ratings of the Temperature was not reliable (F (1, 61) = 0.17, p>0.05). There was a reliable interaction between the condition and the group (F (3, 183) = 2.82, p<0.05), indicating that the presentation of the mower sound and the cut-grass odour did not have similar effects on the evaluation of how pleasant the Temperature was across the conditions for both groups. The mean Positive ratings of the Temperature across the conditions for each group are illustrated in Figure 2.2.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Positive ratings of the Temperature for Group 2 (F (3, 96) = 6.42, p<0.005). The effect of condition was not reliable for Group 1. The post hoc tests for Group 2 revealed that the Temperature was considered less pleasant when both the cut-grass odour and the mower sound were presented than during the Neutral condition. There were no reliable differences in the remaining comparisons.
The results suggest that for participants who moved from odour free room (Room A) to the odour room (Room B), the presentation of the mower sound and the cut-grass odour did not influence the evaluations of pleasantness of the Temperature. However, for reasons unknown, the presentation of the cut-grass odour and the mower sound together caused the remaining participants to consider the Temperature to be more unpleasant in the odour room (Room A) than the odour-free room (Room B).

2.3.2.1.3 Temperature: Negative
There was a reliable main effect of condition on the Negative ratings of the Temperature ($F (3, 183) = 7.14, p<0.001$), however the main effect of group on the Negative ratings of the Temperature was not reliable ($F (1, 61) = 1.57, p>0.05$). There was a reliable interaction between the condition and the group ($F (3, 183) = 5.43, p<0.005$), indicating that the extent to which the Temperature was considered to make them feel ill was not similar across the conditions for both groups. The mean
Negative ratings of the Temperature across the conditions for each group are illustrated in Figure 2.3.

![Figure 2.3. The Mean and Standard Error Negative Ratings of Temperature for each group across the four conditions](chart)

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Negative ratings of the Temperature for Group 2 ($F(3, 96) = 11.52, p<0.001$). The effect of condition was not reliable for Group 1. The post hoc tests revealed that for Group 2, the Temperature made participants feel more ill when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than during the neutral condition. The post hoc tests revealed that for Group 2, the Temperature made participants feel more ill when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than when the only the mower sound was presented. There were no reliable differences in the remaining comparisons.

The results suggest that the presentation of the mower sound and the cut-grass odour did not influence the extent to which the Temperature made the participants feel sick.
for those who moved from the odour-free room (Room A) to the odour room (Room B). However, although the mower sound did not influence the evaluations of the Temperature, the presentation of the cut-grass odour caused the remaining participants to consider the Temperature to make them feel more ill in the odour-free room (Room B) than in the odour room (Room A). It is not known why the presentation of the cut-grass odour would affect evaluations regarding the extent to which the Temperature made them feel ill.

2.3.2.1.4 Temperature: Cognitive
There were no reliable main effects on the Cognitive ratings of the Temperature (condition: F (3, 183) = 0.91, p>0.05, group: F (1, 61) = 0.73, p>0.05). The interaction between the condition and the group was also not reliable (F (3, 183) = 0.61, p>0.05). These results indicate that the presentation of the mower sound and the cut-grass odour did not influence the extent to which the participants evaluated the Temperature as facilitating concentration.

2.3.2.2 Lighting
The mean environmental ratings of the Lighting across the conditions are listed in Table 2.6.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut grass odour</th>
<th>Neutral plus mower sound and cut grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>3.78</td>
<td>3.81</td>
<td>3.80</td>
<td>3.97</td>
</tr>
<tr>
<td>Positive</td>
<td>3.23</td>
<td>3.31</td>
<td>3.27</td>
<td>3.29</td>
</tr>
<tr>
<td>Negative</td>
<td>2.14</td>
<td>2.01</td>
<td>2.09</td>
<td>2.01</td>
</tr>
<tr>
<td>Cognitive</td>
<td>2.82</td>
<td>2.79</td>
<td>2.71</td>
<td>2.70</td>
</tr>
</tbody>
</table>

* Ratings ranged from 1 to 5

2.3.2.2.1 Lighting: Intensity
There were no reliable main effects on the Intensity ratings of the Lighting (condition: F (3, 183) = 1.07, p>0.05, group: F (1, 61) = 1.11, p>0.05). There was a reliable interaction between the condition and the group (F (3, 183) = 6.78, p<0.001),
indicating that the evaluation of the brightness in the room was not similar across the conditions for both groups. The mean Intensity ratings of the Lighting across the conditions for each group are illustrated in Figure 2.4.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Intensity ratings of the Lighting for Group 1 (F (3, 87) = 5.40, p<0.005). The effect of condition was not reliable for Group 2. The post hoc tests revealed that for Group 1, the environment was considered darker when the mower sound and the cut-grass odour were presented than when only the mower sound was presented. There were no reliable differences in the remaining comparisons. The results suggest that overall the presentation of the mower sound and the cut-grass odour did not influence the evaluations of how bright the room with one exception. For unknown reasons, the presentation of the cut-grass odour caused participants who moved from odour-free room (Room A) to the odour room (Room B) to consider Room B to be darker than Room A, although the Light meter indicated that Room B was the brighter of the two rooms.

![Figure 2.4. The Mean and Standard Error Intensity Ratings of Lighting for each group across the four conditions](image)
2.3.2.2 Lighting: Positive

There were no reliable main effects on the Positive ratings of the Lighting (condition: $F (3, 183) = 0.31, p>0.05$, group: $F (1, 61) = 1.91, p>0.05$). The interaction between the condition and the group was reliable ($F (3, 183) = 4.12, p<0.05$), indicating that the groups' evaluation of the pleasantness of the Lighting in the room was not similar across the conditions. The mean Positive ratings of the Lighting across the conditions for each group are illustrated in Figure 2.5.

The one-way related ANOVAs for each group revealed that there were no reliable effects of condition on the Positive ratings of the Lighting (Group 1: $F (3, 87) = 2.24, p>0.05$ and Group 2: $F (3, 96) = 2.10, p>0.05$). These results indicate that the presentation of the mower sound and the cut-grass odour did not influence the participants' evaluation of the pleasantness of the Lighting.
2.3.2.2.3 Lighting: Negative

There were no reliable main effects on the Negative ratings of the Lighting (condition: \( F(3, 183) = 0.71, p>0.05 \), group: \( F(1, 61) = 0.47, p>0.05 \)). The interaction between the condition and the group also not reliable (\( F(3, 183) = 0.47, p>0.05 \)). These results indicated that the presentation of the mower sound and the cut-grass odour did not affect the extent to which the participants evaluated the Lighting made them feel ill.

2.3.2.2.4 Lighting: Cognitive

There were no reliable main effects on the Cognitive ratings of the Lighting (condition: \( F(3, 183) = 1.21, p>0.05 \), group: \( F(1, 61) = 1.27, p>0.05 \)). The interaction between the condition and the group was also not reliable (\( F(3, 183) = 0.68, p>0.05 \)). These results indicate that the presentation of the mower sound and the cut-grass odour did not influence the extent to which the Lighting was evaluated as facilitating concentration.

2.3.2.3 Spaciousness

The mean environmental ratings of the Spaciousness across the conditions are listed in Table 2.7.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut grass odour</th>
<th>Neutral plus mower sound and cut grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>Mean</td>
<td>2.11</td>
<td>2.28</td>
<td>2.51</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>0.11</td>
<td>0.13</td>
<td>0.14</td>
</tr>
<tr>
<td>Positive</td>
<td>Mean</td>
<td>2.65</td>
<td>2.72</td>
<td>2.93</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>0.10</td>
<td>0.11</td>
<td>0.10</td>
</tr>
<tr>
<td>Negative</td>
<td>Mean</td>
<td>2.62</td>
<td>2.45</td>
<td>2.42</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>0.11</td>
<td>0.12</td>
<td>0.11</td>
</tr>
<tr>
<td>Cognitive</td>
<td>Mean</td>
<td>2.43</td>
<td>2.62</td>
<td>2.48</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>0.08</td>
<td>0.10</td>
<td>0.09</td>
</tr>
</tbody>
</table>

(N=64) (N=64) (N=63) (N=64)

* Ratings ranged from 1 to 5

2.3.2.3.1 Spaciousness: Intensity

There was a reliable main effect of condition on the Intensity ratings of the Spaciousness (\( F(3, 183) = 5.77, p<0.005 \)). The main effect of group was not reliable (\( F(1, 61) = 0.33, p>0.05 \)). The interaction between the condition and the group was also not reliable (\( F(3, 183) = 2.03, p>0.05 \)), indicating that the presentation of the
mower sound and the cut-grass odour had similar effects on the evaluation of the amount of space in the room for both groups. The mean Intensity ratings of the Spaciousness in each condition collapsed across both groups are illustrated in Figure 2.6.

The post hoc tests revealed that the room was considered more spacious when both the mower sound and the cut-grass odour were presented, and when only the cut-grass odour was presented than during the neutral condition. There were no reliable differences in the remaining comparisons. The results suggest that the mower sound did not influence the evaluations of how spacious the room was. Rather, the presentation of the cut-grass odour caused the environment to be considered more spacious than when the cut-grass odour was absent. These results are surprising because participants from Group 2 moved from Room B to the slightly smaller room (i.e. Room A) between the odour-free and the odour conditions.
2.3.2.3.2 Spaciousness: Positive

There was a reliable main effect of condition on the Positive ratings of the Spaciousness ($F(3, 183) = 3.97, p < 0.01$). The main effect of group was not reliable ($F(1, 61) = 0.15, p > 0.05$). The interaction between the condition and the group was also not reliable ($F(3, 183) = 0.63, p > 0.05$), indicating that the presentation of the mower sound and the cut-grass odour had similar effects on the evaluation of how pleasant the space in the room was for both groups. The mean Positive ratings of the Spaciousness for each conditions collapsed across both groups are illustrated in Figure 2.7.

The post hoc tests revealed that the space of the room was considered more pleasant when both the mower sound and the cut-grass odour were presented than during the neutral condition. There were no reliable differences in the remaining comparisons. The results suggest that the mower sound and the cut-grass presented individually did not influence the evaluations of how pleasant the space of the room was. Rather, the
presentation of the both stimuli together caused the space of the room to be considered more pleasant than when they were absent.

2.3.2.3 Spaciousness: Negative
There were no reliable main effects on the Negative ratings of the Spaciousness (condition: $F(3, 183) = 1.03, p > 0.05$, group: $F(1, 61) = 0.52, p > 0.05$). The interaction between the condition and the group was also not reliable ($F(3, 183) = 1.77, p > 0.05$). The results suggest that the presentation of the mower sound and the cut-grass odour did not influence the extent to which the Spaciousness made the participants feel ill.

2.3.2.3.4 Spaciousness: Cognitive
There were no reliable main effects on the Cognitive ratings of the Spaciousness (condition: $F(3, 183) = 1.58, p > 0.05$, group: $F(1, 61) = 2.70, p > 0.05$). The interaction between the condition and the group was also not reliable ($F(3, 183) = 1.17, p > 0.05$). These results indicate that the presentation of the mower sound and the cut-grass odour did not influence the extent to which the Spaciousness was evaluated as facilitating concentration.

2.3.2.4 Noise
The mean environmental ratings of the Noise across the conditions are listed in Table 2.8.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut grass odour</th>
<th>Neutral plus mower sound and cut grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>Mean 1.69</td>
<td>Mean 2.94</td>
<td>Mean 1.84</td>
<td>Mean 3.36</td>
</tr>
<tr>
<td></td>
<td>Standard Error 0.11</td>
<td>Standard Error 0.13</td>
<td>Standard Error 0.10</td>
<td>Standard Error 0.11</td>
</tr>
<tr>
<td>Positive</td>
<td>Mean 3.31</td>
<td>Mean 2.22</td>
<td>Mean 3.48</td>
<td>Mean 2.09</td>
</tr>
<tr>
<td></td>
<td>Standard Error 0.10</td>
<td>Standard Error 0.09</td>
<td>Standard Error 0.11</td>
<td>Standard Error 0.08</td>
</tr>
<tr>
<td>Negative</td>
<td>Mean 1.71</td>
<td>Mean 2.45</td>
<td>Mean 1.72</td>
<td>Mean 2.63</td>
</tr>
<tr>
<td></td>
<td>Standard Error 0.11</td>
<td>Standard Error 0.12</td>
<td>Standard Error 0.09</td>
<td>Standard Error 0.12</td>
</tr>
<tr>
<td>Cognitive</td>
<td>Mean 2.92</td>
<td>Mean 2.96</td>
<td>Mean 2.94</td>
<td>Mean 2.67</td>
</tr>
<tr>
<td></td>
<td>Standard Error 0.03</td>
<td>Standard Error 0.09</td>
<td>Standard Error 0.09</td>
<td>Standard Error 0.08</td>
</tr>
</tbody>
</table>

(N=64) (N=64) (N=63) (N=64)

* Ratings ranged from 1 to 5
2.3.2.4.1 Noise: Intensity

The main effects on the Intensity ratings of the Noise were reliable (condition: F (3, 183) = 50.58, p<0.001, group: F (1, 61) = 9.61, p<0.005). The interaction between the condition and the group was also reliable (F (3, 183) = 2.79, p<0.05), indicating that the presentation of the mower sound and the cut-grass odour did not have similar effects on the evaluation of the loudness in the room for both groups. The mean Intensity ratings of the Noise for each group across the conditions are illustrated in Figure 2.8. The graph in Figure 2.8 suggests that although both groups showed an increase in Intensity ratings in the presence of the mower sound, the increase between the Neutral and the Neutral plus Sound condition is smaller for Group 2 than for Group 1.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Intensity ratings of the Noise for both groups (Group 1: F (3, 87) = 29.49, p<0.001 and Group 2: F (3, 96) = 24.97, p<0.001). The post hoc tests revealed that for both groups, the Noise was considered louder when both the cut-grass odour
and the mower sound were presented, and when only the mower sound was presented than during the neutral condition. Also the Noise was considered louder when both the cut-grass odour and the mower sound were presented, and when only the mower sound was presented than when only the cut-grass odour was presented. The results suggest that overall the presentation of the cut-grass odour did not influence the loudness of the Noise. The presentation of the mower sound caused participants to evaluate the Noise to be louder than when the mower sound was absent.

2.3.2.4.2 Noise: Positive
There was a reliable main effect of condition on the Positive ratings of the Noise (F(3, 183) = 62.75, p<0.001). The main effect of group was not reliable (F (1, 61) = 0.12, p>0.05). The interaction between the condition and the group was reliable (F (3, 183) = 3.10, p<0.05), indicating that the presentation of the mower sound and the cut-grass odour did not have similar effects on the evaluation of how pleasant the Noise in the room for both groups. The mean Positive ratings of the Noise for each group across the conditions are illustrated in Figure 2.9.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Positive ratings of the Noise for both groups (Group 1: F (3, 87) = 27.48, p<0.001 and Group 2: F (3, 96) = 38.85, p<0.001). The post hoc tests revealed that for both groups, the Noise in the room was considered less pleasant when both the mower sound and the cut-grass odour were presented than during the neutral condition, and when only the odour was presented. The Noise in the room was also considered less pleasant when only the mower sound was presented than during the neutral condition, and when only the odour was presented. Furthermore, for Group 2 the Noise in the room was considered more pleasant when the cut-grass odour was presented than during the neutral condition. The Noise in the room was also considered less pleasant when both the mower sound and the cut-grass odour were presented than when only the sound was presented. There were no reliable differences in the remaining comparisons. The results suggest that the cut-grass odour did not influence the evaluations of how pleasant the Noise was for participants who moved from Room A to Room B. The presentation of the mower sound caused the Noise in the room to be considered less pleasant than when the mower sound was absent. For unknown reasons, the remaining participants' evaluations of the
pleasantness of the Noise were influenced by the presentation of the cut-grass odour and the mower sound apart and together.

![Figure 2.9. The Mean and Standard Error Positive Ratings of the Noise for each group across the four conditions](image)

2.3.2.4.3 Noise: Negative

There was a reliable main effect of condition on the Negative ratings of the Noise \( (F(3, 183) = 30.35, p<0.001) \). The main effect of group was not reliable \( (F(1, 61) = 0.00, p>0.05) \). The interaction between the condition and the group was also not reliable \( (F(3, 183) = 0.90, p>0.05) \). This indicated that the presentation of the mower sound and the cut-grass odour had similar effects on the groups' evaluation of the extent to which the Noise made the participants feel ill. The mean Negative ratings of the Noise across the conditions collapsed across the group are illustrated in Figure 2.10.
The post hoc tests revealed that the *Noise* in the room made participants feel more ill when both the mower sound and the cut-grass odour were presented than during the neutral condition, and when only the odour was presented. The *Noise* in the room also made participants feel more ill when only the mower sound was presented than during the neutral condition, and when only the odour was presented. There were no reliable differences in the remaining comparisons. Again, the results suggest that the cut-grass odour did not influence the extent to which the *Noise* in the room made participants feel sick. The presentation of the mower sound caused the *Noise* in the room to make the participants feel more ill than when the mower sound was absent.

