



CREATE

Canterbury Research and Theses Environment

Canterbury Christ Church University's repository of research outputs

<http://create.canterbury.ac.uk>

Copyright © and Moral Rights for this thesis are retained by the author and/or other copyright owners. A copy can be downloaded for personal non-commercial research or study, without prior permission or charge. This thesis cannot be reproduced or quoted extensively from without first obtaining permission in writing from the copyright holder/s. The content must not be changed in any way or sold commercially in any format or medium without the formal permission of the copyright holders.

When referring to this work, full bibliographic details including the author, title, awarding institution and date of the thesis must be given e.g. Meehan, P. (2018) "Draw me a map of your town": An investigation of the construction of a free-recall hand-drawn map of a known physical environment by young children. Ed.D. thesis, Canterbury Christ Church University.

Contact: create.library@canterbury.ac.uk



“Draw me a map of your town”: An investigation of the construction of a free-recall hand-drawn map of a known physical environment by young children.

Submitted by

Patrick Joseph Meehan

Canterbury Christ Church University

A thesis submitted for the Degree of

Doctor of Education

Abstract

The underlying thesis of this research was that children possess more complex understandings of their large scale physical environment than were captured by existing models of classification for their artefact maps. In order to investigate this thesis, a convenience sample of 40 children was obtained at three (3) schools in East Kent in the United Kingdom and those children were asked to perform two tasks. Task One investigated whether or not children of 7-9 years of age could identify nominated features on a map of a fictional area through their ability to interpret conventional cartographic symbols. Task Two investigated the children's survey and environmental knowledge of a known large scale environment by constructing a free-recall sketch map of 'their town' without them being given a subsequent purpose for this map. During the construction of this artefact map the researcher interacted verbally with the children so that the temporal order of construction could be examined and the environmental knowledge of the children could be explored. Consistent with the thesis, the children displayed considerably more detailed environmental and survey knowledge about their town that it would have been possible to obtain from adult-centric post-factum interpretations of their artefact maps. Following this finding a new model for the classification of children's artefact maps was proposed.

Statement of Authorship and sources

This thesis contains no material published elsewhere or extracted in part or in total from a thesis by which I have been awarded, or qualified for any other degree or diploma.

It contains no work of other persons except where such work is fully and duly acknowledged.

This thesis has not been submitted in whole or in part to any other tertiary institution in pursuit of qualification or award of any degree or diploma.

All research procedures used in this thesis were approved by the relevant Ethics/Safety Committee where required.

Informed consent was obtained from the schools and parents and informed assent to participate in the data collection was obtained from each child.

Maps are graphic representations that facilitate a spatial understanding of things, concepts, processes or events in the human world.

Harley and Woodward (1987, p. XVI)

Acknowledgements

The completion of this thesis has been a long and at times frustrating experience both personally and professionally as I have moved from being an Australian detective to an expatriate Academic in the UK. My undergraduate studies were in Modern History/Government, my MA was in Justice Studies and my Doctorate is about how young children understand and depict their physical environment so it is fair to call the journey eclectic.

The selection of the topic was driven by two core interests of mine which are maps, and the journey of children from infancy to adult citizenship. Initially I was reluctant to undertake Doctoral studies as I genuinely prefer teaching to research and felt that I had little of utility to add to the field. Along the way however, I have discovered that the views of child cognition from meta-theorists like Piaget bear re-examination given what we now know about children's development, and the debates about children and mapping from 1970 - 1999 have gone somewhat cold. So it seems that there is still considerable room for exploration of how children in the 21st century understand and depict their world.

Thanks to my wife Catherine, and daughter Sophie, who have endured the experience of doctoral studies with me.

Their support has been vital in remaining focused on the eventual outcome. Thanks to my mother for teaching me the value of education and hard work. In truth there is nothing that hard work and diligent effort cannot overcome and it is our response to a situation which determines its impact upon us.

Thanks to my high school teachers, Mr Les Gamble, Mr Greg Peet and the late Mr Maurice Keenan and the late Lt. Col. Garry Chandler RFD, who taught me that the world is a place to explore and that human rights have to apply to everyone at all times if they are to have meaning for anyone at any time.

Thanks also to John Goldsworthy, Rick Draper and Dr Wendy Sarkissian for inducting me into the field of Crime Prevention Through Environmental Design (CPTED) and the work of Jane Jacobs and to Dr Paula Whitman for introducing me to the work of Kevin Lynch.

Thanks to Claire Alfrey and the School of Childhood and Education Sciences for their financial support of this doctorate.

Thank you to my supervisors Dr Gill Hope who helped me understand children's cognition better and Dr Peter Vujakovic who guided my passion for mapping in useful rather than merely interesting directions.

Thanks to the staff and children at the three schools where this research was undertaken.