2.3.2.4.4 *Noise*: Cognitive

There was a reliable main effect of condition on the Cognitive ratings of the *Noise* ($F(3, 183) = 3.88, p<0.05$). The main effect of group was not reliable ($F(1, 61) = 1.46, p>0.05$). The interaction between the condition and the group was also not reliable ($F(3, 183) = 1.59, p>0.05$). The analyses indicated that the presentation of the mower
sound and the cut-grass odour had similar effects for all groups on the extent to which the *Noise* in the room was considered to facilitate concentration. The mean Cognitive ratings of the *Noise* in each condition collapsed across both groups are illustrated in Figure 2.11.

The graph in Figure 2.11 suggests that when the mower sound was presented, the *Noise* was considered to decrease concentration. However, the post hoc tests revealed a marginal reliable difference in the Cognitive ratings between the conditions where only the mower sound was presented and when only the odour was presented (*p* = 0.07). There were no reliable differences in the remaining comparisons. The results suggest that the mower sound and the cut-grass odour did not influence the extent to which the *Noise* in the room was considered to facilitate concentration.
### 2.3.2.5 Smell

The mean environmental ratings of the *Smell* across the conditions are listed in Table 2.9.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Condition</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>Neutral</td>
<td>1.98</td>
<td>0.12</td>
<td>2.08</td>
<td>0.12</td>
<td>4.21</td>
<td>0.11</td>
<td>4.24</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>Neutral plus mower sound</td>
<td>3.36</td>
<td>0.10</td>
<td>3.35</td>
<td>0.06</td>
<td>2.21</td>
<td>0.12</td>
<td>2.25</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cut grass odour</td>
<td>1.80</td>
<td>0.10</td>
<td>1.91</td>
<td>0.10</td>
<td>3.18</td>
<td>0.15</td>
<td>3.21</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Neutral plus mower sound and cut grass odour</td>
<td>2.55</td>
<td>0.09</td>
<td>2.79</td>
<td>0.09</td>
<td>2.92</td>
<td>0.10</td>
<td>2.86</td>
<td>0.10</td>
</tr>
</tbody>
</table>

*Ratings ranged from 1 to 5

**2.3.2.5.1 Smell: Intensity**

The main effect of condition on the Intensity ratings of the *Smell* was reliable ($F (3, 180) = 128.92, p<0.001$). The main effect of group on the Intensity ratings of the *Smell* was not reliable ($F (1, 60) = 0.82, p>0.05$). The interaction between the condition and the group was reliable ($F (3, 180) = 2.77, p<0.05$), indicating that the presentation of the mower sound and the cut-grass odour did not have similar effects on the evaluation of the strength of the *Smell* in the room for both groups. The mean Intensity ratings of the *Smell* for each group across the conditions are illustrated in Figure 2.12.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Intensity ratings of the *Smell* for both groups (Group 1: $F (3, 87) = 49.55, p<0.001$ and Group 2: $F (3, 93) = 81.95, p<0.001$). The post hoc tests revealed that both groups considered that the *Smell* was stronger when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than during the neutral condition. Also the *Smell* was considered stronger when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than when only the mower sound was presented. There were no reliable differences in the remaining comparisons. These results suggest that overall the presentation of the mower sound did not influence the strength
of the Smell. Rather, the presentation of the cut-grass odour caused the participants to evaluate the Smell to be stronger than when the cut-grass odour was absent.

![Figure 2.12. The Mean and Standard Error Intensity Ratings of the Smell for each group across the four conditions](image)

2.3.2.5.2 Smell: Positive

The main effects on the Positive ratings of the Smell were reliable (condition: $F(3, 180) = 51.19, p<0.001$, group: $F(1, 60) = 4.37, p<0.05$). The interaction between the condition and the group was also reliable ($F(3, 180) = 6.51, p>0.001$), indicating that the presentation of the mower sound and the cut-grass odour did not have similar effects on the groups' evaluation of the pleasantness of the Smell in the room across the conditions. The mean Positive ratings of the Smell for each group across the conditions are illustrated in Figure 2.13.

The graph in Figure 2.13 suggests that the presentation of the cut-grass odour influenced the participants' evaluations more in Group 2 than Group 1. The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Positive ratings of the Smell for both groups (Group 1: $F(3, 87) = 10.37$, $p<0.001$, Group 2: $F(3, 93) = 10.37$, $p<0.001$).
The post hoc tests revealed that the Smell was considered less pleasant when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than during the neutral condition. Also the Smell was considered less pleasant when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than when only the mower sound was presented. There were no reliable differences in the remaining comparisons. These results suggest that overall the presentation of the mower sound did not influence the participants’ evaluation of the pleasantness of the Smell. The presentation of the cut-grass odour caused the participants to evaluate the Smell as less pleasant than when the cut-grass odour was absent.

2.3.2.5.3 Smell: Negative

The main effects on the Negative ratings of the Smell were reliable (condition: $F(3, 180) = 65.72, p<0.001$ and group: $F(1, 60) = 4.22, p<0.05$). The interaction between the condition and the group was also reliable ($F(3, 180) = 10.14, p<0.001$). This
indicated that the presentation of the mower sound and the cut-grass odour did not have similar effects on the groups’ evaluation of the extent to which the Smell made the participants feel ill. The mean Negative ratings of the Smell for each group across the conditions are illustrated in Figure 2.14.

Similar to the results of the evaluation of the pleasantness of the Smell the graph in Figure 2.14 suggests that the presentation of the cut-grass odour influenced the participants’ evaluations more in Group 2 than Group 1.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Negative ratings of the Smell for both groups (Group 1: F (3, 87) = 12.61, p<0.001 and Group 2: F (3, 93) = 62.65, p<0.001). The post hoc tests revealed that the Smell was evaluated to make the participants feel more ill when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than during the neutral condition. Also the Smell was evaluated to make the participants feel more ill when both the cut-grass odour and the mower sound were presented, and when only the cut-grass odour was presented than when
only the mower sound was presented. There were no reliable differences in the remaining comparisons. These results suggest that overall the presentation of the mower sound did not influence evaluations of the extent to which the Smell made the participants feel ill. The presentation of the cut-grass odour caused the participants to evaluate the Smell as making them feel more ill than when the cut-grass odour was absent.

2.3.2.5.4 Smell: Cognitive

There was a reliable main effect of condition on the Cognitive ratings of the Smell \( (F(3, 180) = 3.61, p<0.05) \). There was also a reliable main effect of group on the Cognitive ratings of the Smell \( (F(1, 60) = 6.80, p<0.05) \). The interaction between the condition and the group was not reliable \( (F(3, 180) = 0.15, p>0.05) \). The analyses indicated that the presentation of the mower sound and the cut-grass odour had similar effects for all groups on the extent to which the Smell in the room was considered to facilitate concentration. Furthermore, one group evaluated that the Smell facilitated concentration more than the other group. To further explore the main effect of condition, post hoc tests were carried out. To illustrate the main effect of condition, the mean Cognitive ratings of the Smell for each condition collapsed across the groups are shown in Figure 2.15.

The post hoc tests revealed that all groups considered the Smell to facilitate concentration more when the cut-grass odour was presented than during the neutral condition. There were no reliable differences in the remaining comparisons. To illustrate the main effect of group, the mean Cognitive ratings of the Smell across the groups collapsed across the conditions are shown in Figure 2.16.
Figure 2.15. The Mean and Standard Error Cognitive Ratings of the Smell for each condition*

*collapsed across both groups

Figure 2.16. The Mean and Standard Error Cognitive Ratings of the Smell for each group*

*collapsed across all four conditions
The graph in Figure 2.16 suggests that the *Smell* was considered to facilitate concentration less for Group 2 than for Group 1. The reason for this difference is unknown. In summary, the results indicate that although the mower sound did not influence the extent to which the *Smell* in the room was considered to facilitate concentration, when the cut-grass odour was presented, the *Smell* in the room was considered to facilitate concentration. Furthermore, the *Smell* was considered to facilitate concentration more for participants who moved from Room A to Room B than for those who moved from Room B to Room A.

Overall, the presentation of the cut-grass odour influenced the evaluation of the *Temperature, Spaciousness* and the *Smell* in the room. However, the presentation of the mower sound only influenced the evaluation of the *Noise*.

### 2.3.3. Word-Environment Relationship Ratings

The mean rating of the word relatedness to the predominant sound and odour was obtained for each category in each condition. Recall that in each condition, participants considered the relationship between the environmental sound and odour, and a list of words. The mean ratings were analysed using a repeated measures two-way (4X8) ANOVA. This analysis was carried out to examine the effects of the presence/absence of the mower sound and/or cut-grass odour on the way participants considered the relationship between the categories and the environment. Follow-up analyses consisted of pair-wise comparisons using Bonferonni adjustments to control for Type 1 error (p<0.05) and/or one-way ANOVAs. Refer to the Method section for a detailed description of the analyses.

The findings pertaining to each environmental stimulus (predominant smell and noise) are presented separately.

#### 2.3.3.1 Mean Ratings of the Words’ relatedness to the Predominant Smell

The mean ratings of the relationship between the word and the predominant smell in each category across the conditions are listed in Table 2.10.
There was a reliable main effect of condition on the mean ratings of the relationship between the word and the predominant smell (F (3, 1302) = 7.49, p<0.001). The main effect of the category on these ratings was also reliable (F (7, 1302) = 69.46, p<0.001). There was a reliable interaction between the condition and the category (F (21, 1302) = 15.72, p<0.001), indicating that the categories were not rated similarly across the conditions.

The follow up one-way related ANOVA tests revealed that the effect of condition on the ratings of the related category (i.e. Plant) was reliable (F (3, 186) = 44.89, p<0.001). The post hoc tests revealed that the words from the Plant category were considered more related to the predominant smell when both the cut-grass odour and the mower sound were presented than during the neutral condition, or when the mower sound was presented. The words from the Plant category were also considered more related to the predominant smell when only the cut-grass odour was presented than during the neutral condition, or when the mower sound was presented. There were no reliable differences in the remaining comparisons.

Table 2.10 Mean (and Standard deviation) rating* of the words’ relationship to the predominant smell for each category in each condition.

<table>
<thead>
<tr>
<th>Category</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut grass odour</th>
<th>Neutral plus mower sound and cut grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Bedroom</td>
<td>4.69  a</td>
<td>0.52</td>
<td>4.80  b</td>
<td>0.39</td>
</tr>
<tr>
<td>Car</td>
<td>4.85  a</td>
<td>0.29</td>
<td>4.87  a</td>
<td>0.41</td>
</tr>
<tr>
<td>Cooking</td>
<td>4.87  a</td>
<td>0.26</td>
<td>4.90  a</td>
<td>0.33</td>
</tr>
<tr>
<td>Health</td>
<td>4.15  a</td>
<td>0.87</td>
<td>4.25  a</td>
<td>0.97</td>
</tr>
<tr>
<td>Kitchen</td>
<td>4.84  a</td>
<td>0.54</td>
<td>4.79  a</td>
<td>0.41</td>
</tr>
<tr>
<td>Plant</td>
<td>4.68  a</td>
<td>0.52</td>
<td>4.67  a</td>
<td>0.54</td>
</tr>
<tr>
<td>Reading</td>
<td>4.68  a</td>
<td>0.38</td>
<td>4.71  a</td>
<td>0.64</td>
</tr>
<tr>
<td>Seaside</td>
<td>4.68  a</td>
<td>0.38</td>
<td>4.83  a</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Mean Rating in each Condition

4.66  0.51  4.73  0.51  4.60  0.62  4.80  0.47

*Ratings ranged from 1 (the predominant smell is very closely related to the word), to 5 (the predominant smell is not at all related to the word)

Means within each category, which have the same letter are not reliably different from each other (p>0.05)

Means within each category, which have a different letter are reliably different from each other (p<0.05)
The follow up one-way related ANOVA tests revealed that the effect of condition on the ratings from the unrelated categories was mixed. The effect of condition on the ratings from the Car, Cooking, Health and Kitchen categories was not reliable indicating that the words from these categories were rated similarly across the conditions.

There was a reliable effect of condition on the ratings from the remaining three unrelated categories (Bedroom: $F (3, 186) = 5.63, p<0.005$, Reading: $F (3, 186) = 14.89, p<0.001$ and Seaside: $F (3, 186) = 3.91, p<0.05$). The post hoc tests revealed that the words from the Bedroom and Reading categories were considered less related to the predominant smell when both the cut-grass odour and the mower sound were presented than during the neutral condition. Furthermore, the words from the Reading category were considered less related to the predominant smell when both the cut-grass odour and the mower sound were presented than when the only mower sound was presented. The words from the Reading category were considered less related to the predominant smell when the cut-grass odour was presented than during the neutral condition, or when the mower sound was presented. Interestingly the post hoc tests revealed that the words from the Seaside category were considered more related to the predominant smell when both the cut-grass odour and the mower sound were presented than when only the mower sound was presented. There were no reliable differences in the remaining comparisons.

### 2.3.3.2 Mean Ratings of the Words' relatedness to the Predominant Noise

The mean ratings given for each category across the conditions are listed in Table 2.11.

There was a reliable main effect of condition on the ratings of the relationship between the words and the predominant noise ($F (3, 1302) = 7.60, p<0.001$). The main effect of the category on the ratings was also reliable ($F (7, 1302) = 10.55, p<0.001$). There was a reliable interaction between the condition and the category ($F (21, 1302) = 15.53, p<0.001$), indicating that the categories were not rated similarly across the conditions.
Table 2.11 Mean (and Standard deviation) rating* of the words' relationship to the predominant noise for each category in each condition.

<table>
<thead>
<tr>
<th>Category</th>
<th>Neutral</th>
<th>Neutral plus mower sound</th>
<th>Neutral plus cut grass odour</th>
<th>Neutral plus mower sound and cut grass odour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Bedroom</td>
<td>4.60bc</td>
<td>0.73</td>
<td>4.81ca</td>
<td>0.55</td>
</tr>
<tr>
<td>Car</td>
<td>4.72a</td>
<td>0.74</td>
<td>3.93b</td>
<td>0.89</td>
</tr>
<tr>
<td>Cooking</td>
<td>4.80a</td>
<td>0.61</td>
<td>4.59b</td>
<td>0.56</td>
</tr>
<tr>
<td>Health</td>
<td>4.33a</td>
<td>1.00</td>
<td>4.64ab</td>
<td>0.74</td>
</tr>
<tr>
<td>Kitchen</td>
<td>4.68b</td>
<td>0.55</td>
<td>4.43ac</td>
<td>0.74</td>
</tr>
<tr>
<td>Plant</td>
<td>4.68a</td>
<td>0.89</td>
<td>4.69a</td>
<td>0.58</td>
</tr>
<tr>
<td>Reading</td>
<td>4.16a</td>
<td>1.01</td>
<td>4.75b</td>
<td>0.63</td>
</tr>
<tr>
<td>Seaside</td>
<td>4.84b</td>
<td>0.74</td>
<td>4.18a</td>
<td>0.98</td>
</tr>
</tbody>
</table>

(N=64) (N=64) (N=63) (N=64)

Mean Rating in each Condition
4.56 0.76 4.50 0.71 4.75 0.49 4.58 0.69

* Ratings ranged from 1 (the predominant noise is very closely related to the word), to 5 (the predominant noise is not at all related to the word)

Means within each category, which have the same letter are not reliably different from each other (p>0.05)
Means within each category, which have a different letter are reliably different from each other (p<0.05)

The follow up one-way related ANOVA tests revealed that the effect of condition on the ratings from the related category (i.e. Plant) was not reliable indicating that the words were rated similarly across the conditions.

The ANOVA revealed mixed effects of condition on the ratings of the relationship between the words from the unrelated categories and the predominant noise. There was a reliable effect of condition on the ratings for the Bedroom, Health and Reading categories (F (3, 186) = 6.01, p<0.005, F (3, 186) = 6.30, p<0.001 and F (3, 186) =13.85, p<0.001 respectively). The post hoc tests revealed that the words from these categories were considered less related to the predominant noise when both the cut-grass odour and the mower sound were presented than during the neutral condition. The words from the Reading category were considered less related to the predominant noise when only the mower sound was presented than during the neutral condition, or when only the cut-grass odour was presented. Interestingly, the words from the Bedroom category were considered less related to the predominant noise when only the cut-grass odour was presented than during the neutral condition, although no sound was presented in either two conditions.
There was also a reliable effect of condition on the ratings for the Car, Cooking and Seaside categories ($F(3, 186) = 39.02, p<0.001$, $F(3, 186) = 8.14, p<0.001$ and $F(3, 186) = 17.52, p<0.001$ respectively). Interestingly the post hoc tests revealed that the words from these categories were considered more related to the predominant noise when both the cut-grass odour and the mower sound were presented than during the neutral condition, or when only the cut-grass odour was presented. The words from these categories were also rated as being reliably more related to the predominant noise when only the mower sound was presented than during the neutral condition, or when only the cut-grass odour was presented.

There was a reliable effect of condition on the ratings from the Kitchen category ($F(3, 186) = 11.64, p<0.001$). The post hoc tests revealed that the words from the Kitchen category were considered more related to the predominant noise when only the mower sound was presented than during the neutral condition, or when only the cut-grass odour was presented. The words from the Kitchen category were considered less related to the predominant noise when only the cut-grass odour was presented than during the neutral condition. The post hoc tests also revealed that the words from the Kitchen category were considered more related to the predominant noise when both the cut-grass odour and the mower sound were presented than during the neutral condition. There were no reliable differences in the remaining comparisons.

The results from Study 1 are summarised in Table 2.12

<table>
<thead>
<tr>
<th>Identification Accuracy</th>
<th>Percentage of Correct Odour Identifications</th>
<th>Percentage of Correct Sound Identifications</th>
<th>Study 1: Mower Sound and Cut-Grass Odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Evaluation</td>
<td>Temperature</td>
<td>Intensity</td>
<td>Odour caused participants from Group 1 to consider room as cooler.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>Odour caused participants from Group 2 to consider Temperature as being less pleasant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>Odour caused participants from Group 2 to consider Temperature as making them feel more ill.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive</td>
<td>No effect</td>
</tr>
<tr>
<td>Environmental Evaluation</td>
<td>Lighting</td>
<td>Intensity</td>
<td>Odour caused participants from Group 1 to consider room as being darker.</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------</td>
<td>-----------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive</td>
<td>No effect</td>
</tr>
<tr>
<td>Spaciousness</td>
<td></td>
<td>Intensity</td>
<td>Odour caused all participants to consider room as being more spacious.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>Sound and odour combined caused all participants to consider Spaciousness as being more pleasant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive</td>
<td>No effect</td>
</tr>
<tr>
<td>Noise</td>
<td></td>
<td>Intensity</td>
<td>Sound caused all participants to consider Noise as being louder.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>Sound caused all participants to consider Noise as being less pleasant. Sound and Odour combined and separately caused participants from Group 2 to consider Noise as less pleasant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>Odour caused all participants to consider Noise as making them feel more ill.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive</td>
<td>No effect</td>
</tr>
<tr>
<td>Smell</td>
<td></td>
<td>Intensity</td>
<td>Odour caused all participants to consider Smell as being stronger.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive</td>
<td>Odour caused all participants to consider Smell as being less pleasant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>Odour caused all participants to consider Smell as making them feel more ill.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive</td>
<td>Odour caused all participants to consider Smell to facilitate concentration. Smell was considered to facilitate concentration more by participants from Group 1 than Group 2.</td>
</tr>
</tbody>
</table>

*Note: Related category.

Unrelated category

Categories are listed according to the participants ratings of the word-environment relationship with the categories considered most related to the ambient environment listed towards the top of the table.

Presentation of the sound and/or odour caused the words from a category to be considered as being:

More related to the ambient environment
Less related to the ambient environment

Other observations included:

Mixed effect on the word-environment relationship
No effect on the word-environment relationship
2.4 Discussion

The findings of the Study 1 have shown that the cut-grass odour was correctly identified by a third of the participants whereas the sound was rarely identified as a mower. Although there is limited research with which to compare the findings concerning the cut-grass odour, the results concerning the identification of the mower sound are consistent with previous research (Marcell, Borella, Greene, Kerr and Rogers, 2000; Ballas, 1993) providing further support for the inability to identify the mower sound. Recall that the mower sound presented was a hand operated mower, which had a cyclic pattern with an accompanying rattling and mechanical sound. The participants may be more accustomed to an electric operated mower than a hand-operated mower and therefore would be likely to correctly identify the former type of mower. The low familiarity of the mower sound possibly led to the absence of change in the correct identifications in the presence and absence of the mower sound. The results show that the participants perceived the mower sound and attempted to identify the mower sound. This was observed by the fact the results showed that participants tended to change their incorrect identifications to borderline identifications when they were exposed to the mower sound. This finding would not have been observed if the identifications were classified purely as “correct/incorrect” identifications. The advantage of using an additional category for borderline identifications (i.e. near hits) was that it provided a clearer way to determine how participants perceived and attempted to identify the sound than if only two categories were used to classify the identifications.

With respect to the evaluation findings, the results show that the presentation of the mower sound and the cut-grass odour led to changes in the degree of pleasant feelings towards the environment. The extent to which the environment caused the participants to feel ill was also affected by the presentation of the mower sound and the cut-grass odour. These results are consistent with some of the elements from Mehrabian and Russell’s (1974) theory that changes in the environment influence emotional states.

The findings showed that in general the evaluations were not influenced by the number of stimuli presented i.e. the effect on the ratings were similar when only the
odour or the sound was presented, compared to when both stimuli was presented at the same time. This suggests that the evaluations were influenced by the change (or information load) per se in the environment rather than the amount of change (or information). Evaluations were influenced by the initial introduction of each stimulus. The presentation of the stimuli together can be interpreted as an increase in the amount of information but not an increase in the information load because the participants had already been exposed to the stimuli in the experimental setting. Therefore the stimuli were no longer considered to be as novel in the second presentation as during the first presentation. A way to further examine this would involve introducing an odour and sound separately and then introducing a different sound and odour together. Based on Mehrabian and Russell’s (1974) predictions, it would be expected that the effect on evaluations would be different when only one stimulus is provided compared to when two stimuli are presented. This is because the presentation of the two stimuli would not only increase the amount of information but also the information load in the environment.

The findings in general provide support for some of the elements from Canter’s (1983) theory. Although the environment changed, the participants’ rating tasks (or goals) did not change over the study. This was reflected in participants’ evaluations of the extent to which the environment facilitated concentration where the cognitive ratings did not change across the conditions (except for the evaluations of the Smell). It could be argued that the reason why the cognitive ratings did not change was because the changes in the environment were not extreme enough to influence these evaluations. However the aim of the study was to examine the effect of change in the environment without inducing discomfort to the participants.

The effect of the changes on some of the evaluations was greater for participants who moved from Room B to Room A than for those who moved from Room A to Room B. For example, participants who moved from Room B to Room A considered the Temperature to be less pleasant and make them feel more ill when the cut-grass was presented than when it was absent. Also the general evaluation of the odour was more negative for the participants who moved from Room B to Room A than for the remaining participants. The differences cannot be attributed to the differences in the overall heat or odour concentration experienced because the analysis showed that
these aspects were evaluated similarly between the two rooms. It is also interesting that the participants who moved from Room B to Room A considered their first room to be less spacious than the second room although the volume of the first room was larger than that of the second room. The theories do not provide any explanations for why some changes in environment (i.e. presentation of the odour) should produce a bigger effect in evaluations for those in one group than the other group in the way observed in Study 1.

The theories also do not account for why the presentation of the odour affected most aspects of the environment (Temperature, Spaciousness and Smell) whereas the sound only affected the Noise. One reason for this could be due to the fact that relatively more people identified the odour than the sound. The ratings of the relationship between the words and the environment also indicated that the odour was correctly perceived whereas the sound was not perceived as a mower.

The analysis of the word ratings showed the expected interaction between word category and the change in the environment with respect to the presentation of the odour. The words from the related category (i.e. Plant) were considered more related to the odour when the cut-grass odour was presented than when the odour was absent. The words from all the unrelated categories, except the Seaside category, were either not influenced by the presentation of the cut-grass odour, or were considered to be less related to the odour when it was presented than when it was absent. These findings are consistent with previous research showing differential performance for related and unrelated words to the odour environment (Schab, 1990; Degel & Koster, 1998; Pauli, Bourne, Diekmann, & Birbaumer, 1999; Parker, Waterman & Gellatly, 2000). However these findings contrast with the Schifferstein and Blok’s (2002) study, where they found that the relationship between the odour and the product did not influence magazine sales of related and unrelated magazines. A possible reason for the difference in results is that Schifferstein and Blok’s (2002) study involved examining participants’ purchasing behaviours and not their evaluations. The participants in Schifferstein and Blok’s (2002) study may have evaluated a congruent magazine to be related to the odour, but this evaluation does not necessarily mean that they will buy the magazine. Other factors could also determine whether a magazine is purchased such as financial costs and interest in the subject covered by the magazine.
The interaction between word category and the change in the environment with respect to the presentation of the sound was less clear cut than during the presentation of the odour. The evaluations of the words from the Plant category were not affected by the presentation of the mower sound. For some of the unrelated categories (Car, Seaside and Cooking), the words were considered more related to the sound when the mower sound was presented than when it was absent. For other unrelated categories (Bedroom, Health and Reading) were considered to be less related to the sound when it was presented than when it was absent. Evaluations of the relatedness of the words from the Kitchen category to the sounds were influenced by the presentation of the sound and the odour. These findings are inconsistent with previous research (e.g. Van Petten & Rheinfelder, 1995). A possible reason for the inconsistency between the present findings and previous research is the type of sound used. Recall that before Van Petten and Rheinfelder (1995) conducted their main study, the sounds were initially presented to participants to determine whether they considered the sounds to be related to the words. Therefore it was ascertained before their experiment that the sounds were related to the words. This process was not carried for the first study. Therefore it is possible that the reason why the expected interaction between the word category and the change in environment was not observed was because the participants did not consider the words from the Plant category to be related to the sound.

Another reason for the unexpected interaction could be due to the inability to identify the mower sound. Recall from the Introduction of the chapter that it was suggested that the extent to which the words are considered to be related to the environment could be a function of the accuracy of identifying the sound/odour. A way to examine whether the ability to identify the sound/odour influenced the ratings of the relationship between the words and the environment would involve analysing the ratings from participants who gave correct identifications compared to those who gave borderline or incorrect ones. It would be predicted that the expected interaction would only be observed in those who gave correct identifications. The comparisons would also reveal whether those who identified the stimuli evaluated the environment differently to the other groups. This comparison could be carried out for the cut-grass odour, but it would not be possible for the sound because only one person correctly
identified the mower. Another way to explore how the ability to identify the sound/odour influenced the evaluations would involve using stimuli which are likely to be identified. In order to explore the role of identification and further test the two theories, the study described in Chapter 3 replicated Study 1 using a different sound and odour.
3. Study 2: The Effect of a Coffee Odour and Cafeteria Sound on Evaluations

To recap, the aim of the present thesis is to determine how people evaluate their surroundings. Specifically, the studies investigate the effect of changes in the environment on evaluations. The findings from Study 1 indicated that changes in the odour or sound environment affected the emotional responses experienced, although arousal was not directly measured. Evaluations of the extent to which the environment facilitated concentration were not influenced by the sound and odour manipulations (except for evaluations of the *Smell*). This chapter presents Study 2, which examines environmental evaluations made in the presence and absence of a cafeteria sound and/or coffee odour. The Introduction to this chapter first reviews the findings from Study 1 and briefly describes research on the ability to identify the cafeteria sound and coffee odour. Study 2 is then reported and the findings of this study confirmed that the coffee odour and the cafeteria sound were familiar and could be identified by the participants. Participants also considered the words from the related category to be more associated to both the cafeteria sound and the coffee odour, which demonstrated that the stimuli were correctly perceived. However, the evaluations of the environment were similar to the findings from Study 1. The similarity in the evaluations made across Study 1 and Study 2 suggests that the ability to identify the stimuli does not influence environmental evaluations. The ability to identify the stimuli also does not account for the differences in the way that the odour and the sound are perceived. The differences between the two studies in relation to the Mehrabian and Russell’s (1974), and Canter’s (1983) theories are discussed towards the end of the chapter.

3.1 Introduction

Study 1 showed that the presentation of the mower sound and the cut-grass odour led to changes in the emotional responses experienced, as measured by the Positive and Negative ratings on the Room Environment Questionnaire (REQ). Furthermore, the presentation of the stimuli did not change the evaluations of the extent to which the environment facilitated concentration (except in relation to the evaluation of the
Smell). Both findings are consistent with some of the elements from Mehrabian and Russell’s (1974), and Canter’s (1983) theories.

However the theories can not account for why the sound and the odour did not have similar effects on the evaluations. The presentation of the cut-grass odour influenced evaluations of most of the aspects of the environment whereas the mower sound only affected evaluations of the Noise. It is unknown whether this effect was because less people were able to identify the sound than the odour.

The mower sound and the cut-grass odour were used in Study 1 because they were easily obtainable and also the words from the Plant category had been used with the cut-grass odour in previous environmental studies. However in retrospect the identification results indicate that the participants did not easily identify these stimuli. The data from the ratings of the relationship between the words and the environment indicated that the words from the Plant category were not considered to be related to the mower sound. This confirms the findings from the identification task. Therefore it was decided to replicate Study 1 by using a sound and odour which were more likely to be identified. The stimuli consisted of recordings of background conversations within a cafeteria setting (cafeteria sound) and a coffee odour. The stimuli were chosen because they were easily obtainable and the words from the Kitchen were judged to be related with the stimuli at the exclusion of the other categories.

Previous research indicates that the cafeteria sound (human speech) and coffee odour can be easily identified. Cycowicz and Friedman (1998) found that over 90% of participants correctly identified human sounds which included speech and laughter. This is expected as people typically encounter these sounds in their everyday life. Grant, Bredhl, Clay, Ferrie, Groves, McDorman & Dark (1998) maintained that the cafeteria sound presented at a moderate level does not interfere with cognitive performance. Based on this research it was decided that the cafeteria sound was appropriate to be used in Study 2. Coffee odour is also documented as a commonly encountered odour (Degel & Koster, 1998). Moncrieff (1966) reported that the coffee odour was ranked at the top of the list in a table of 12 food odours listed in descending order of naming accuracy. The naming accuracy was 82% suggesting that the coffee
odour is relatively easy to identify. Research using electrophysiological measures of brain activity also suggests that the coffee odour is related to feelings of arousal (Kole, Snel & Lorist, 1998). If evaluations are based on feelings of arousal, then it is likely that the presentation of the coffee odour will affect the way that the environment is perceived.

One study that investigated the effects of a loud continuous white noise and coffee odour on the perceived sound level, comfort and health was conducted by Pan, Kjaergaard and Molhave (2003). Nine participants made their evaluations in a climate chamber. These evaluations were measured during exposures to the stimuli alone and in combination i.e. there were not control (or neutral) conditions. All measures were affected by the white noise and the coffee odour when they were presented alone. The findings also indicated that the addition of the noise reduced the perception of discomfort from the odour, whereas the addition of the coffee odour did not affect the discomfort from the noise. The results from this study are inconsistent with Mehrabian and Russell’s (1974) predictions and the findings from Study 1. A possible reason for the differences in the results between Study 1 and Pan et al’s (2003) study could be due to the odour used. Study 1 used a cut-grass odour whereas Pan et al (2003) used a coffee odour. As Study 2 uses the coffee odour, comparisons can be made between this and Pan et al’s (2003) study to determine the effects on sound and odour on evaluations.

So to summarise, the aim of Study 2 was to further examine how changes in the environment affected evaluations. Study 2 was designed to determine whether the effects of the mower sound and cut-grass odour in Study 1 was due to the inability to identify these stimuli. The same paradigm from Study 1 was used for Study 2 but the stimuli for the latter study consisted of a cafeteria sound and coffee odour. It was predicted that these stimuli would be easier to identify than those used in Study 1. This would be reflected by more correct identifications of the odour and sound during Study 2 in comparison to Study 1. Based on elements from Mehrabian and Russell’s (1974) theory, the Positive and Negative ratings of the REQ will be affected by the initial presentation of the stimuli. The evaluation of the environment when each stimulus is presented in isolation will be similar to evaluations made when the stimuli
are presented together. Consistent with elements from Canter's (1983) and the findings from Study 1, the manipulations of the sound and odour was predicted not to affect the extent to which the environment facilitates concentration, as measured by the Cognitive ratings on the REQ. This is because the tasks (or goals) carried out was the same across Study 2. When the stimuli are present, it was predicted that the environment would be more associated to the words from the related (Kitchen) category than the unrelated (remaining) categories. The predicted interaction between the manipulation of the sound and odour and the category on the word-environment ratings would demonstrate that the participants correctly perceived the stimuli.

3.2 Method

3.2.1. Participants and Design

Sixty-one (sixteen males) 1st year psychology undergraduate students of the University of Surrey participated as part of a lab class. The mean age was 20.9 years (range = 18 - 47 years). Participants were divided into four groups and the males were distributed equally to each group. Information about any health conditions that may affect their performance was collected and four participants reported having a cold or any other illnesses that may affect their olfactory abilities. No student reported any hearing difficulties.

The design was identical to the Study 1.

3.2.2. Environmental Manipulations and Evaluation Measures

The environmental manipulations consisted of the room in which the evaluation was made and the presentation of the stimuli. The rooms and evaluation measures were identical to those used in Study 1. The only difference between Study 1 and Study 2 was the environmental stimuli used. The environmental stimuli used in Study 2 consisted of a coffee odour and a cafeteria sound. The coffee odour had a sweet coffee-cream scent (i.e. as opposed to the strong black coffee scent). The odour was presented using the same method described in Study 1. The sound consisted of tape recordings of a university cafeteria during lunchtime. Care was taken to prevent complete conversations from being audible; thus the cafeteria recordings consisted of
a continuous conversational hum intermixed with sounds of moving chairs and dishes. The cafeteria sound was presented at that 40dBA using the same equipment as during Study 1.