Contents

| | |
|---|----|
| Chapter 1 Introduction | 12 |
| 1.0 Introduction | 13 |
| 1.1 Themes of the Research..... | 13 |
| 1.2 Origins of the research..... | 13 |
| 1.3 Overview of the research..... | 15 |
| 1.4 Significance of the Research | 17 |
| 1.4.1 Historical underestimation of children’s capability | 17 |
| 1.4.2 Problems of conducting research indoors using artificial tasks..... | 17 |
| 1.4.3 Improved understandings of child capabilities | 17 |
| 1.4.4 Originality of this research | 18 |
| 1.4.5 Relevance of this research to Early Childhood Education, (0-8 years) | 18 |
| 1.5 Executive Summary of research..... | 19 |
| 1.5.1 Formation of Research Questions..... | 20 |
| Chapter 2 Literature Review | 21 |
| 2.0 Introduction | 22 |
| 2.1 Background to research | 23 |
| 2.2 Maps and types of knowledge | 24 |
| 2.2.1 Cognitive maps and Cognitive mapping..... | 24 |
| 2.2.2 Sequential, Survey and Environmental knowledge | 27 |
| 2.2.3 Children’s understanding of aerial photos and maps | 29 |
| 2.2.4 Humans and mapping | 30 |
| 2.2.5 How adults make and use maps | 33 |
| 2.3 Children’s cognitive and physical development..... | 34 |
| 2.3.1 Piaget, children’s cognitive capacity and maps | 35 |
| 2.3.2 Problems with Piagetian constructions of children and maps..... | 37 |
| 2.4 Children and maps | 41 |
| 2.4.1 Two schools of thought about children and maps..... | 41 |
| 2.4.2 Children’s cognition and maps..... | 43 |
| 2.4.3 The role of language..... | 47 |
| 2.4.4 The role of children’s independent mobility..... | 49 |
| 2.4.5 The role of gender..... | 49 |
| 2.4.6 Children’s understanding of orthogonal depictions of the physical environment | 50 |
| 2.4.7 How children use maps | 51 |
| 2.4.8 How children draw physical spatial environments | 52 |
| 2.4.9 The voice of the child | 53 |
| 2.4.10 Children and indoor artificial tasks | 54 |

| | |
|--|------------|
| 2.5 Spatial Typologies for classifying children’s artefact maps..... | 55 |
| 2.5.1 Ladd (1970) | 55 |
| 2.5.2 Moore (1973) | 58 |
| 2.5.3 Hart (1981) | 62 |
| 2.5.4 Matthews (1984)..... | 64 |
| 2.5.5 What the existing typologies show | 67 |
| 2.6 Summary of Literature Review | 68 |
| 2.6.1 Research questions | 69 |
| Chapter 3 Methodology | 70 |
| 3.1 Introduction | 71 |
| 3.2 What is a Paradigm? | 73 |
| 3.3 Positionality..... | 81 |
| 3.4 What is Truth?..... | 82 |
| 3.4.1 Paradigmatic and Narrative ways of knowing | 84 |
| 3.5 Paradigm adopted for the study – Pragmatism..... | 87 |
| 3.6 Rationale for my research | 88 |
| 3.7 Conduct of research | 90 |
| 3.8 Anticipated research outcomes | 93 |
| 3.9 Specifics of the proposed data collection task..... | 94 |
| 3.9.1 Task 1 – Artefact interpretation..... | 95 |
| 3.9.2 Task Two – Production of artefact map | 100 |
| 3.10 Data analysis | 102 |
| 3.11 Ethical Considerations..... | 103 |
| 3.11.1 General research issues | 103 |
| 3.11.2 Issues for male researchers today | 104 |
| 3.11.3 Adult Consent and Child Assent..... | 105 |
| 3.12 Logistics of the research..... | 106 |
| 3.12.1 Selection of schools and gaining of consent | 106 |
| 3.12.2 Visits to the three schools..... | 107 |
| 3.12.3 Number of children involved | 107 |
| 3.12.4 Recording of data collection activities | 107 |
| 3.12.5 Return of artefact maps to schools..... | 107 |
| 3.13 Conclusion | 108 |
| Chapter 4 Findings..... | 109 |
| 4.1 Spatial versus Environmental Knowledge..... | 110 |
| 4.1.1 Notes on content of this chapter | 110 |
| 4.1.2 Classification of artefact maps | 111 |

| | |
|---|------------|
| 4.1.3 School S1 | 121 |
| 4.1.4 School S2 | 134 |
| 4.1.5 School S3 | 149 |
| Chapter 5 Discussion | 176 |
| 5.0 Introduction | 177 |
| 5.1 What can I say with certainty from my research? | 177 |
| 5.2 Task 1 Interpretation of common cartographic symbols from map of fictional town | 178 |
| 5.3 Task 2 Free-recall hand-drawn artefact map of known large-scale environment..... | 178 |
| 5.4 Response of research to the proposed questions. | 180 |
| 5.4.1 Primary Question | 180 |
| 5.4.2 Sub-Question 1..... | 181 |
| 5.4.3 Sub-Question 2..... | 181 |
| 5.4.4 Sub-Question 3..... | 182 |
| 5.5 Anomalies in data..... | 182 |
| 5.5.1 Drawing boundaries as first object | 182 |
| 5.5.2 Drawing unclassifiable images | 183 |
| 5.6 What have we learned about children and maps? | 184 |
| 5.6.1 Importance of toy play in developing spatial knowledge | 185 |
| 5.6.2 Gender as a significant variable | 185 |
| 5.6.3 Children’s independent mobility..... | 187 |
| 5.6.4 Children not being sufficiently engaged with data collection task..... | 188 |
| 5.6.5 Drawing landmarks before paths..... | 189 |
| Chapter 6 Proposal for new model for classification of children’s free-recall sketch maps | 191 |
| 6.0 Rationale for proposal of new model for classification of children’s free-recall sketch maps.. | 192 |
| 6.1 Proposed model | 193 |
| 6.2 Original contribution to the field | 199 |
| Chapter 7 Conclusion..... | 200 |
| 7.0 Introduction | 201 |
| 7.1 Summary | 202 |
| 7.2 Limitations..... | 204 |
| 7.3 Directions for future research..... | 205 |
| 7.3.1 Replication of study outside the United Kingdom | 205 |
| 7.3.2 Exploration of children’s cartographic knowledge through diorama models | 205 |
| 7.3.3 Replication of Task 2 with adults to investigate their ability to construct a free recall sketch map of a known large scale area..... | 205 |
| 7.4 Closing comments | 206 |
| Bibliography..... | 207 |