3.2.3. Procedure
The first two conditions were conducted without the coffee odour and the latter two conditions were conducted in the presence of the odour. The procedure was identical to that used in Study 1, except that the coffee odour and the cafeteria sound was used instead of the cut-grass odour and the mower sound.

3.2.4. Data Analyses and Scoring Procedures
The ratings were analysed to determine how the environmental evaluations were influenced by the presence/absence of the coffee odour and/or the cafeteria sound. The design of the study allowed for pair-wise comparisons to be carried out between the conditions (neutral, neutral plus cafeteria sound, neutral plus coffee odour, and neutral plus cafeteria sound and coffee odour). As in Study 1, the main dependent measures were the identifications of the predominant sound and odour, the environmental ratings from the REQ and the ratings of the relationship between the words and the environmental sound and odour. The data analyses and the scoring procedures for the three main dependent measures were as follows:

3.2.4.1 Identifications
The initial tabulation of the identifications revealed that the odour and the sound were rarely correctly and consistently described as “coffee” or “cafeteria”. The identifications frequently consisted of combination of several different but appropriate words, or a combination of the correct word with extraneous information (e.g. “Coffee Cream Sweets” for “coffee”). Therefore it was necessary to develop a criterion for evaluating multiple identifications of the stimuli. A similar criterion for Study 1 was used for the identifications made during Study 2.

The corpus of odour identifications generated during the neutral plus odour, and the neutral plus odour and sound conditions was used to discover consistencies in the odour identifications. Similarly a corpus of sound identifications generated during the neutral plus sound, and the neutral plus sound and odour conditions was used to
discover consistencies in the sound identifications. The scoring criteria for identifications made during exposure to the coffee odour was based on the frequency of the identifications and whether the identification referred to the target odour source i.e. coffee. Frequent (e.g. “Coffee/Tea”) and non-modal (e.g. “Bailey’s”) identifications referring to the odour source were classified as correct identifications. The identifications that did not refer to the target odour source but smelled similar to the coffee odour (e.g. “Cinnamon”) were labelled as near-hits.

The tabulation of the identifications for the cafeteria sound revealed that a correct identification should include the element of a public eating area (e.g. “canteen”). This was because 20 unique identifications made reference to the element of a public eating area during the neutral plus sound condition. The identifications referring to the element of a public eating area were differentiated from identifications purely referring to a public area (e.g. “Market Place”). Although 17 unique identifications made reference to a public area during the neutral plus sound condition, these identifications were not classified as correct. Identifications referring to the element of a public eating area capture the target sound source whereas identifications purely referring to a public area are ambiguous and therefore could not be restricted to the target sound source. The identifications purely referring to a public area or other sources different from target sound source but sounding similar to the “cafeteria” sound were classified as near hits.

Other identifications were classified as correct when they fulfilled at least one of the following characteristics:

1. An obvious spelling mistake of the target stimuli (e.g. "cofee" for “coffee”).
2. A word or phrase containing the correct root word but with a different grammatical ending (e.g. “coffee chocolates” for “coffee chocolate”).
3. A correct identification with additional information (e.g. “Noisy Cafeteria Environment” for “cafeteria”).

The remaining identifications were classified as either a near hit or a miss. An identification was classified as incorrect (miss) when the identification fulfilled at least one of the following characteristics:
1. An inaccurate description of the stimuli (e.g. “Paper Rustling” for “cafeteria”).
2. Consisting only of an adjective word or phrase (e.g. “strong” or “loud”).
3. A broad, ambiguous or generalised description to the extent that it could be applied to a number of odours or sounds (e.g. “food” for “coffee” or “Eating” for “cafeteria”).

Four individuals, two of which were unaware of the purpose of the research, then independently sorted each identification into one of three categories corresponding to the stimuli. For the coffee odour, the categories were as follows (a) Odours associated with Coffee: (b) Odours associated with Sweetness e.g. Cinnamon: (c) Other. For the cafeteria sound, the categories were as follows: a) Sounds associated with Cafeteria/the element of a public eating area: (b) Sounds associated with a public area: (c) Other. A discussion was held with the sorters to settle any disagreements before using the agreed criteria to score the identifications.

The scoring criteria were then applied for the identifications made in all four conditions.

Multiple McNemar tests on the identifications were carried out as in Study 1.

3.2.4.2 Environmental Ratings
A mixed two-way (4 X 2) ANOVA was conducted to analyse the effect of the cafeteria sound and the coffee odour on the evaluations for each aspect of the environment: Temperature, Lighting, Spaciousness, Noise and Smell. The within-subject factor was the condition (neutral, neutral plus cafeteria sound, neutral plus coffee odour, and neutral plus cafeteria sound and coffee odour). The between-subject factor was the order in which the participants rated the two rooms. Follow-up analyses were similar to that used in Study 1.

3.2.4.3 Word-Environment Relationship Ratings
The mean rating of the word relatedness to the predominant sound and odour was obtained for each category in each condition. Again the analyses was similar to those used in Study 1.
3.3 Results

This section presents the results in the identical manner to the way that they were presented in Chapter 2.

3.3.1 Identifications

Multiple pair-wise comparisons using McNemar tests were carried out to test whether there were reliable differences in the correct (hits), borderline (near hits) or incorrect (misses) identifications between conditions. The findings pertaining to each stimulus (coffee odour and cafeteria sound) are presented separately.

3.3.1.1 Coffee Odour

The identifications given by more than one individual are listed in Table 3.1 with the most frequent identifications listed towards the top of the table. Table 3.2 shows the frequency of hits, near hits and misses in each condition for exposures to the coffee odour.

<table>
<thead>
<tr>
<th>Table 3.1: Frequency of Smell Identifications made in each condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
</tr>
<tr>
<td>Identifications* made by more than 1 person</td>
</tr>
<tr>
<td>Nothing</td>
</tr>
<tr>
<td>Neutral</td>
</tr>
<tr>
<td>No Response</td>
</tr>
<tr>
<td>Perfume</td>
</tr>
<tr>
<td>Stale</td>
</tr>
<tr>
<td>Unsure</td>
</tr>
<tr>
<td>Total Number of Unique Identifications = 40</td>
</tr>
</tbody>
</table>

*Italicised identifications were considered near hits.
Underlined identifications were considered as hits.
All other identifications were considered as misses.

Table 3.2 suggests that all correct odour identifications were made when the odour was present except for one identification in the neutral plus sound condition. No borderline identifications were made of the coffee odour during the odour-free conditions, which is to be expected as no odour was added between the neutral and the neutral plus sound conditions.
Table 3.2 Frequency of Hits, Near Hits and Misses in each condition for the Coffee Odour (N = 61)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Hits</th>
<th>Near Hits</th>
<th>Misses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>0</td>
<td>0</td>
<td>61</td>
</tr>
<tr>
<td>Neutral plus cafeteria sound</td>
<td>1</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>Neutral plus coffee odour</td>
<td>14</td>
<td>4</td>
<td>42</td>
</tr>
<tr>
<td>Neutral plus cafeteria sound and coffee odour</td>
<td>42</td>
<td>2</td>
<td>17</td>
</tr>
</tbody>
</table>

Using the McNemar tests, it was found that there were no reliable changes in the type of odour identifications made between the neutral and the neutral plus sound conditions. This was expected because there were no changes in the odour environment between these two conditions. The tests also revealed that there were no reliable changes in the type of odour identifications made between the neutral plus odour, and the neutral plus sound and odour conditions. This was also expected because there were no odour manipulations between these two conditions.

The McNemar test revealed that the changes in the odour environment affected the correct identifications made between the odour-free conditions and the odour conditions. Identifications in the miss category during the neutral ($\chi^2 (1) = 41.02, p<0.001$), and the neutral plus sound ($\chi^2 (1) = 40.02, p<0.001$) conditions showed a reliable tendency to move into the hit category during the neutral plus odour condition. Also identifications in the miss category during the neutral ($\chi^2 (1) = 40.02, p<0.001$), and the neutral plus sound ($\chi^2 (1) = 39.02, p<0.001$) conditions showed a reliable tendency to move into the hit category during the neutral plus sound and odour condition. These findings showed that the presentation of the coffee odour changed incorrect to correct identifications.

However, identifications in the miss category during the neutral, and the neutral plus sound conditions did not show a reliable tendency to move into the near hit category during the neutral plus odour condition ($\chi^2 (1) = 2.25, p>0.05$ for both comparisons). Similarly, identifications in the miss category during the neutral, and the neutral plus sound conditions did not show a reliable tendency to move into the near hit category during the neutral plus sound and odour condition ($\chi^2 (1) = 0.50, p>0.05$ for both
comparisons). This confirms the results shown in Table 3.2 where the introduction of the odour did not influence the number of borderline identifications made across the conditions as few of these identifications were made throughout Study 2.

3.3.1.2 Cafeteria sound

The sound identifications given by more than one individual are listed in Table 3.3 with the most frequent identifications listed towards the top of the table.

Table 3.3 Frequency of Sound Identifications made in each condition

<table>
<thead>
<tr>
<th>Condition</th>
<th>Identifications made by more than 1 person</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral plus cafeteria sound</td>
<td>Quiet</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Office</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Rustling Papers</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Exam</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Paper</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total Number of Unique Identifications</td>
<td>= 37</td>
</tr>
</tbody>
</table>

Table 3.4 shows the frequency of hits, near hits and misses in each condition for exposures to the cafeteria sound.

Table 3.4 Frequency of Hits, Near Hits and Misses in each condition for the Cafeteria Sound (N = 61)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Hits</th>
<th>Near Hits</th>
<th>Misses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral plus cafeteria sound</td>
<td>0</td>
<td>0</td>
<td>61</td>
</tr>
<tr>
<td>Neutral plus coffee odour</td>
<td>25</td>
<td>26</td>
<td>10</td>
</tr>
<tr>
<td>Neutral plus cafeteria sound and coffee odour</td>
<td>0</td>
<td>2</td>
<td>59</td>
</tr>
</tbody>
</table>

Table 3.4 suggests that overall more correct sound identifications were made when the sound was present than when the sound was absent. No correct identifications were
made during the silent conditions, which is to be expected as no sound was added during the neutral and the neutral plus odour conditions.

The McNemar tests revealed that there were no reliable changes in the type of sound identifications made between the neutral and the neutral plus odour conditions. This was expected because no sound was added during these two conditions. The tests also revealed that there were no reliable changes in the type of sound identifications made between the neutral plus sound, and the neutral plus sound and odour conditions indicating that the coffee odour did not change the type of sound identifications made.

The McNemar tests showed that the changes in the sound environment affected the identifications made between the sound conditions and the silent conditions. Specifically, identifications in the miss category during the neutral ($\chi^2 (1) = 23.04, p<0.05$), and the neutral plus odour ($\chi^2 (1) = 21.04, p<0.05$) conditions showed a reliable tendency to move into the hit category during the neutral plus sound condition. Also identifications in the miss category during the neutral, and the neutral plus odour conditions showed a reliable tendency to move into the hit category during the neutral plus sound and odour condition ($\chi^2 (1) = 26.04, p<0.05$ for both comparisons). These findings showed that the presentation of the cafeteria sound changed incorrect to correct identifications.

Identifications in the miss category during the neutral, and the neutral plus odour conditions showed a reliable tendency to move into the near hit category during the neutral plus sound condition ($\chi^2 (1) = 24.04, p<0.001$ for both comparisons). Also identifications in the miss category during the neutral ($\chi^2 (1) = 20.05, p<0.001$), and the neutral plus odour ($\chi^2 (1) = 16.41, p<0.001$) conditions showed a reliable tendency to move into the near hit category during the neutral plus sound and odour condition. This indicated that the cafeteria sound also changed the incorrect to borderline identifications.

In summary, most participants correctly identified the coffee odour and the cafeteria sound. These results contrast with the findings from Study 1 where relatively few correct identifications were made of the stimuli. This shows that the aim to use
stimuli that were more identifiable in Study 2 than in Study 1 was achieved. Fewer borderline identifications were made of the coffee odour than the cafeteria sound. The accuracy of the identifications made when the odour and the sound were presented in isolation was similar to the accuracy of the identifications made when the odour and the sound were presented in combination. This indicates that the identification of one stimulus was not aided by the addition of another stimulus. The next section will address how participants evaluate their environment in the presence and absence of the coffee odour and/or the cafeteria sound.

3.3.2. Environmental Rating
Recall from the Method section that Room B was slightly brighter and, on average, 2°C warmer than Room A. Room B was also slightly larger than Room A. Refer to the Method section for a detailed description of the analyses. The results pertaining to each aspect of the environment (Temperature, Lighting, Spaciousness, Noise and Smell) are presented separately.

3.3.2.1 Temperature
The mean environmental ratings of the Temperature across the conditions are listed in Table 3.5.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Condition</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutral</td>
<td>3.21</td>
<td>0.09</td>
<td>3.20</td>
<td>0.10</td>
<td>3.61</td>
<td>0.09</td>
<td>3.55</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound</td>
<td>3.52</td>
<td>0.11</td>
<td>3.57</td>
<td>0.11</td>
<td>3.06</td>
<td>0.14</td>
<td>3.17</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>Neutral plus coffee odour</td>
<td>1.98</td>
<td>0.12</td>
<td>1.88</td>
<td>0.11</td>
<td>2.35</td>
<td>0.14</td>
<td>2.28</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound and coffee odour</td>
<td>2.91</td>
<td>0.08</td>
<td>2.88</td>
<td>0.09</td>
<td>2.96</td>
<td>0.08</td>
<td>2.97</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*N=61* *N=61* *(N=56)*(N=60)

*Ratings ranged from 1 to 5*

3.3.2.1.1 Temperature: Intensity
There was a reliable main effect of condition on the Intensity ratings of the Temperature (F (3, 171) = 7.03, p<0.001). There was also a reliable main effect of
group on the Intensity ratings of the Temperature (F (1, 57) = 7.23, p<0.01). The interaction between the condition and the group was not reliable (F (3, 171) = 1.08, p>0.05). The analyses indicated that the presentation of the cafeteria sound and the coffee odour had similar effects for all groups on the heat experienced. Furthermore, the environments were considered to be warmer by one group than the other group. To further explore the main effect of condition, post hoc tests were carried out.

To illustrate the main effect of condition, the mean Intensity ratings of the Temperature for each condition collapsed across the groups are shown in Figure 3.1.

The post hoc tests revealed that both groups considered the environment to be warmer when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than during the neutral condition. Also both groups considered the environment to be warmer when only the coffee odour was presented than when only the cafeteria sound was presented. There were no reliable differences in the remaining comparisons. To illustrate the main effect of group, the mean
Intensity ratings of the *Temperature* across the groups collapsed across the conditions are shown in Figure 3.2.

The graph in Figure 3.2 shows that the environments were considered to be warmer for Group 2 than for Group 1. The reason for this difference is unknown. The results suggest that the cafeteria sound did not influence the evaluations of the heat experienced in the rooms. Rather, the presentation of the coffee odour caused the environment to be considered warmer than when the coffee odour was absent. These results are surprising because participants from Group 2 moved from Room B to the slightly cooler room (i.e. Room A) between the odour-free and the odour conditions. The findings also show that on average the environment was considered to be warmer by participants from Group 2 than those from Group 1.

![Figure 3.2. The Mean and Standard Error Intensity Ratings of the Temperature for each group](image-url)
3.3.2.1.2 Temperature: Positive

There was a reliable main effect of condition on the Positive ratings of the Temperature (F (3, 171) = 6.71, p<0.001), however the main effect of group on the Positive ratings of the Temperature was not reliable (F (1, 57) = 1.50, p>0.05). There was a reliable interaction between the condition and the group (F (3, 171) = 5.75, p<0.05), indicating that the presentation of the cafeteria sound and the coffee odour did not have similar effects on the evaluation of how pleasant the Temperature was across the conditions for both groups. The mean Positive ratings of the Temperature across the conditions for each group are illustrated in Figure 3.3.

![Figure 3.3](image)

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Positive ratings of the Temperature for Group 2 (F (3, 87) = 6.49, p<0.001). The effect of condition was not reliable for Group 1. The post hoc tests for Group 2 revealed that the Temperature was considered less pleasant when both the coffee odour and the cafeteria sound were presented than when only the cafeteria sound was presented and during the Neutral condition. The Temperature was also
considered less pleasant when only the coffee odour was presented than when only the cafeteria sound was presented and during the Neutral condition. There were no reliable differences in the remaining comparisons. The results suggest that for participants who moved from odour free room (Room A) to the odour room (Room B), the presentation of the cafeteria sound and the coffee odour did not influence the evaluations of pleasantness of the Temperature. However, for reasons unknown, the presentation of the coffee odour caused the remaining participants to consider the Temperature to be more unpleasant in the odour room (Room A) than the odour-free room (Room B). These findings are similar to the ones from Study 1 which suggests that the effect on the pleasantness of the Temperature is not unique to the coffee odour and the cafeteria sound.