| | |
|---|-----|
| Appendices | 225 |
| Appendix A Ethics Proposal..... | 226 |
| Appendix B – Ethics Approval | 232 |
| Appendix C Letter to Schools | 233 |
| Appendix D – Letter to Parents..... | 235 |
| Appendix E – Map of fictitious town, used for Task 1 child interpretation | 236 |
| Appendix F – Artefact maps by Children..... | 237 |

List of figures

| | | |
|------------------|--|-----|
| Figure 1 | Ladd (1970) Type 1 Pictorial Drawings | 56 |
| Figure 2 | Ladd (1970) Type 2 Schematic Drawings | 56 |
| Figure 3 | Ladd (1970) Type 3 Images resembling maps | 57 |
| Figure 4 | Ladd (1970) Type 4 Maps with specific landmarks | 57 |
| Figure 5 | Moore (1973) Level 1 Undifferentiated egocentric | 61 |
| Figure 6 | Moore (1973) Level 2 Differentiated and partially organised | 61 |
| Figure 7 | Moore (1973) Level 3 Abstractly and Hierarchically coordinated | 62 |
| Figure 8 | Appleyard (1969) Methods of structuring maps | 64 |
| Figure 9 | Matthews (1984) Grade 1 | 66 |
| Figure 10 | Matthews (1984) Grade 2 | 66 |
| Figure 11 | Matthews (1984) Grade 3 | 67 |
| Figure 12 | Children's reasons for identification of image as a map | 111 |
| Figure 13 | Children interpreting common cartographic symbols | 112 |
| Figure 14 | Features of Lynch's (1960) model in children's maps | 113 |
| Figure 15 | Appleyard (1969) Classification of maps | 114 |
| Figure 16 | Ladd (1970) Classification of maps | 115 |
| Figure 17 | Moore (1973) Classification of maps | 116 |
| Figure 18 | Hart (1981) Classification of maps | 117 |
| Figure 19 | Matthews (1984) Classification of maps | 118 |
| Figure 20 | First object drawn by children | 119 |
| Figure 21 | Children who left spaces but drew no roads | 120 |

Glossary of Terms

Unless specifically referenced otherwise the following definitions are the common knowledge meanings of the respective terms.

An '**artefact**' is

the deliberate creation of an object or ritual by conscious mind/s for the performance of a specific function or functions, and the examination of which can yield insights into the ontological and epistemological views of the creators of said artefact, (Hilpinen, 1995 p.138).

Early Childhood Education – the care and education of children during the period 0-8 years of age, (Marope and Kaga, 2015 p. 26).

A '**map**' is both a cognitive process and a physical (including oral) artefact. The construction of these artefacts occurs through a logical process, by humans for the sorting, recording, storage and communication of information about the physical world. They will also frequently include information about social, economic and political relationships even if only in implicit ways such as selection of colours and symbols as well as the more explicit inclusions and exclusions of objects.

An **artefact map** is the physical object drawn or modelled by a person when asked to produce a map of a specified location or a familiar **Large scale space**. It will contain objects which the producer of the map considered worthy of inclusion and necessary to meet the instruction set. e.g. within this research it includes those things which the child considered comprised 'your town'.

The term '**Large-scale space**' means a portion of the physical environment including both natural and built environment that is larger than a single property boundary or building footprint. Using this definition, the neighbourhood around a school is large-scale space but the area within the school fence or wall is not.

'**Horizontal rotation**' means the child turning their artefact map around on the table to realign it for ease of drawing an object. After doing this, the child may or may not return the artefact map to its original alignment and this will need clarification with each child.

'**Vertical rotation**' means the child displaying the cognitive ability to adopt an orthogonal view of an environment that they have experienced in an isometric manner. Within this research, it primarily means that they are able to imagine looking down at their town from above and drawing it from that perspective.

NB - Possibly due to the variety of disciplines from which the literature on this topic comes, there is use of both terms '**planometric**' and '**orthogonal**' to refer to the view generated by vertically rotating a view of the environment 90 degrees. Within my research I shall use orthogonal as the main term.