3.3.2.1.3 Temperature: Negative
There was a reliable main effect of condition on the Negative ratings of the Temperature ($F(3, 171) = 6.86, p<0.001$). The main effect of group was not reliable ($F(1, 57) = 2.17, p>0.05$). The interaction between the condition and the group was also not reliable ($F(3, 171) = 1.21, p>0.05$), indicating that the presentation of the cafeteria sound and the coffee odour had similar effects on the extent to which the Temperature made participants feel sick for both groups. The mean Negative ratings of the Temperature in each condition collapsed across both groups are illustrated in Figure 3.4.

The post hoc tests revealed that the Temperature was considered to make participants feel more ill when both the cafeteria sound and the coffee odour were presented, and when only the coffee odour was presented than when only the cafeteria sound was presented. There were no reliable differences in the remaining comparisons. The results suggest that the cafeteria sound did not influence the extent to which the Temperature made participants feel sick. Although the results were not reliable concerning the comparisons between the neutral conditions and the conditions in the odour environments, the direction of the findings suggest that the coffee odour influenced the Negative ratings. Specifically, the presentation of the coffee odour caused the Temperature to make the participants feel more ill than when the coffee odour was absent.
3.3.2.1.4 Temperature: Cognitive

There were no reliable main effects on the Cognitive ratings of the Temperature (condition: F (3, 171) = 0.36, p>0.05, group: F (1, 57) = 2.58, p>0.05). The interaction between the condition and the group was also not reliable (F (3, 171) = 1.37, p>0.05). These results indicate that the presentation of the cafeteria sound and the coffee odour did not influence the extent to which the participants evaluated the Temperature as facilitating concentration.

3.3.2.2 Lighting

The mean environmental ratings of the Lighting across the conditions are listed in Table 3.6.
3.3.2.2.1 Lighting: Intensity

There were no reliable main effects on the Intensity ratings of the Lighting (condition: F (3, 171) = 1.55, p>0.05, group: F (1, 57) = 0.24, p>0.05). The interaction between the condition and the group was also not reliable (F (3, 171) = 2.58, p>0.05). These results indicated that the presentation of the cafeteria sound and the coffee odour did not affect evaluations of the brightness of the room for both groups.

3.3.2.2.2 Lighting: Positive

There were no reliable main effects on the Positive ratings of the Lighting (condition: F (3, 171) = 0.79, p>0.05, group: F (1, 57) = 0.68, p>0.05). The interaction between the condition and the group was reliable (F (3, 171) = 4.14, p<0.01), indicating that the groups’ evaluation of the pleasantness of the Lighting in the room was not similar across the conditions. The mean Positive ratings of the Lighting across the conditions for each group are illustrated in Figure 3.5.

The one-way related ANOVAs for each group revealed that there were no reliable effects of condition on the Positive ratings of the Lighting (Group 1: F (3, 84) = 2.35, p>0.05 and Group 2: F (3, 87) = 2.60, p>0.05). These results indicate that the presentation of the cafeteria sound and the coffee odour did not influence the participants’ evaluation of the pleasantness of the Lighting.
3.3.2.2.3 Lighting: Negative

There were no reliable main effects on the Negative ratings of the Lighting (condition: $F (3, 171) = 0.40, p>0.05$, group: $F (1, 57) = 0.25, p>0.05$). The interaction between the condition and the group was also not reliable ($F (3, 171) = 2.35, p>0.05$). These results indicated that the presentation of the cafeteria sound and the coffee odour did not affect the extent to which the participants evaluated the Lighting made them feel ill.

3.3.2.2.4 Lighting: Cognitive

There were no reliable main effects on the Cognitive ratings of the Lighting (condition: $F (3, 171) = 0.88, p>0.05$, group: $F (1, 57) = 2.63, p>0.05$). The interaction between the condition and the group was also not reliable ($F (3, 171) = 2.11, p>0.05$). These results indicate that the presentation of the cafeteria sound and the coffee odour did not influence the extent to which the Lighting was evaluated as facilitating concentration.
3.3.2.3 Spaciousness

The mean environmental ratings of the *Spaciousness* across the conditions are listed in Table 3.7.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Scale</th>
<th>Neutral</th>
<th>Neutral plus cafeteria sound</th>
<th>Neutral plus coffee odour</th>
<th>Neutral plus cafeteria sound and coffee odour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Error</td>
<td>Mean</td>
<td>Standard Error</td>
<td>Mean</td>
</tr>
<tr>
<td>Intensity</td>
<td>1.97</td>
<td>0.11</td>
<td>2.08</td>
<td>0.13</td>
<td>2.65</td>
</tr>
<tr>
<td>Positive</td>
<td>2.47</td>
<td>0.10</td>
<td>2.46</td>
<td>0.10</td>
<td>2.99</td>
</tr>
<tr>
<td>Negative</td>
<td>2.68</td>
<td>0.13</td>
<td>2.61</td>
<td>0.12</td>
<td>2.30</td>
</tr>
<tr>
<td>Cognitive</td>
<td>2.58</td>
<td>0.05</td>
<td>2.70</td>
<td>0.09</td>
<td>2.63</td>
</tr>
</tbody>
</table>

* Ratings ranged from 1 to 5

3.3.2.3.1 Spaciousness: Intensity

There was a reliable main effect of condition on the Intensity ratings of the *Spaciousness* ($F (3, 174) = 18.20, p<0.001$). The main effect of group was not reliable ($F (1, 58) = 0.06, p>0.05$). The interaction between the condition and the group was reliable ($F (3, 174) = 3.00, p<0.05$), indicating that the groups' evaluation of amount of space in the room was not similar across the conditions. The mean Intensity ratings of the *Spaciousness* across the conditions for each group are illustrated in Figure 3.6. The graph in Figure 3.6 suggests that although both groups showed an increase in Intensity ratings in the presence of the coffee odour, the increase between the Neutral plus Sound and the Neutral plus Odour conditions is larger for Group 1 than for Group 2.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Intensity ratings of the *Spaciousness* for both groups (Group 1: $F (3, 87) = 22.01, p<0.001$ and Group 2: $F (3, 87) = 4.37, p<0.01$). The post hoc tests for Group 1 revealed that the room was considered more spacious when both the cafeteria sound and the coffee odour were presented, and when only the coffee odour was presented than during the neutral condition. Group 1 also considered that the room was more spacious when both the cafeteria sound and the coffee odour were presented, and when only the coffee odour was presented than when only the cafeteria...
sound was present. However Group 2 only considered that the room was more spacious when only the coffee odour was presented than during the neutral condition. There were no reliable differences in the remaining comparisons.

![Figure 3.6. The Mean and Standard Error Intensity Ratings of the Spaciousness for each group across the four conditions](image)

The results suggest that the cafeteria sound did not influence the evaluations of how spacious the room was. For Group 1, the presentation of the coffee odour caused the environment to be considered more spacious than when the coffee odour was absent. Although the results were not reliable in all the comparisons between the odour-free and the odour conditions for Group 2, the direction of the findings suggest that the coffee odour influenced their ratings. These results are surprising because this group moved from Room B to the slightly smaller room (i.e. Room A) between the odour-free and the odour conditions. These findings are similar to the evaluations made during the cut-grass odour suggesting that the effect on the evaluation of space in the room is not unique to the coffee odour.
3.3.2.3.2 Spaciousness: Positive

There was a reliable main effect of condition on the Positive ratings of the Spaciousness (F (3, 174) = 12.93, p<0.001). The main effect of group was not reliable (F (1, 58) = 0.15, p>0.05). The interaction between the condition and the group was also not reliable (F (3, 174) = 2.55, p>0.05), indicating that the presentation of the cafeteria sound and the coffee odour had similar effects on the evaluation of how pleasant the space in the room was for both groups. The mean Positive ratings of the Spaciousness for each condition collapsed across both groups are illustrated in Figure 3.7.

The post hoc tests revealed that the Spaciousness of the room was considered more pleasant when both the cafeteria sound and the coffee odour were presented, and when only the coffee odour was presented than during the neutral condition. The space of the room was also considered more pleasant when both the cafeteria sound and the coffee odour were presented, and when only the coffee odour was presented than when only the cafeteria sound was presented. There were no reliable differences
in the remaining comparisons. The results suggest that the cafeteria sound did not influence the evaluations of how pleasant the space of the room was. Rather, the presentation of the coffee odour caused the space of the room to be considered more pleasant than when the odour was absent.

3.3.2.3.3 Spaciousness: Negative
There was a reliable main effect of condition on the Negative ratings of the Spaciousness ($F (3, 174) = 6.48, p<0.001$). The main effect of group was not reliable ($F (1, 58) = 0.09, p>0.05$). The interaction between the condition and the group was also not reliable ($F (3, 174) = 1.16, p>0.05$), indicating that the presentation of the cafeteria sound and the coffee odour had similar effects on the extent to which the Spaciousness made the participants feel ill for both groups. The mean Negative ratings of the Spaciousness for each conditions collapsed across both groups are illustrated in Figure 3.8.
The post hoc tests revealed that the space of the room was considered to make participants feel less ill when both the cafeteria sound and the coffee odour were presented, and when only the coffee odour was presented than during the neutral condition. There were no reliable differences in the remaining comparisons. The results suggest that the cafeteria sound did not influence the evaluations of the extent to which the Spaciousness made the participants feel ill. Although the results were not reliable in all the comparisons between the odour-free and the odour conditions, the direction of the findings suggest that the coffee odour influenced their ratings. The presentation of the coffee odour caused the space of the room to be considered as making the participants less ill than when the odour was absent.

3.3.2.3.4 Spaciousness: Cognitive
There was a reliable main effect of condition on Cognitive ratings of the Spaciousness (F (3, 174) = 3.49, p<0.05). There was also a reliable main effect of group on the Cognitive ratings of the Spaciousness (F (1, 58) = 4.53, p<0.05). The interaction between the condition and the group was not reliable (F (3, 174) = 0.48, p>0.05). The analyses indicated that the presentation of the cafeteria sound and the coffee odour had similar effects for both groups on the extent to which the Spaciousness was evaluated as facilitating concentration. Furthermore, the Spaciousness was evaluated as facilitating concentration more by one group than the other group. To further explore the main effect of condition, post hoc tests were carried out.

To illustrate the main effect of condition, the mean Cognitive ratings of the Spaciousness for each condition collapsed across the groups are shown in Figure 3.9. The post hoc tests revealed that both groups considered the space in the room to facilitate concentration more when only the coffee odour was presented than during the neutral condition. There were no reliable differences in the remaining comparisons.
To illustrate the main effect of group, the mean Cognitive ratings of the *Spaciousness* across the groups collapsed across the conditions are shown in Figure 3.10. The graph in Figure 3.10 shows that overall, the *Spaciousness* of the room was considered to facilitate concentration more for Group 1 than for Group 2. The reason for this difference is unknown. The results suggest that the cafeteria sound did not influence the extent to which the *Spaciousness* was evaluated as facilitating concentration. Rather, the presentation of the coffee odour caused the *Spaciousness* of the room to be considered to facilitate concentration more than when the coffee odour was absent. The findings also show that for unknown reasons the *Spaciousness* of the room was considered to facilitate concentration more for Group 1 than Group 2.
3.3.2.4 Noise

The mean environmental ratings of the Noise across the conditions are listed in Table 3.8.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Neutral</th>
<th>Neutral plus cafeteria sound</th>
<th>Neutral plus coffee odour</th>
<th>Neutral plus cafeteria sound and coffee odour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean and Standard Error</td>
<td>Mean and Standard Error</td>
<td>Mean and Standard Error</td>
<td>Mean and Standard Error</td>
</tr>
<tr>
<td>Intensity</td>
<td>1.02 ± 0.12</td>
<td>3.23 ± 0.10</td>
<td>2.18 ± 0.12</td>
<td>3.25 ± 0.11</td>
</tr>
<tr>
<td>Positive</td>
<td>3.25 ± 0.10</td>
<td>2.93 ± 0.10</td>
<td>3.27 ± 0.10</td>
<td>2.97 ± 0.10</td>
</tr>
<tr>
<td>Negative</td>
<td>1.89 ± 0.10</td>
<td>1.90 ± 0.10</td>
<td>1.80 ± 0.11</td>
<td>2.07 ± 0.13</td>
</tr>
<tr>
<td>Cognitive</td>
<td>3.12 ± 0.11</td>
<td>3.16 ± 0.06</td>
<td>3.03 ± 0.10</td>
<td>3.11 ± 0.09</td>
</tr>
<tr>
<td>(N=61)</td>
<td>(N=61)</td>
<td>(N=60)</td>
<td>(N=60)</td>
<td></td>
</tr>
</tbody>
</table>

*Ratings ranged from 1 to 5

3.3.2.4.1 Noise: Intensity

There was a reliable main effect of condition on Intensity ratings of the Noise ($F(3,174) = 58.09, p<0.001$). The main effect of group was not reliable ($F(1, 58) = 0.53$, $p=0.47$).
The interaction between the condition and the group was reliable \( (F (3, 174) = 3.00, p < 0.05) \), indicating that the presentation of the cafeteria sound and the coffee odour did not have similar effects on the evaluation of the loudness in the room for both groups. The mean Intensity ratings of the *Noise* for each group across the conditions are illustrated in Figure 3.11.

![Figure 3.11. The Mean and Standard Error Intensity Ratings of the Noise for each group across the conditions](image)

The graph in Figure 3.11 suggests that although both groups showed an increase in Intensity ratings in the presence of the cafeteria sound, the increase between the Neutral plus Odour and the Neutral plus Sound and Odour condition is smaller for Group 2 than for Group 1.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Intensity ratings of the *Noise* for both groups (Group 1: \( F (3, 87) = 42.21, p < 0.001 \) and Group 2: \( F (3, 87) = 19.84, p < 0.001 \)). The post hoc tests revealed that for both groups, the *Noise* was considered louder when both the coffee odour and the cafeteria sound were presented, and when only the cafeteria sound was presented than during the neutral condition. Also the *Noise* was considered louder when both the...
coffee odour and the cafeteria sound were presented, and when only the cafeteria sound was presented than when only the coffee odour was presented. There were no reliable differences in the remaining comparisons. The results suggest that the presentation of the coffee odour did not influence the loudness of the Noise. The presentation of the cafeteria sound caused participants to evaluate the Noise to be louder than when the cafeteria sound was absent.

3.3.2.4.2 Noise: Positive

There was a reliable main effect of condition on the Positive ratings of the Noise ($F(3, 174) = 3.70, p<0.05$). The main effect of group was not reliable ($F(1, 58) = 0.10, p>0.05$). The interaction between the condition and the group was also not reliable ($F(3, 174) = 0.72, p>0.05$), indicating that the presentation of the cafeteria sound and the coffee odour had similar effects on the evaluation of how pleasant the Noise in the room was for both groups. The mean Positive ratings of the Noise for each conditions collapsed across both groups are illustrated in Figure 3.12.

The graph in Figure 3.12 suggests that the Noise was considered to be less pleasant when the cafeteria sound was presented than when the sound was absent. However the post hoc tests did not reveal a reliable difference in any of the pair-wise comparisons between the conditions. The results suggest that the cafeteria sound and the coffee odour did not influence evaluations of the pleasantness of the Noise in the room.

3.3.2.4.3 Noise: Negative

There were no reliable main effects on the Negative ratings of the Noise (condition: $F(3, 174) = 1.72, p>0.05$, group: $F(1, 58) = 0.11, p>0.05$). The interaction between the condition and the group was also not reliable ($F(3, 174) = 0.84, p>0.05$). These results indicated that the presentation of the cafeteria sound and the coffee odour did not affect the extent to which the participants evaluated the Noise made them feel ill.
3.3.2.4.4 Noise: Cognitive

There were no reliable main effects on the Cognitive ratings of the Noise (condition: $F(3, 174) = 0.49, p>0.05$, group: $F(1, 58) = 2.76, p>0.05$). The interaction between the condition and the group was reliable ($F(3, 174) = 3.23, p<0.05$), indicating that the presentation of the cafeteria sound and the coffee odour did not have similar effects on the extent to which the Noise in the room was considered to facilitate concentration for both groups. The mean Cognitive ratings of the Noise for each group across the conditions are illustrated in Figure 3.13.

The one-way related ANOVAs for each group revealed that there was a reliable effect of condition on the Cognitive ratings of the Noise for Group 2 ($F(3, 87) = 3.22, p<0.05$). The effect of condition was not reliable for Group 1. The post hoc tests for Group 2 did not reveal a reliable difference in any of the pair-wise comparisons between the conditions. The results suggest that the cafeteria sound and the coffee odour did not influence the extent to which the Noise in the room was considered to facilitate concentration.
3.3.2.5 **Smell**

The mean environmental ratings of the *Smell* across the conditions are listed in Table 3.9.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Condition</th>
<th>Mean</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Neutral</td>
<td>2.08</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound</td>
<td>2.23</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Neutral plus coffee odour</td>
<td>4.23</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound and coffee odour</td>
<td>4.03</td>
<td>0.10</td>
</tr>
<tr>
<td>Intensity</td>
<td>Neutral</td>
<td>3.42</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound</td>
<td>3.32</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Neutral plus coffee odour</td>
<td>2.93</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound and coffee odour</td>
<td>2.08</td>
<td>0.14</td>
</tr>
<tr>
<td>Positive</td>
<td>Neutral</td>
<td>3.67</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound</td>
<td>1.80</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>Neutral plus coffee odour</td>
<td>2.65</td>
<td>0.17</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound and coffee odour</td>
<td>2.70</td>
<td>0.16</td>
</tr>
<tr>
<td>Negative</td>
<td>Neutral</td>
<td>2.66</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound</td>
<td>2.76</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>Neutral plus coffee odour</td>
<td>3.09</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Neutral plus cafeteria sound and coffee odour</td>
<td>3.16</td>
<td>0.00</td>
</tr>
</tbody>
</table>

*Ratings ranged from 1 to 5*
3.3.2.5.1 *Smell*: Intensity

There was a reliable main effect of condition on the Intensity ratings of the *Smell* ($F(3, 174) = 162.40, p<0.001$). The main effect of group was not reliable ($F(1, 58) = 0.00, p>0.05$). The interaction between the condition and the group was also not reliable ($F(3, 174) = 0.62, p>0.05$), indicating that the presentation of the cafeteria sound and the coffee odour had similar effects on the evaluation of the strength of the *Smell* in the room for both groups. The mean the Intensity ratings of the *Smell* for each condition collapsed across both groups are illustrated in Figure 3.14.

![Figure 3.14. The Mean and Standard Error Intensity Ratings of the Smell for each condition.*](image)

The post hoc tests revealed that the *Smell* was considered to be stronger when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than during the neutral condition. The *Smell* was also considered to be stronger when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than when only the cafeteria sound was presented. There were no reliable differences in the remaining comparisons. These results suggest that the presentation of the cafeteria sound did not influence the strength of the *Smell*. Rather, the presentation of the coffee odour caused the
participants to evaluate the Smell to be stronger than when the coffee odour was absent.

3.3.2.5.2  Smell: Positive

There was a reliable main effect of condition on the Positive ratings of the Smell ($F (3, 174) = 7.72, p<0.001$). There was also a reliable main effect of group on the the Positive ratings of the Smell ($F (1, 58) = 4.88, p<0.05$). The interaction between the condition and the group was not reliable ($F (3, 174) = 1.18, p>0.05$). The analyses indicated that the presentation of the cafeteria sound and the coffee odour had similar effects for both groups on the evaluations of the pleasantness of the Smell. Furthermore, the Smell was evaluated as being more pleasant by one group than the other group. To further explore the main effect of condition, post hoc tests were carried out.

To illustrate the main effect of condition, the mean Positive ratings of the Smell for each condition collapsed across the groups are shown in Figure 3.15.

The post hoc tests revealed that the Smell was considered to be less pleasant when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than during the neutral condition. The Smell was also considered to be less pleasant when only the coffee odour was presented than during the neutral condition. There were no reliable differences in the remaining comparisons.

To illustrate the main effect of group, the mean Positive ratings of the Smell for each group collapsed across the conditions are shown in Figure 3.16.
The graph in Figure 3.16 shows that overall, the *Smell* was considered to be more pleasant for Group 1 than for Group 2. The reason for this difference is unknown. The results suggest that the cafeteria sound did not influence evaluations of the pleasantness of the *Smell*. Although the results were not reliable in all the comparisons between the odour-free and the odour conditions, the direction of the findings suggest that the coffee odour influenced these ratings. The presentation of the coffee odour caused the *Smell* to be evaluated as being less pleasant than when the coffee odour was absent. The findings also show that for unknown reasons the *Smell* was considered to more pleasant for Group 1 than Group 2.
There was a reliable main effect of condition on the Negative ratings of the Smell (F(3, 174) = 31.36, p<0.001). The main effect of group was not reliable (F(1, 58) = 0.32, p>0.05). The interaction between the condition and the group approached reliability (F(3, 174) = 2.56, p=0.06), indicating that the presentation of the cafeteria sound and the coffee odour had similar effects on the groups' evaluation of the extent to which the Smell made the participants feel ill. The mean Negative ratings of the Smell for each conditions collapsed across both groups are illustrated in Figure 3.17.

The post hoc tests revealed that Smell was evaluated to make the participants feel more ill when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than during the neutral condition. The Smell was also evaluated to make the participants feel more ill when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than when only the cafeteria sound was presented. There were no reliable differences in the remaining comparisons. These results suggest that the presentation of the
cafeteria sound did not influence evaluations of the extent to which the Smell made
the participants feel ill. The presentation of the coffee odour caused the participants
to evaluate the Smell as making them feel more ill than when the coffee odour was
absent.

![Figure 3.17. The Mean and Standard Error Negative Ratings of the Smell for each condition*](image)

Figure 3.17. The Mean and Standard Error Negative Ratings of the Smell for each condition*

3.3.2.5.4 Smell: Cognitive

There was a reliable main effect of condition on the Cognitive ratings of the Smell (F
(3, 174) = 11.09, p<0.001). There was also a reliable main effect of group on the
Cognitive ratings of the Smell (F (1, 58) = 5.81, p<0.05). The interaction between the
condition and the group was not reliable (F (3, 174) = 0.81, p>0.05). The analyses
indicated that the presentation of the cafeteria sound and the coffee odour had similar
effects for both groups on the extent to which the Smell in the room was considered to
facilitate concentration. Furthermore, one group evaluated that the Smell facilitated
concentration more than the other one.

To illustrate the main effect of condition, the mean Cognitive ratings of the Smell for
each condition collapsed across the groups are shown in Figure 3.18.
The post hoc tests revealed that the Smell was considered to facilitate concentration more when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than during the neutral condition. The Smell was also considered to facilitate concentration more when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than when only the cafeteria sound was presented. There were no reliable differences in the remaining comparisons.

To illustrate the main effect of group, the mean Cognitive ratings of the Smell for each group collapsed across the conditions are shown in Figure 3.19.
The graph in Figure 3.19 shows that that the Smell was considered to facilitate concentration less for Group 2 than for Group 1. The reason for this difference is unknown. These findings indicate that the evaluation of the potential of Smell to enhance concentration was influenced by the coffee odour and not by the cafeteria sound. Furthermore, the Smell was considered to facilitate concentration more for participants who moved from Room A to Room B than for those who moved from Room B to Room A. These findings are similar to the evaluations made during the cut-grass odour, which suggests that the effect on the extent to which the Smell considered to facilitate concentration is not unique to the coffee odour.

Overall, these findings are similar to those of the evaluations made during the presence/absence of the cut-grass odour and/or the mower sound. Specifically, the presentation of the coffee odour influenced the evaluation of the Temperature, Spaciousness and the Smell in the room. However the presentation of the cafeteria sound only influenced the evaluation of the Noise.
3.3.3. **Word-Environment Relationship Ratings**

The results pertaining to each environmental stimulus (predominant smell and noise) are presented separately.

3.3.3.1. **Mean Ratings of the Words’ relatedness to the Predominant Smell**

The mean ratings of the relationship between the word and the predominant smell in each category across the conditions are listed in Table 3.10.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Neutral</th>
<th>Neutral plus cafeteria sound</th>
<th>Neutral plus coffee odour</th>
<th>Neutral plus cafeteria sound and coffee odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Bedroom</td>
<td>4.83a</td>
<td>0.50</td>
<td>4.61a</td>
<td>0.54</td>
</tr>
<tr>
<td>Car</td>
<td>4.85c</td>
<td>0.35</td>
<td>4.84b</td>
<td>0.45</td>
</tr>
<tr>
<td>Cooking</td>
<td>4.39c</td>
<td>0.37</td>
<td>4.72b</td>
<td>0.54</td>
</tr>
<tr>
<td>Health</td>
<td>4.39c</td>
<td>0.81</td>
<td>4.38a</td>
<td>0.74</td>
</tr>
<tr>
<td>Kitchen</td>
<td>4.39ac</td>
<td>0.30</td>
<td>4.55bc</td>
<td>0.68</td>
</tr>
<tr>
<td>Plant</td>
<td>4.57b</td>
<td>0.65</td>
<td>4.74b</td>
<td>0.40</td>
</tr>
<tr>
<td>Reading</td>
<td>4.50b</td>
<td>0.68</td>
<td>4.62b</td>
<td>0.43</td>
</tr>
<tr>
<td>seaside</td>
<td>4.67c</td>
<td>0.63</td>
<td>4.74c</td>
<td>0.66</td>
</tr>
</tbody>
</table>

* Ratings ranged from 1 (the predominant smell is very closely related to the word), to 5 (the predominant smell is not at all related not the word)

Means within each category, which have the same letter are not reliably different from each other (p>0.05)

Means within each category, which have a different letter are reliably different from each other (p<0.05)

There was a reliable main effect of condition on mean ratings of the relationship between the word and the predominant smell (F (3, 1197) = 4.66, p<0.005). The main effect of the category on these ratings was also reliable (F (7, 1197) = 17.40, p<0.001). There was a reliable interaction between the condition and the category (F (21, 1197) = 6.86, p<0.001), indicating that the categories were not rated similarly across the conditions.

The follow up one-way related ANOVA tests revealed that the effect of condition on the ratings from the related category (i.e. Kitchen) was reliable (F (3, 171) = 4.24, p<0.01). The post hoc tests revealed that the words from the Kitchen category were considered more related to the predominant smell when both the coffee odour and the
cafeína sound was presented than during the neutral condition. There were no reliable differences in the remaining comparisons.

The follow up one-way related ANOVA tests revealed that the effect of condition on the ratings from the unrelated categories was mixed. The effect of condition on the ratings from the Car, Plant, and Seaside categories was not reliable. This indicated that the relationship between the words from these categories and the predominant smell was rated similarly across the conditions.

There was a reliable effect of condition on the ratings from the remaining four unrelated categories (Bedroom: $F(3, 171) = 11.58, p<0.001$, Cooking: $F(3, 174) = 3.20, p<0.05$, Health: $F(3, 174) = 8.65, p<0.001$ and Reading: $F(3, 171) = 13.40, p<0.001$). The post hoc tests revealed that the words from the Bedroom, Health and Reading categories were considered less related to the predominant smell when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than during the neutral condition. Furthermore, the words from these categories were considered less related to the predominant smell when both the coffee odour and the cafeteria sound were presented, and when only the coffee odour was presented than when the only cafeteria sound was presented. The post hoc tests also revealed that the words from the Cooking category were considered more related to the predominant smell when both the coffee odour and the cafeteria sound were presented than during the neutral condition. There were no reliable differences in the remaining comparisons.

3.3.3.2. Mean Ratings of the Words' relatedness to the Predominant Noise

The mean ratings given for each category across the conditions are listed in Table 3.11.

There was a reliable main effect of condition on the ratings of the relationship between the words and the predominant noise ($F(3, 1197) = 11.82, p<0.001$). The main effect of the category on the ratings was also reliable ($F(7, 1197) = 14.08, p<0.001$). There was a reliable interaction between the condition and the category ($F(21, 1197) = 8.64, p<0.001$), indicating that the categories were not rated similarly across the conditions.
The follow up one-way related ANOVA tests revealed that the effect of condition on the ratings from the related category (i.e. Kitchen) was reliable ($F(3, 174) = 24.30$, $p<0.001$). The post hoc tests revealed that the words from the Kitchen category were considered more related to the predominant noise when both the coffee odour and the cafeteria sound were presented, and when only the cafeteria sound was presented than during the neutral condition. Also the words from the Kitchen category were considered more related to the predominant noise when both the coffee odour and the cafeteria sound was presented, and when only the cafeteria sound was presented than when the only coffee odour was presented. There were no reliable differences in the remaining comparisons.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Category</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>Bedroom</td>
<td>4.61b</td>
<td>0.70</td>
</tr>
<tr>
<td>Neutral</td>
<td>Car</td>
<td>4.84ac</td>
<td>0.46</td>
</tr>
<tr>
<td>Neutral</td>
<td>Cooking</td>
<td>4.61ac</td>
<td>0.60</td>
</tr>
<tr>
<td>Neutral</td>
<td>Health</td>
<td>4.50bc</td>
<td>0.81</td>
</tr>
<tr>
<td>Neutral</td>
<td>Kitchen</td>
<td>4.76b</td>
<td>0.40</td>
</tr>
<tr>
<td>Neutral</td>
<td>Plant</td>
<td>4.72b</td>
<td>0.54</td>
</tr>
<tr>
<td>Neutral</td>
<td>Reading</td>
<td>4.13b</td>
<td>1.03</td>
</tr>
<tr>
<td>Neutral</td>
<td>Seaside</td>
<td>4.30bc</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Mean Rating in each Condition:

- Neutral: 4.64 (N=60/61)
- Neutral plus cafeteria sound: 4.48 (N=60/61)
- Neutral plus coffee odour: 4.48 (N=59/58)
- Neutral plus cafeteria sound and coffee odour: 4.47 (N=60)

*Ratings ranged from 1 (the predominant noise is very closely related to the word), to 5 (the predominant noise is not at all related not the word)

Means within each category, which have the same letter are not reliably different from each other ($p>0.05$).

Means within each category, which have a different letter are reliably different from each other ($p<0.05$).

The ANOVA revealed mixed effects of condition on the word ratings from the unrelated categories. The effect of condition on the ratings from the Plant category was not reliable indicating that the relationship between the words from this category and the predominant noise was rated similarly across the conditions.
There was a reliable effect of condition on the ratings for the Bedroom and Reading categories ($F(3, 171) = 6.90, p<0.001$ and $F(3, 174) = 8.63, p<0.001$ respectively). The post hoc tests revealed that the words from these categories were considered less related to the predominant noise when both the coffee odour and the cafeteria sound were presented, and when only the cafeteria sound was presented and than during the neutral condition. There were no reliable differences in the remaining comparisons.

There was also a reliable effect of condition on the ratings from the remaining four unrelated categories (Car: $F(3, 171) = 4.83, p<0.005$, Cooking: $F(3, 174) = 7.93, p<0.001$, Health: $F(3, 171) = 3.12, p<0.05$ and Seaside: $F(3, 174) = 8.00, p<0.001$). Interestingly, the post hoc tests revealed that the words from these categories were considered more related to the predominant noise when both the coffee odour and the cafeteria sound were presented than during the neutral condition. The words from the Car, Cooking and Seaside categories were also rated as being reliably more related to the predominant noise when only the cafeteria sound was presented than when only the coffee odour was presented. The words from the Seaside category were also rated as being reliably more related to the predominant noise when both the coffee odour and the cafeteria sound were presented than when only the coffee odour was presented. There were no reliable differences in the remaining comparisons.

To recap, the results from both Study 1 and Study 2 are summarised in Table 3.12
Table 3.12 Summary of the Effects of the odour and sound on the Identification Accuracy, Environmental Evaluations and Word-Environment Relationship Ratings during Study 1 and Study 2.

<table>
<thead>
<tr>
<th>Identification Accuracy</th>
<th>STUDY 1: Mower Sound and Cut-Grass Odour</th>
<th>STUDY 2: Cafeteria Sound and Coffee Odour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of Correct Odour Identifications</td>
<td>Up to 38%</td>
<td>Up to 70%</td>
</tr>
<tr>
<td>Percentage of Correct Sound Identifications</td>
<td>Up to 2%</td>
<td>Up to 46%</td>
</tr>
<tr>
<td><strong>Environmental Evaluation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Temperature</strong></td>
<td>Intensity</td>
<td>Odour caused participants from Group 1 to consider room as cooler.</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Odour caused participants from Group 2 to consider Temperature as being less pleasant.</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>Odour caused participants from Group 2 to consider Temperature as making them feel more ill.</td>
</tr>
<tr>
<td></td>
<td>Cognitive</td>
<td>No effect</td>
</tr>
<tr>
<td><strong>Lighting</strong></td>
<td>Intensity</td>
<td>Odour caused participants from Group 1 to consider room as being darker.</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td>Cognitive</td>
<td>No effect</td>
</tr>
<tr>
<td><strong>Spaciousness</strong></td>
<td>Intensity</td>
<td>Odour caused all participants to consider room as being more spacious.</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Sound and odour combined caused all participants to consider Spaciousness as being more pleasant.</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td>Cognitive</td>
<td>No effect</td>
</tr>
<tr>
<td><strong>Noise</strong></td>
<td>Intensity</td>
<td>Sound caused all participants to consider Noise as being louder.</td>
</tr>
<tr>
<td></td>
<td>Positive</td>
<td>Sound caused all participants to consider Noise as being less pleasant. Sound and Odour combined and separately caused participants from Group 2 to consider Noise as less pleasant.</td>
</tr>
<tr>
<td>Environmental Evaluation</td>
<td>Noise</td>
<td>Negative</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive</td>
</tr>
<tr>
<td></td>
<td>Smell</td>
<td>Intensity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cognitive</td>
</tr>
</tbody>
</table>

**Word-Environment Relationship Evaluation**

<table>
<thead>
<tr>
<th>Relationship to the predominant smell</th>
<th>Plant</th>
<th>Kitchen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seaside</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kitchen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedroom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relationship to the predominant noise</th>
<th>Car</th>
<th>Seaside</th>
<th>Kitchen</th>
<th>Cooking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Related category.
Unrelated category

Categories are listed according to the participants ratings of the word-environment relationship with the categories considered most related to the ambient environment listed towards the top of the table.