'Temporal construction order' means the order in which the child drew the objects depicted in their artefact map. In this research, it primarily relates to whether the child drew landmarks or paths first. In adopting this definition I am conscious of the concept of Element Hierarchies which means the '*reliable tendency of participants to subdivide the environments and to draw or describe one set of features prior to another*', (Taylor and Tversky, 1992, p.494).

This last definition is crucial because the existence of such hierarchy implies that the first drawn objects have the greatest importance for the participants, (Hunyh, Hall, Doherty and Smith, 2008). This significant because I am expressly investigating the veracity of Lynch's (1960) asserted construction hierarchy by identifying which of two types of object the contemporary children choose to depict first.

Chapter 1 Introduction

1.0 Introduction

In this Introduction I will provide the key thematic areas within in this research and will outline the origins of my interest in the field. This section will give an outline of the conduct of the research as well as discussing its' significance and originality within the field.

1.1 Themes of the Research

Within this research four thematic areas are examined in order to discuss the origins of the research and the current state of knowledge in the field. Then the existing models for the classification of children's artefact maps will be considered in terms of their continued suitability and lastly a new model for the classification of such maps will be proposed.

- The thematic areas are :
- The nature of maps and knowledge
- Understandings of child development and children's maps
- The ways in which humanity uses maps
- Typologies of maps

1.2 Origins of the research

This research derives from two of my fundamental ontological beliefs about the world of humanity and the place of children within it. Firstly, the world of humans and the societies they create is knowable, (Reid, 1764). That is to say, the social structures, modes of thought, speech and action, and the physical artefacts which collectively comprise both specific cultures and cultures in general, are rational and deliberate reflections of human experience. As such, maps are physical artefacts which humans use to convey information about their experiences pictorially (Blaut and Blaut, 1987) and therefore must be understood as purposive utterances by an individual, (Schiller, 1929).

Secondly, the social and technological advances since the 1960's have enabled us to generate improved understandings of both the innate and acquired capabilities of very young children which challenge the Piagetian construction of the capabilities of children under the age of ten years, (Blaut, 1997), (Reggio Children, 2000).

Attaching a label to one's philosophical position is always limiting, so at this early stage I will confine myself to saying that I began this journey with a Constructivist view of child development but have moved much closer to an Incrementalist position as it draws to a close. That is to say, I agree with Matthews (1992) and Blaut (1997) that children possess considerable innate capacity to understand and depict their environment, and these capacities will blossom or atrophy depending on the child's individual experience of the world, (Blaut, McCleary and Blaut ,1970 ; Hart,1981; Karsten, 2005 ; Lehman-Frisch, Authier and Dufaux 2012).

Maps have always been an important part of my life as a child, as a soldier, as a police officer and university lecturer. Being able to understand and represent how the physical environment shapes human society has always been a fascination and this is why the thesis topic was chosen.

Having come to the field of Early Childhood Studies after several other careers I had not encountered the dominance of Piagetian theory which characterised the education of many of my peers. Instead my introduction into the field began with the work of Reggio Emilia with its' greater emphasis on the child as a competent capable agent in its own right. This led me to question the continued utility of existing models for the classification of children's artefact maps.

1.3 Overview of the research

The landmark study by Lynch (1960) sought to understand how people conceptualise and depict the different parts of a city as individual areas and as a whole image. He was interested in the identification of the most common or public mental images which are used by adults to understand and navigate their city. This is significant, because it appears that little work has yet been undertaken using Lynch's method and typology either with children or with adults of differing ages to see how life experience might alter the resulting mental and artefact maps, (Saarinen, 1976). It is strongly suggested that nearly 60 years later, this remains a gap in knowledge as it appears that age is an important variable in how people of different ages perceive, respond to and depict the same urban stimuli, (Pocock, 1975). The work of Craik (1969) and Gardner (1983) suggests that all humans possess a basic level of ability to map the large scale physical environment, indeed Larsen (1983) argues that this is a survival level skill. But the work of Trowbridge (1913), Murray and Spencer (1979), Spencer, Blades and Morsley (1989) and Matthews (1992) suggests that this is an ability which must be applied in independent mobility if it is to be developed beyond base level.

The original work by Lynch (1960) led to the conclusion that people's spatial typology begins with an understanding of any city as a collection of *districts* with visually definable *edges*. Both within and between those districts people mentally map out networks of *paths* and *nodes* upon which *landmarks* are then identified. He theorised that this spatial typology led people to use the *paths*, *nodes*, *landmarks*, *edges* and *districts* as aids to both spatial organisation of cognitive mapping and navigation in the physical world. According to Lynch (1960) humans create an artefact map according to an Element Hierarchy, (Taylor and Tversky, 1992, p.494), by first drawing a network of paths and nodes which they subsequently populate with landmarks and organise into districts with identifiable edges. This does not appear to be the case though with young children or indeed women, as both of these groups appear to create artefact maps by first drawing landmarks and then linking them with paths and nodes. My research seeks to investigate the Temporal Construction Order employed by the children as this will provide insight about the objects they perceive as significant, Hunyh, Hall, Doherty and Smith, (2008).