Presentation of the sound and/or odour caused the words from a category to be considered as being:

- More related to the ambient environment
- Less related to the ambient environment

Other observations included:

- Mixed effect on the word-environment relationship
- No effect on the word-environment relationship
3.4 Discussion

Study 2 was designed to further examine how changes in the environment affected evaluations. Study 2 also served to determine whether the effect of the sound and odour on evaluations in Study 1 was due to the inability to identify these stimuli. A cafeteria sound and coffee odour was used in Study 2 instead of the mower sound and the cut-grass odour. The cafeteria sound and coffee odour was used because previous research indicated that these stimuli are commonly encountered and could be easily identified (Cycowicz & Friedman, 1998; Degel & Koster, 1998; Moncrieff, 1966, Grant, Bredhl, Clay, Ferrie, Groves, McDorman & Dark, 1998). The results from the identification tasks were consistent with previous research. Up to 70% of participants correctly identified the coffee odour and approximately half of all participants correctly identified the cafeteria sound. This is an improvement to Study 1 where only a third of participants correctly identified the cut-grass odour and the mower was rarely identified. This demonstrated that the aim to use stimuli which could be easily identified was achieved.

With respect to the evaluation results, the effects of the exposure to both stimuli simultaneously are consistent with the findings from Study 1 and some of the predictions derived from Mehrabian and Russell’s (1974) theory. However the results contrast with those from Pan, Kjaergaard and Molhave’s (2003) study who found different evaluations when the sound and the odour was presented in combination compared to when they were presented separately.

One reason for the difference is due to the methodology used in the studies. In Pan et al’s (2003) study, participants were exposed to sounds at an average level of 75dB for 80 minutes in a chamber whereas participants in Study 2 were exposed to sound levels of 40dB for 10 minutes in a classroom. Recall that this thesis focuses on the type of evaluations made during the initial exposures to an environment. Hence it was deemed unnecessary to expose participants to sounds and odour for long periods. Also for practical reasons, the study was carried out in a classroom rather than a chamber. The testing environment is more likely to replicate real life settings in the studies reported in this thesis than in studies where chambers are evaluated. Other differences between the two studies were that Study 2 included a condition where the sound and the odour were both absent whereas Pan et al’s (2003) study did not
include a control condition. Hence Pan et al.’s (2003) study did not have a baseline with which to compare the responses to the changes in the environment. Also Pan et al.’s (2003) study only used nine participants, which limits the power of the study, whereas Study 2 used over sixty participants.

Study 2 revealed that the cafeteria sound did not influence any evaluations other than the perceived loudness of the noise. This contrasts with the findings from Study 1 where the mower sound influenced the Positive and Negative ratings of the Noise in the environment. Mehrabian and Russell’s (1974), and Canter’s (1983) theories do not adequately explain why the ability to identify the sound should influence environmental evaluations.

It could be argued that the participants were not sensitive to the presentation of the cafeteria sound whereas they were aware of the presence of the mower sound. This is unlikely since the analyses revealed that there was a reliable increase in the ratings of the Intensity of the Noise (perceived loudness) when the cafeteria sound was presented. Evidence for participants’ sensitivity of the presence of the cafeteria sound would not be observed if only Mehrabian and Russell’s (1974) and/or Canter’s (1983) Scales were used. Furthermore this evidence would not be found if the Room Environment Questionnaire (REQ) only included aspects relating to their theory (Positive, Negative and Cognitive components). This demonstrates the advantage of including an additional component (Intensity) to monitor participants’ awareness of any changes in the strength of each environmental aspect.

The manipulation of the coffee odour influenced not only evaluations of the Smell with respect to the emotional component but also the Temperature and the Spaciousness. This is similar to the effect of the cut-grass odour in Study 1. The ability to identify the stimuli can not account for this because the differential effect on evaluations of the sound and the odour was observed regardless of whether or not the participants could identify the stimuli. The theories do not account for why the presentation of the odour affected these aspects of the environment whereas the presentation of the sound only affected the evaluation of the Noise in the environment. The inherent differences between the sensory modalities may account for the differential effect on evaluations of the sound and the odour.
In contrast to Study 1, the coffee odour influenced the extent to which the Spaciousness and the Smell was considered to facilitate concentration. The coffee odour was believed to increase concentration. This negates the predictions derived from Canter's (1983) theory that were explored in this thesis. Recall that according to Canter (1983), evaluations are unlikely to be influenced by the changes in the environment unless the goals are changed simultaneously. Study 2 showed that although the goals were kept constant across the conditions, the presentation of the coffee odour led to changes in the evaluations of the extent to which the environment facilitated concentration. Canter's (1983) theory does not account for why the evaluations would be a function of the type of odour.

The presentation of the coffee odour led to more unfavourable evaluations of the environment for those in Group 2 than those in Group 1. For example, the presence of the coffee odour led to the Smell being considered as less pleasant for participants who moved from Room B to Room A than those who moved from Room A to Room B. Similarly, the Spaciousness and the Smell was considered to hinder concentration more for participants who moved from Room B to Room A than those who moved from Room A to Room B. The differences in these evaluations can not be accounted for by the differences in the odour concentration because the results revealed that the perceived strength of the odour was similar across both groups. These findings are similar to those from Study 1, which demonstrates consistency in carrying out the procedures across the two studies. Nevertheless, the reasons for the differences between the groups remain unknown.

The results from the ratings of the relationship between the words and the environment lend support to the fact that the stimuli were correctly perceived. In general, the results were consistent with previous research as the hypothesised interaction was observed between the categories and the presentation of the stimuli. Words from the related (Kitchen) category were considered to be associated with the cafeteria sound and the coffee odour.

The results regarding the relationship between the environment and the words from the unrelated category were less clear cut for the sound than the odour. The words
from all the unrelated categories (except for the Cooking category) were considered not to be related to the coffee odour. However, similar to the mower sound, words from some of the unrelated categories (Car, Cooking, Health and Seaside) were considered to be associated with the cafeteria sound. The words from the remaining unrelated categories (Bedroom, Plant and Reading) were considered not to be related to the cafeteria sound.

Although there were some similarities between the findings from the ratings of the relationship between the words and the sounds for both the mower and the cafeteria sound, there remains one key difference between the two studies presented in this thesis. The words from the related category (i.e. Kitchen) were considered to be associated with the cafeteria sound whereas the words from the related category (i.e. Plant) in Study 1 were not considered to be associated with the mower sound. This supports the predictions made earlier that when a stimulus can be identified, then it is more likely to be considered to be associated with related words. A way to further test this would involve analysing the ratings from those who had correctly identified the cafeteria sound and comparing this with the analysis of the ratings from those who did not correctly identify the cafeteria sound. It would be predicted that the analyses of the ratings from those who correctly identified the cafeteria sound would clearly show the hypothesised interaction between the categories and the presentation of the stimuli. The analyses from the remaining participants would not show this interaction.

The final chapter considers the two theories in light of the findings from both Study 1 and 2 and suggests implications for further research.
4. General Discussion

It was identified earlier in the thesis that there has been a lack of integration between theory and empirical findings within the area of evaluation research (Sundstrom, Bell, Busby, & Asmus, 1996; Stokols, 1978). The purpose of this thesis was to begin to address this issue by using two theories (The Emotional Response to the Environment (Mehrabian & Russell, 1974); The Purposive Evaluation of Places (Canter, 1983)) to examine how people evaluate their surroundings, particularly the built environment. In the studies reported in this thesis, theoretical and empirical derived methods were used to determine how evaluations are affected when the environmental sound and odour are manipulated. These studies provided a systematic examination of some of the predictions from the two theories. This chapter considers each theory separately in light of the other theories and the findings described in this thesis.

4.1 Emotional (Affective) Response to the Environment (Mehrabian & Russell, 1974)

Mehrabian and Russell (1974) proposed that the environment generates emotional (pleasure, arousal and dominance) responses. One hypothesis derived from the theory is that changes in evaluations are due to changes in the emotional responses elicited from the environment. This was supported by the two studies reported in this thesis. Changes in the ratings, which corresponded to emotional responses, were observed when the environmental sounds and odours were manipulated, although arousal was not directly measured.

Recall that Mehrabian and Russell (1974) posited that the environment is perceived in terms of its complexity and novelty. This aspect of the theory is consistent with other theories such as Kaplan and Kaplan (1982, 1989; Kaplan, 1987, 1995). Kaplan and Kaplan (1982) stated that Complexity and Mystery are two of the four criteria that people use to make evaluations. The advantage of Mehrabian and Russell’s (1974) theory over theories such as Kaplan and Kaplan (1982) is that Mehrabian and Russell (1974) provided clear operational definitions concerning how to measure the environment by developing the concept of information rate (load). Evaluations are predicted to be affected by changes in the information load (e.g. the initial
presentation of each stimulus) and not necessarily the amount of information in the environment (e.g. the re-presentation of the ambient sound and odour). Both studies in this thesis supported this hypothesis. Similar evaluations were made when the sound and the odour were presented separately and together. However as the arousal was not directly measured in the studies featured in this thesis, the proposed relationship between information load, arousal and evaluations was not tested in this thesis. Therefore the precise role of the emotional responses as measured by pleasure and arousal responses is yet to be verified.

Proponents of the appraisal theory question the role of emotion in evaluations. The premise of this theory is that emotions are products of appraisals of the environment. In other words an environment is perceived in terms of its personal significance so that it can be responded to in terms of its emotional quality. This contrasts with Mehrabian and Russell’s (1974) theory in which emotions precede evaluations. To illustrate the difference between the two theories, according to Mehrabian and Russell (1974), the environment will elicit an emotional response which will cause a student to prefer or dislike their classroom. In contrast, proponents of the appraisal theory such as Lazarus (1991) and Scherer, Schorr and Johnstone (2001) would argue that the environment is perceived in terms of its significance to the student’s goal and experience. This determines the emotion experienced within the environment, which will affect the evaluations of the classroom. The appraisal theorists’ arguments are consistent with other researcher identified in this thesis (e.g. Russell and Snodgrass, 1987) who propose that both emotional and perceptual/cognitive responses contribute to evaluations.

The studies in this thesis do not clearly show whether emotions are antecedents of perceptual/cognitive responses, vice versa, or whether they interact with each other to influence evaluations. Nevertheless, the main point is that Mehrabian and Russell’s (1974) definition of emotions are at best over-simplistic and at worse inaccurate. This questions the proposed role of emotions in evaluations. It may also be naïve to suggest that emotion (however it is defined) is the only response involved in environmental evaluations. Before considering the implications of the combined contribution of emotional and perceptual/cognitive responses in evaluations for future
research, Canter’s (1983) theory will be considered in light of the findings of the two studies and the other theories described in this thesis.

4.2 The Purposive Evaluation of Places (Canter, 1983)

This thesis used the theory of place and provided a systematic way of exploring some elements from Canter’s (1983) model. Two of the three components of place were taken into consideration: activities (the identification and word rating tasks) and physical attributes (manipulation of the sound and odour). However, no attempt was made to control the conceptions (or socially constructed rules) of the participants. Other theories have considered the role of people’s conceptions in how they evaluate their surroundings. For example, Barker’s (1968) and Wicker’s (1987) notion of Behaviour Setting can correspond to Canter’s (1977) notion of conceptions as both refer to a set of rules that people follow and use to categorise and guide the activities within an environment. Although theory suggests that conceptions affect the way people evaluate their environment, the role of conceptions when the environment is changed is not clearly defined. This makes it difficult to empirically determine how conceptions affect evaluations.

Based on the theory of place, Canter (1983) proposed that the criterion on which evaluations are made is the extent to which the environment facilitates or inhibits the completion of a goal. Therefore, providing that the goals do not change and that any environmental manipulations do not interfere with the completion of a task, evaluations should not be affected by manipulations of sound and/or odour.

Study 1 supported this hypothesis as manipulations of the mower sound and/or the cut-grass odour did not change the extent to which the environment (except for the Smell environment) was considered to facilitate concentration. However, Study 2 did not support this hypothesis as manipulations of the coffee odour changed the extent to which the Spaciousness and the Smell was considered to facilitate concentration.

Canter’s (1983) model does not account for why evaluations should be a function of the type of odour. The following section will consider two reasons for why the predictions derived from the theory were not entirely supported by the findings.
One reason is that Canter's (1983) theory does not adequately account for how changes in the environment relate to the facets of evaluation. Nevertheless, the role of goals in evaluations is still important and this is supported by other empirical research. For example Custers and Aarts (2003) found that evaluations are a function of whether the person enters the environment with or without a goal. The goal serves as a filter as it allows participants to attend to aspects of the environment which are perceived to be relevant. However there are also other factors that determine the amount of attention given to a particular aspect of the environment such as its novelty and saliency. For example, this thesis demonstrated that evaluations are more likely to be affected by an unfamiliar sound than a familiar one. Canter's (1983) model fails to account for how novelty and saliency influence evaluations. It is essential that future research examining the role of goals in evaluations takes these factors into account.

Another reason for why the predictions derived from the theory were not entirely supported by the findings is that the tasks carried out by the participants (identification and ratings of the relationship between a word and the environment) were not typical activities which are carried out within the setting. It is likely that students typically associate the classroom setting with specific functions such as lectures or exams. Furthermore previous research indicates that people do not evaluate their environment in terms of how it fulfils an arbitrary function or goal (Donald, 1994; Kramer, 1995). People attach affective value to goals and this will also influence how the environment is perceived. These issues were not taken into consideration in the studies reported in this thesis. One way of taking these issues into account for future research is by asking participants to carry out activities which are typically associated with the environment (e.g. study and exam within a classroom environment). Afterwards, participants could also report their preference of these activities to determine how this corresponds to how they evaluate their environment.

Previous research and the limitation of Canter's (1983) theory identified in this thesis demonstrate the need to further examine the combined contribution of emotional and perceptual/cognitive responses in evaluations for future research. The next section will identify the implications of the issues considered in this thesis on future research.
4.3 Practical Implications and Proposals for Future Research

One implication is that research into environmental evaluations should use scales which measure both emotional and perceptual/cognitive responses. This thesis did this by using The Room Environment Questionnaire (REQ). Few published studies have used scales which include both emotional and perceptual/cognitive measures to monitor evaluations (Rodriguez, 1994; Gonzalez, Fernandez & Cameselle, 1997). Gonzalez, Fernandez and Cameselle's (1997) 13-item questionnaire included the same dimensions as the ones from the REQ except that Lighting was excluded because Vischer (1989) had demonstrated that people were not the best judge of their lighting conditions. In addition, their scale included an Evaluation item which measured the perception of the environment as a whole.

Gonzalez et al (1997) asked participants to rate how satisfied they were with their immediate surroundings, the building in which they were in, and this building in comparison with other buildings of similar nature. They found that the Evaluation item was the best predictors of satisfaction with the built environment. Among the remaining four components, Temperature and Noise were the best predictors followed by Air and Space (which corresponds respectively to Odour and Spaciousness on the REQ).

It is probably not surprising that the Evaluation item was the best predictor as it is a broad concept which could refer to the whole or any part of the environment. It would be useful to determine which dimension(s) contributed to the Evaluation dimension. This was not investigated in Gonzalez et al's (1997) study. Another limitation of this study was that it was not adequately guided by a theoretical framework. But these limitations could be addressed in future research where the effects on evaluations of changes in the environment are studied. Further investigations could consist of using the REQ with an additional item which measures how people evaluate their environment as a whole. These evaluations can be monitored during manipulations of particular environmental aspects to determine not only how the Evaluation item changes, but also how it corresponds to how the individual dimensions are considered.
One limitation of the studies in this thesis was that the evaluations during the odour-free and odour conditions were not carried out in the same room. Recall that this was done to maintain involvement and to assess whether the sounds and odours would be perceived similarly in the different rooms. In general, the findings showed that the sounds and odours were perceived similarly across the rooms. However, the room manipulation may have also introduced a confounding variable. The findings revealed that odour manipulation affected the evaluations of the Temperature, Spaciousness and Smell. Although it was expected that participants' evaluations of the Smell would be affected by the manipulation of the odour, it is not known why the manipulation would also influence the perceptions of the Temperature and Spaciousness. The two theories also do not account for this difference. One explanation is that the room manipulation may have affected the evaluations of the Temperature and Spaciousness. The only way this could be determined would be to replicate the studies with all the conditions occurring in the same room.

Recall from the studies reported in this thesis that whilst the odour influenced the evaluations of the Temperature, Spaciousness and Smell, the sound manipulation only influenced the evaluation of the Noise. The theories do not account for this effect, however other empirical studies suggest that odour perception is qualitatively different to perception from the other sense modalities (Herz, 1998). It can be argued that this may account for the differences between the effects on evaluations of the sound and odour manipulations. Odours have been known to have a capacity to induce arousal as measured by increased heart rate and EEG recordings (Lorig & Schartz, 1988; Herz & Cupchick, 1992; Herz, 1998). Some researchers interpret these findings to argue that odours are more emotional and evocative than cues from other modalities. However, as mentioned in the first chapter, physiological measures of arousal do not necessarily correspond to emotional responses. For example, a person is less aroused when they are sleeping than when awake, but this does not relate to whether they are feeling happy or sad.

Furthermore, as research shows that odours are difficult to identify, it is possible that compensatory perceptual/cognitive mechanisms are in place where odours are easily associated with people, events and objects (Kirk-Smith, 1994). This may explain the popular Proust phenomenon (Proust, 1928) where odours trigger intense pleasure by
retrieving personal memories which may also be emotionally significant. This shows the involvement of both emotional and perceptual/cognitive processes.

However the argument for the odours’ unique qualities does not explain why and odour affects evaluations of one environmental aspect (e.g. Temperature) and not another (e.g. Lighting). Future research should involve using physiological measures to identify the neuroanatomical associations with changes in the odour and sound environment. This could be compared with self-report measures such as ratings on the REQ to determine how this correlates with physiological measures. Specifically, activity in the amygdala-hypocampus and the frontal regions of the brain can be examined as they correspond to emotional and perceptual/cognitive functioning respectively. This type of research could also be used to examine how people respond to changes in the lighting and temperature.

It would be expected that these types of experiments would provide more understanding on how changes in the environment affects behaviour. It is possible that changes in the environment maybe detected using physiological measures, but not in self-reports or behavioural measures. For example, Kole, Snel and Lorist (1998) found that coffee odour did not affect performance on a visual decision reaction task (behavioural measure) but the ERPs component, the parietal P1 and frontal N1-P2 amplitudes (physiological measure) were more positive when the coffee odour was present that when the odour was absent. Other physiological data from this study taken together with the observed variation of the parietal P1 and frontal N1-P2 amplitudes led the authors to conclude that coffee odour influences the early stages of information processing. This would not have been found if only behaviour and/or evaluation measures were used. The eclectic approach in methodology is recommended for future studies into the effects of the environment on behaviour.

Nevertheless, regardless of the method used to examine evaluations, the main emphasis of this thesis is that it is essential that research on effects of the environment on behaviour, especially on evaluation, should be carried out within a theoretical framework. The development of theory can provide a clear and comprehensive understanding of how people perceive their surroundings. It was not possible to test
all the aspects of the two theories in this thesis. But future research could begin to examine these aspects which were not examined in studies reported in this thesis.

For example, future studies could investigate how arousal tendency determines environmental evaluations. This could involve replicating the studies reported in the thesis and ask participants to fill out Mehrabian and Russell’s (1974) Measure of Arousal Seeking Tendency. Based on Mehrabian and Russell’s (1974) theory, high arousal seekers would prefer environments containing unfamiliar sounds and odours whereas low arousal seekers would prefer environments containing familiar sounds and odours. If this was supported by empirical research, then this would have implications on various areas of everyday life. For example, designers of retail settings would have to consider the music, odour and other features used to ensure that the environment elicits moderate stimulation. This would serve to attract a wide range of customers.

The ratings of the relationship between the words and the environment demonstrated that the environment is evaluated in relation to events, people and objects. This is consistent with Canter’s (1977) theory where people evaluate their environment in relation to their objectives. The implications of this are that research into the effect of the environment of behaviour should not only measure changes in performance on various tasks, but also on how people perceive their environment in relation to the task. To illustrate, in determining the effect of changes in the sound environment on a reading task in a library setting, it could be predicted that the changes are more likely affect the performance a student who loves reading than another student who is only found reading in the library to complete an assignment for their least liked subject. The importance of choosing tasks that are typically associated with a given environment should also be considered in future research.

4.4 Conclusion

The findings of the present series of studies do not provide conclusive support for one theory over the other. Consistent with some of the elements from Mehrabian and Russell’s (1974) theory, evaluations which corresponded to emotional responses were
affected by the changes in the environment. However, in retrospect, Mehrabian and Russell's (1974) definition of emotion is questionable and this clearly suggests that other responses may be involved in evaluations. Previous published empirical research is consistent with Canter's (1983) proposal of the importance of goals in the way that people interact with their surroundings. However, the results of the studies reported provide limited support for Canter's (1983) purposive evaluation of places framework. The findings also identified a difference in the effects of the sound and odour manipulation suggesting that evaluations are a function of the type of environmental change. Both Mehrabian and Russell (1974) and Canter (1983) do not account for these effects in their theory. It is suggested that further empirical investigations into the effects of the environment should focus on the combined contribution of emotional and perceptual/cognitive responses within a theoretical framework.
REFERENCES


*Environment and Behavior, 15,* 659-698.


Royet, J. P., Koenig, O., Gregoire, M. C., Cinotti, L., Lavenne, F., Le Bars, D., Costes, N., Vigouroux, M., Farget, V., Sicard, G., Holley, A., Mauguiere, F., Comar,


APPENDICES

Appendix 1: Semantic Differential Measures of Emotional State or Characteristic (Trait) Emotions

Instructions to Subjects
When these scales are used as measures of EMOTIONAL STATE in a particular setting, the instructions are as follows:

Take about two minutes to really get into the mood of the situation; then rate your feelings in the situation with the adjective pairs below. Some of the pairs might seem unusual, but you’ll probably feel more one way than the other. So, for each pair, put a check mark (Example: ----:√::----) close to the adjective which you believe to describe your feelings better. The more appropriate that adjective seems, the closer you put your check mark to it.

When scales are used as TRAIT measures, that is, as measures of a person’s characteristic emotions over time, the instructions are as follows:

Each pair of words below describes a feeling dimension. Some pairs might seem unusual, but you may generally feel more one way than the other. So, for each pair, put a check mark (Example: ----:√::----) to show how you feel IN GENERAL, that is, most of the time. Please take your time so as to arrive at a real characteristic description of your feelings.

A numerical scale of +4 to −4 is used for each dimension (e.g., +4 is assigned for extremely happy and −4 for extremely unhappy). Subjects’ responses are averaged across the six dimensions of each of the three factors. In the actual administration of these measures, three scales are inverted, and all the scales are presented in random order.
<table>
<thead>
<tr>
<th>Pleasure</th>
<th>Unhappy</th>
<th>Annoyed</th>
<th>Unsatisfied</th>
<th>Melancholic</th>
<th>Despairing</th>
<th>Bored</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleased</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfied</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contented</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hopeful</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relaxed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arousal</td>
<td>Relaxed</td>
<td>Calm</td>
<td>Sluggish</td>
<td>Dull</td>
<td>Sleepy</td>
<td>Unaroused</td>
</tr>
<tr>
<td>Stimulated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excited</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frenzied</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jittery</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wide-awake</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aroused</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominance</td>
<td>Controlled</td>
<td>Influenced</td>
<td>Cared-for</td>
<td>Awed</td>
<td>Submissive</td>
<td>Guided</td>
</tr>
<tr>
<td>Controlling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Influential</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dominant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomous</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix 2: A General Measure of Information Rate*

Instructions to Subjects

Please use the following adjective pairs to describe the situation shown (or described). Each of the following adjective pairs helps define the situation or the relation among the various parts of the situation. Put a check mark somewhere along the line (Example: ———————-) to indicate what you think is an appropriate description.

(-) varied
(+ ) simple
(-) novel
(+ ) small-scale
(+ ) similar
(-) dense
(-) intermittent
(+ ) usual
(-) heterogeneous
(+ ) uncrowded
(-) asymmetrical
(-) immediate
(+ ) common
(+ ) patterned

redundant
complex
familiar
large-scale
contrasting
sparse
continuous
surprising
homogeneous
crowded
symmetrical
distant
rare
random

*In actual administration, the scoring direction signs to the left of each scale are omitted. Assign a score of −4 to checks placed in the farthest left space, −3 to the space next to it, on to +4 to checks placed in the farthest right space. To obtain a total score, change the signs of responses to the negatively signed items, and then sum over all responses.

Appendix 3: Booklet used in Study 1 and 2

Room Environment Study

Participant Code: _________

Age: _________

Gender: _________

Condition: _________

Group Number: _________
This booklet contains a number of rating scales, that we will ask you to use to assess various aspects of your current environment. It also contains lists of words, which we will ask you to rate in terms of their similarity to your environment. Over the next hour or so the environment you are in will be changed in various ways so that we can assess how sensitive you are to environmental change. At various times throughout the afternoon, the predominant smell or noise around you, or room in which you make these judgements, will be changed. None of the changes to smell, noise or your physical surroundings are in any way damaging or injurious. The data collected will be stored anonymously and no subsequent analysis will identify any individual participant.

Should you wish not to participate, you must remain in the room to avoid disturbing the other participants, until the session has ended.

The researcher running the study will now answer any questions you may have.

Consent:

I have read and understood the above description of the nature and purpose of this environmental evaluation study, and any questions I have been adequately addressed.

I agree to take part in this study.

Signed ___________________________ Date: __________________
Do not turn this page until the experimenter instructs you
# Room Environment Questionnaire

The following questionnaire is designed to find out your thoughts on the environment you are in during this experiment.

Please read the following statements carefully and circle the number which best reflects your judgement.

Think about the TEMPERATURE in the room.

<table>
<thead>
<tr>
<th>The temperature...</th>
<th>...increases my concentration</th>
<th>...decreases my concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The temperature...</th>
<th>...is pleasant</th>
<th>...is unpleasant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The temperature...</th>
<th>...makes me feel comfortable</th>
<th>...makes me feel uncomfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The temperature...</th>
<th>...reminds me of many things</th>
<th>...does not remind me of anything</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The temperature...</th>
<th>...does not make me feel sick</th>
<th>...makes me feel sick</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The temperature...</th>
<th>...is not oppressive</th>
<th>...is oppressive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The temperature...</th>
<th>...is hot</th>
<th>...is cold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Think about the **LIGHTING** in the room,

<table>
<thead>
<tr>
<th>The lighting...</th>
<th>...increases my concentration</th>
<th>...decreases my concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The lighting...</th>
<th>...is pleasant</th>
<th>...is unpleasant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The lighting...</th>
<th>...makes me feel comfortable</th>
<th>...makes me feel uncomfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The lighting...</th>
<th>...reminds me of many things</th>
<th>...does not remind me of anything</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The lighting...</th>
<th>...does not make me feel sick</th>
<th>...makes me feel sick</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The lighting...</th>
<th>...is not oppressive</th>
<th>...is oppressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The lighting is...</th>
<th>...bright</th>
<th>...is dim</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Think about the NOISE in the room,

<table>
<thead>
<tr>
<th>The noise...</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>...increases my concentration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...is pleasant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...is unpleasant</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>...makes me feel comfortable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...makes me feel uncomfortable</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>...reminds me of many things</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...does not remind me of anything</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>...does not make me feel sick</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...makes me feel sick</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>...is not oppressive</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>...is oppressive</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>...is loud</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>...is quiet</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Think about the **SPACIOUSNESS** of the room,

<table>
<thead>
<tr>
<th>The Spaciousness...</th>
<th>increases my concentration</th>
<th>...decreases my concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>is pleasant</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>makes me feel</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>comfortable</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>reminds me of</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>many things</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>does not make me</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>feel sick</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>not oppressive</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>ample</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
<tr>
<td>limited</td>
<td>1  2  3</td>
<td>4  5</td>
</tr>
</tbody>
</table>
Think about the SMELL in the room,

<table>
<thead>
<tr>
<th>The smell...</th>
<th>...increases my concentration</th>
<th>...decreases my concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The smell...</th>
<th>...is pleasant</th>
<th>...is unpleasant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The smell...</th>
<th>...makes me feel comfortable</th>
<th>...makes me feel uncomfortable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The smell...</th>
<th>...reminds me of many things</th>
<th>...does not remind me of anything</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The smell...</th>
<th>...does not make me feel sick.</th>
<th>...makes me feel sick.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The smell...</th>
<th>...is not oppressive</th>
<th>...is oppressive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The smell...</th>
<th>...is strong</th>
<th>...is weak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
Do not turn this page until the experimenter instructs you
WORD RATING TASK

Participant Code: Age: Gender: Condition:

Rate each of the words below in terms of how closely they are related to the predominant SMELL in the room. Then rate each word in terms of how closely they are related to the predominant SOUND you can hear. A rating of 1 means that a word and the SMELL or SOUND are closely related (e.g. the word “dog” and the sound of barking), a rating of 5 means the SMELL or SOUND are not at all related. At the end of the list identify the SMELL and SOUND that is in the room. Work through the words as quickly as possible, circling the appropriate rating in each case and then name the SMELL and the SOUND in the room.

The SMELL is...

<table>
<thead>
<tr>
<th>Word</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulance</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Apple</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Beach</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Bed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Bike</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Blender</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Book</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Clinic</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Cupboard</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Engine</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Flowers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Frying-pan</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Hedge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Hospital</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Knife</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Letter</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Mirror</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Pages</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Pebble</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Plate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Seaside</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Skirt</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sun</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Truck</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

The SOUND is...

<table>
<thead>
<tr>
<th>Word</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulance</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Apple</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Beach</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Bed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Bike</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Blender</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Book</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Clinic</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Cupboard</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Engine</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Flowers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Frying-pan</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Hedge</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Hospital</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Knife</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Letter</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Mirror</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Pages</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Pebble</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Plate</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Seaside</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Skirt</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Sun</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Truck</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Now identify the SMELL and the SOUND in the room in the boxes below.

The SMELL in the room is...

The SOUND in the room is...
Appendix 4: Wordlists

<table>
<thead>
<tr>
<th>BEDROOM</th>
<th>COOKING</th>
<th>KITCHEN**</th>
<th>READING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed</td>
<td>Blender</td>
<td>Apple</td>
<td>Book</td>
</tr>
<tr>
<td>Blouse</td>
<td>Cooker</td>
<td>Chair</td>
<td>Bookmark</td>
</tr>
<tr>
<td>Duvet</td>
<td>Dish</td>
<td>Clock</td>
<td>Desk</td>
</tr>
<tr>
<td>Hangers</td>
<td>Freezer</td>
<td>Cook</td>
<td>Lamp</td>
</tr>
<tr>
<td>Mirror</td>
<td>Frying-pan</td>
<td>Cupboard</td>
<td>Letter</td>
</tr>
<tr>
<td>Pillow</td>
<td>Grater</td>
<td>Food</td>
<td>Magazine</td>
</tr>
<tr>
<td>Sheet</td>
<td>Hob</td>
<td>Fork</td>
<td>Newspaper</td>
</tr>
<tr>
<td>Shirt</td>
<td>Microwave</td>
<td>Kitchen</td>
<td>Newspaper</td>
</tr>
<tr>
<td>Skirt</td>
<td>Plate</td>
<td>Knife</td>
<td>Notebook</td>
</tr>
<tr>
<td>Socks</td>
<td>Sauce-pan</td>
<td>Oven</td>
<td>Pages</td>
</tr>
<tr>
<td>Trousers</td>
<td>Spoon</td>
<td>Stool</td>
<td>Paper</td>
</tr>
<tr>
<td>Wardrobe</td>
<td>Toaster</td>
<td>Table</td>
<td>Pencil</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAR</th>
<th>HEALTH</th>
<th>PLANT*</th>
<th>SEASIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bike</td>
<td>Ambulance</td>
<td>Flowers</td>
<td>Beach</td>
</tr>
<tr>
<td>Car</td>
<td>Anaesthetic</td>
<td>Forest</td>
<td>Fish</td>
</tr>
<tr>
<td>Door</td>
<td>Antiseptic</td>
<td>Gardens</td>
<td>Harbour</td>
</tr>
<tr>
<td>Drive</td>
<td>Bandages</td>
<td>Grass</td>
<td>Market</td>
</tr>
<tr>
<td>Engine</td>
<td>Clinic</td>
<td>Hedge</td>
<td>Pebbles</td>
</tr>
<tr>
<td>Lorry</td>
<td>Dentist</td>
<td>Lake</td>
<td>Rockpools</td>
</tr>
<tr>
<td>Petrol</td>
<td>Disinfectant</td>
<td>Landscape</td>
<td>Sand</td>
</tr>
<tr>
<td>Traffic</td>
<td>Doctor</td>
<td>Pine</td>
<td>Seashell</td>
</tr>
<tr>
<td>Truck</td>
<td>Hospitals</td>
<td>Sun</td>
<td>Seaside</td>
</tr>
<tr>
<td>Tyre</td>
<td>Medicine</td>
<td>Trees</td>
<td>Seaweed</td>
</tr>
<tr>
<td>Van</td>
<td>Mothballs</td>
<td>Tulips</td>
<td>Shellfish</td>
</tr>
<tr>
<td>Wheel</td>
<td>Surgery</td>
<td>Woods</td>
<td>Town</td>
</tr>
</tbody>
</table>

* Words in this category were considered to be related to the cut-grass odour and mower sound.
** Words in this category were considered to be related to the coffee odour and cafeteria sound.
All other words were considered to be unrelated to the predominant odour and the sound.