Historically Lynch's ideas have been used to assert the existence of a universal human way of conceptualising storing, using and reproducing spatial information, (Lynch, 1960). Although his work noted variations in how adults in traditional non-urban societies did this, he appeared to suggest that people in urban industrialised societies all performed these tasks in a similar manner. This is a position broadly in accordance with the findings of Trowbridge (1913) which explored people's cognitive mapping processes although he did not use such terms. It is noted that Trowbridge's research was also conducted with adult males in a Western urban industrial context. Lynch's (1960) characterisation of child cognitive processes is consistent with the then unchallenged work of Piaget and Inhelder (1956) and subsequently also Piaget and Inhelder (1967). Their research made assertions about the capacity of children at particular ages to understand and represent the physical environment. It now appears though that several of those assertions may have been derived from flawed methods which caused the researchers to underestimate children's capabilities as the subsequent work of Donaldson (1978), Hart (1981) and the experiences of Reggio Children (2000) have demonstrated.

Several of those assumptions about child cognition were specifically contradicted by Siegel and White (1975) who suggested that children do not process or organise the same environmental stimuli in the same way that Lynch (1960) found adults doing. They argue instead that children identify visible landmarks along a route and thereafter recall the route through successive recourse to those landmarks.

The work of Neisser (1976) and Spencer and Darvizeh (1983) clearly supports the 'tacit knowledge' view, Polanyi (1966), of broader cognition by demonstrating that quite young children can both walk a route and successfully describe it orally to a stranger even if they are unable to draw a recognisable map of it. Indeed both Spencer and Darvizeh (1983) and Matthews (1984) explicitly make the point that despite their occasional difficulties in articulating routes orally or depicting them graphically, young children do not seem to 'get lost' with any notable frequency in their everyday lives.

1.4 Significance of the Research

1.4.1 Historical underestimation of children's capability

The work of 1960s theorists like Lynch (1960), Cullen (1961), Mumford (1961) and Appleyard (1969), and their successors like Liben and Downs (1997), Kastens and Liben (2010) who were often from outside the field of education, seem to have had a comparatively superficial understanding of Piagetian constructions of children and their competence. This led to the design of experiments and the drawing of conclusions which severely underestimated the competence of children's ability to understand and depict their physical environment. These understandings and experiments will be discussed further in Chapter 2. It is explicitly stated here that the model proposed by Lynch (1960) remains robust for its intended purpose. My research seeks to propose a more suitable model for the classification of children's artefact maps as the use of Lynch's model in this manner appears insufficient to capture the full breadth of children's knowledge and capabilities.

1.4.2 Problems of conducting research indoors using artificial tasks

Several studies on child cognitive mapping, Acredolo, Pick and Olsen (1975), Hazen, Lockman and Pick (1978), Bluestein and Acredolo (1979) were conducted in comparatively small scale space (e.g. inside a laboratory or a school building) and used tasks that were divorced from concrete daily experiences of children, (Siegel, 1982). The issue of how using such small scale, indoor 'artificial' tasks and routes might confuse children was addressed by several researchers such as Herman and Siegel (1980), Herman, Kolker and Shaw, (1982), Gauvain and Rogoff (1986), as well as Spencer, Blades and Morsley (1989).

1.4.3 Improved understandings of child capabilities

Improved understandings of child capabilities have been developed in the past few decades through research and practice (notably in Scandinavia, and Reggio Emilia). Such understandings gravitate toward the Incrementalist position that children possess significant innate capacities for exploring the world and for conveying their understandings of it. These improved understandings of child capability lead to questions about how the policy and practice of educating children from 0-8 years can be altered to facilitate the drawing out of those capabilities.

1.4.4 Originality of this research

The research for this doctoral thesis involved contemporary seven (7) to nine (9) year old children in East Kent in the United Kingdom, through an activity similar to Ladd (1970), Moore (1973), Hart (1981) and Matthew's (1984), namely the creation of free-recall sketch maps depicting a known large-scale environment. Much of the originality was that the researcher did not specify a purpose for the artefact maps and interacted with the children during creation of the maps rather than attempting post-factum interpretation. This difference leads to the conclusion that children in fact possess considerably more spatial, sequential and environmental knowledge about their local large scale physical environments than has previously been assumed. This realisation led to the conclusion that a new model for classification of children's artefact maps might be required, and a potential model is proposed in Chapter 6.

1.4.5 Relevance of this research to Early Childhood Education, (0-8 years)

One of the implied goals in any form of education of children is to enable them to independently 'make their way' or to navigate their chosen path through life. This is a useful idea to begin with, because Froebel (1826) and Dewey (1915) argued that children needed real life first hand experiences of the concrete world if they were to understand the abstract symbol systems on which literacy and numeracy rest. Given the current government and media obsession with formal high stakes testing it is worth revisiting the above assertion in regard to children and maps as it can equally be applied to children's acquisition of other forms of knowledge.

People do not study maps to understand maps. They study maps to understand the earth and its inhabitants. Every map symbol stands for something real and a student has truly learned the meaning of a symbol only when he understands the real thing for which it stands. (Parker, 1942 p.6).

Children do not learn to read so that they can obtain a high grade for their English test. They learn to read so that they can obtain information and enjoyment from the ideas of other people in other places and times. If children are to understand the physical world in which they live, then learning about how maps enable us to gather, store, recall, represent and use information is very important, (Dewey, 1915; Thralls, 1958; Dale, 1971 ; Matthews, 1992 and Danforth, 2014).

1.5 Executive Summary of research

The underlying thesis of this research was that children possess more complex understandings of their large scale physical environment than was suggested by the existing classification models. In order to investigate this thesis, a convenience sample of 40 children was obtained at three (3) schools in East Kent in the United Kingdom and those children were asked to perform two tasks. The first task sought to learn whether or not children of 7-9 years of age could identify nominated features on a map of a fictional area through their ability to interpret conventional cartographic symbols. The second task sought to investigate the children's survey and environmental knowledge of a known large scale environment. It did this by having them construct a free-recall sketch map of 'their town' without them being given a subsequent purpose for this map. During the construction of this artefact map the researcher interacted verbally with the children. This was done so that the temporal construction order could be examined and the environmental knowledge of the children could be explored. Consistent with the thesis, the children displayed considerably more detailed environmental and survey knowledge about their town that it would have been possible to obtain from adult-centric post-factum interpretations of their artefact maps. Following this finding a new model for the classification of children's artefact maps was proposed.

1.5.1 Formation of Research Questions

Primary:

What physical objects and spatial relationships do children aged 7-8 years include in their map when drawing a free-recall map of a known physical environment?

Sub-questions:

- 1. To what extent can children interpret a map of a fictional location through understanding of cartographic conventional symbols?*
- 2. To what extent do these artefact maps of contemporary children conform to the spatial typology models from the literature, for example Lynch (1960), Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984)?*
- 3. To what extent are existing models sufficient for the classification of children's artefact maps today?*

Conclusion

This chapter has provided only a brief overview of where this research came from and where it went, and we now move into a detailed examination of the relevant literature underpinning the research.

Chapter 2 Literature Review

2.0 Introduction

This research begins with the idea that maps are a deliberate and organised mental and physical activity through which humans attempt to understand and depict their world. They are always a subjective abstraction rather than an accurate illustration, as by definition they encompass more physical space than can be easily seen from a single viewpoint, (Brotton, 2012). The landmark work of Lynch (1960) proposed a universal typology by which all humans were asserted as classifying types of space and objects within it. However, it now seems that the uncritical use of Piagetian constructions of children's cognitive abilities by Lynch and other researchers has often led to an underestimation of children's capacity to understand and represent their world. It is worth restating here that the model proposed by Lynch (1960) was, and remains, robust and entirely fit for its intended purpose. What this research demonstrates however is that a new and more nuanced model is required in order to capture the complexity of children's knowledge of their large scale physical environment.

This chapter will discuss the background assumptions underpinning my research interest and provide a summary of the existing body of research about children and their cognitive mapping abilities. Section 2.1.2 will examine the nature of cognitive maps and cognitive mapping while Section 2.2 will summarise the things we can conclude about children and maps from existing research. Section 2.3 will discuss the contribution and limitations of Piaget's contribution to this topic will be discussed outline the difference between sequential and survey knowledge and what each means for research on mapping. The issues around children's ability to interpret data from aerial photographs versus maps will be discussed in Section 2.4. In Section 2.5 the four selected models for classification of children's artefact maps will be discussed and Section 2.6 will summarise the chapter.

2.1 Background to research

To test the quality of a map is to determine how well it has solved the geometric problem imposed upon it of reproducing constructively the distribution in space of geographic objects. Due allowance should be made, however, for the actual state of geographic knowledge and for the scale and purpose of the map, as these are the factors, that determine the number and extent of geographic features to be represented on it. (Eckert, 1908, p. 345).

At first glance it may seem odd to start a 21st century discussion of the hand drawn sketch maps of 7-9 year old children with a quote from an early 20th century article on the different methods that cartographers then used to illustrate physical features and vertical land relief. The reason for choosing this point of departure however, is that Eckert's (1908) point remains valid regardless of when the map is drawn or by whom. He argued that all maps are drawn with a purpose and they involve choices about what to depict and how to do so. Further, he understood that since mapping is always an imperfect two dimensional representation of a three dimensional reality, any attempt to assess the quality of an artefact map should specifically address how well it serves the purpose for which it was created.

This research proceeds from a view that any attempt to understand artefact maps, (whether of children or adults), requires attention to the temporal construction order' (Taylor and Tversky, 1992), of the objects depicted within those artefacts. Much of the historical research in the field of children's mapping however seems to have assumed the existence of the universal spatial typology postulated by Lynch (1960) This is chiefly reflected in the conduct of post-factum adult interpretations of the children's artefact maps. Unfortunately this typology was based upon a limited understanding of Piaget and Inhelder's (1956) construction of children's cognitive development. Those authors evolved their concepts in their later work (Piaget and Inhelder, 1967), and many subsequent researchers adapted accordingly. Outside of education however, the initial understanding seemingly persisted due to the pre-eminence of Lynch's work. It is therefore important to consider whether this typology can still be satisfactorily applied to the free recall sketch maps produced by contemporary British children under ten years of age.

2.2 Maps and types of knowledge

2.2.1 Cognitive maps and Cognitive mapping

The definition developed by Tolman (1948) through his work on how both rats and humans navigate mazes, is that a cognitive map is the information comprising an individuals' knowledge of the layout of an environment. Building on this definition, Downs and Stea (1977), described cognitive mapping as the group of abilities which enable individuals to collect, organise, store, recall and manipulate spatial information about their physical environment.

It is argued by Blaut (1991) that the construction and use of maps is a behavioural adaptation of humans derived from our interactions with large-scale (Macro) physical environments. Because such environments contain too much detail and are too large for a person to see them completely from a single view point we have developed what Mead (1938) called the 'Cyclopean Eye'. By that he meant that we have learned to imagine large portions of the Earth as if looking down from above (Orthogonal perspective). Central to the successful use of that perspective is to position objects within the landscape via the device of Meaning-Distance-Direction triads. Firstly that means adopting a consistent symbol to represent things (e.g. square topped by triangle to represent a house). Secondly we must adopt a consistent scale to represent the particular landscape and finally we must adopt a consistent means of spatially ordering our image (map) through logical placement of depicted objects, (e.g. objects that lie to our right in the physical world are placed on the right-hand side of our map). This deliberate process of construction of an artefact map clearly positions such an artefact as a purposive utterance, Schiller (1929), which is intended to convey a particular set of meanings from the creator of the artefact to the reader of it.

The argument advanced by Blaut (1991) is essentially that humans evolved maps because they are far more efficient as a means of communicating detailed information about large sections of landscape than normal language is. Cartography is therefore aptly understood as a limited purpose language, (Head, 1984; Schlichtmann, 1985).

Although he did not use the term, Trowbridge (1913) certainly understood the importance of cognitive maps in the daily lives of individuals. His work investigated why some 'civilised' people (especially those living in cities), seem to get lost more often than other 'primitive' people (who live in villages). Once the antiquated and vaguely discriminatory language is set aside, Professor Trowbridge's work remains quite interesting and could usefully be revisited today as it illustrates the importance of exposure to maps in early childhood as an aid to developing understanding of the world as a whole. For that reason a short discussion of his work will now be attempted.

The principal finding of Trowbridge's (1913) study is that there appear to be three major ways in which individuals navigate their way through the physical world, namely Domi-Centric, Ego-centric and Imaginary Orientation. Primitive people who rarely travel far beyond their immediate village or hunting grounds are constantly surrounded by landmarks whose importance is reinforced in story and song, (Boas, 1911; Mountford and Walsh, 1943; Lynch, 1960; Levi-Strauss, 1966 and Spink and Moodie, 1972). These people employ a Domi-centric (home-centred) form of cognitive mapping, meaning that all objects and routes are referenced to the home village within an understood landscape. The journeys undertaken by these people are usually hunting or foraging expeditions and all navigation is conducted with reference to readily visible features of physical geography such as a particular bend in the river or a certain shaped hill. Any journeys of greater distances are usually for purposes of ceremony, trade or warfare and as such they are usually led by some member of a cultural elite with specialised navigational knowledge such as the famed maritime navigators of Polynesia with their formal apprenticeship and woven palm and shell maps of the major currents and constellations, (Davenport, 1960).

Consequently, these kinds of people rarely if ever find themselves unable to locate their position within their landscape or to develop a route which will return them to more familiar ground when temporarily disorientated. Trowbridge argues that this form of cognitive understanding of the physical environment is naturally acquired through everyday activities. He says that because it is developed by each individual in their own way and time, it is always fit for their purposes even if it lacks modern, industrial exactitude. He does however acknowledge that a version of Domicentric navigation is also found in 'civilised' people. For example, a man may know that in order to reach the nearest shop from his house he must walk certain distances and alter his path in certain directions and yet have neither the vaguest idea of, (nor interest in), which compass direction the shop lies from his front door.

It was suggested by Trowbridge (1913), that 'civilised' (permanently settled) people on the other hand, live in small bubbles of much larger urban environments and employ an artificially taught form of navigation based on compass directions (or major routes) and success in finding one's way depends on developing a reasonably accurate overall map of the general layout of the entire city or country. It was such thinking which led to Lynch's (1960) research on how adults construct an overall 'image of the city'.

It is argued by Trowbridge (1913), Craik (1969), Pocock (1975), Hart (1981) and Gardner (1983) that all individuals have some level of basic spatial ability and carry the Domicentric maps of their immediate neighbourhood. They suggest however, that becoming proficient at creating and using the Ego-centric compass-based overall cognitive maps of a larger area requires individual practice. Therefore, the people who fail to develop the overall maps based on compass directions through independent mobility (ideally as a child), are the ones who routinely get lost on any journey beyond their immediate experience, Spencer, Blades and Morsley (1989), Matthews (1992). Today, it is postulated that such people may also have a cognitive difference which inhibits executive functions of the brain and thereby makes it difficult (but by no means impossible), for them to plan routes, estimate distances and times and to retain spatial layouts of large scale physical environments whilst moving within them, (Cooper-Kahn and Dietzel, 2008)

The work of Trowbridge (1913) suggested that the people who get lost most often are those who have failed to become proficient in the sort of navigation that is taken for granted among adults living in cities, especially by Lynch (1960). It was argued by Pocock (1975), Spencer, Blades and Morsley (1989) and Matthews (1992) that successful individuals have not only acquired reasonably accurate maps of their immediate physical environment, but they have also developed mental tools which enable them to map any new environment rapidly and accurately. In contrast, Trowbridge (1913) postulated that the adults who routinely get lost (which he argued was due to lack of early childhood exposure to maps), have failed to acquire those mental tools required to map and manipulate physical environments. His research led him to propose a seven stage typology of the most common errors of orientation, e.g. that a major thoroughfare will always align to one of the four cardinal compass directions, which these people either consciously or unconsciously apply in daily life.

Such research forms a fascinating future direction for research on how individuals develop and use cognitive maps of their physical environment, but for now it causes me to concur with Kohn (1953), Riffle (1969), and Boardman (1989) about the importance of allowing young children to spend time exploring and investigating maps of all types. It also suggests that Blaut, McCleary and Blaut (1970) and Hart (1981) have a valid point about allowing children time to play with blocks, figurines and toy vehicles as an important stage in them learning to mentally rotate the isometric world into an orthogonal lay-out.

2.2.2 Sequential, Survey and Environmental knowledge

In considering what people in general and children in particular, know about maps and mapping, it is necessary to split the forms of knowledge into three kinds, namely sequential, survey and environmental knowledge.

The first type, (sequential knowledge), is about people's ability to recall, describe or follow a specific route between known locations e.g. finding one's way from home to school. Many previous researchers have investigated children's ability to recall a route by drawing, describing or following it themselves.

The second type, (survey knowledge), relates to the ability of children to describe the location of objects in the area around them to the researcher or to draw these objects for them, This echoes the work of Huynh, Ball, Doherty and Smith (2008) which asserts a map classification divided between those subjects who primarily focus on linear features such as roads and paths, and those who focus on environmental objects of importance to the observer. Those authors do however indicate that many people in fact utilise a hybrid of these two styles when asked to draw a map. The type of knowledge of interest to Lynch (1960) was the overall 'survey' mental image of a given area that is held by an individual and from which sequential route knowledge can be recalled at will.

The third type, (environmental knowledge), which has been far less researched, refers to the information that the child holds about aspects of their environment. For example, the child knowing that the former butchers' shop is now a newsagent because the butcher retired and sold the premises. This aspect of knowledge came through very clearly in my research, with children possessing quite high levels of such knowledge about their local physical environment.

Much of the research on children and maps has been investigating sequential knowledge and it is for this reason that I have instead chosen Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984). All of those researchers worked with children to produce artefact maps in order to understand the nature and extent of the survey knowledge held by the child. However, only Hart (1981) actively engaged with the children during construction of their artefact map, the others engaged in post-factum interpretations in the absence of the child.

2.2.3 Children's understanding of aerial photos and maps

Within the research on children's knowledge, (both sequential and survey), of maps there have been a variety of studies which used either aerial photographs or cartographic maps. Although some of this research uses quite different methods to investigate similar things it is still possible to make some general observations based upon the collective conclusions. Notably, Dale (1971) used both types of image and produced strong indications that children possessed more sophisticated understandings of orthographic views of the environment than had been previously thought.

It appears that aerial photographs may provide children with a form of transitional cognitive step in their learning to rotate their 3D isometric experience of the world into a 2D orthogonal representation of it via arbitrary symbols, (Thralls, 1958; Riffle, 1969; and Boardman, 1989). It appears from the three studies by Blaut, McCleary and Blaut (1970) that children aged 3-6 years in such diverse places as the USA, Puerto Rico and St Vincent were able to fairly easily identify their school and neighbourhoods from aerial photographs of appropriate scale (taken from 5000 ft.). This was supported by the work of Dale (1971) who found that 7-11 year olds using similar scale aerial photographs were able to locate their school and to trace familiar routes to known locations in their neighbourhoods. It is necessary here to acknowledge the 1997 debate between the position of Blaut and Stea who said that young children could interpret aerial photographs and that of Liben and Downs who said that they couldn't. My position accords with that of Blaut and Stea (1997) and having read both sides, I agree that the results obtained by Liben and Downs (1997) were more likely due to using photographs taken from a far greater height rather than the inability of the children to interpret the images in those photographs.

It is interesting that neither side attempted to replicate the methodology of the other in order to objectively test the truth of either their own or the other position. Therefore it would be worth repeating this experiment using images from both heights in order to confirm which position appears to have greater validity.

2.2.4 Humans and mapping

This is relevant to studies involving the production of artefact maps, because individuals render the physical world into a cognitive landscape which is coherent within (but not automatically outside of), their particular cultural group due to use of different symbols which may cause the same physical object to possess multiple meanings, Gillespie (2010). In this context it is worth reflecting that Western maps are orientated with North at the top as the cardinal direction mainly because Westerners agree that it is, rather than through any intrinsic 'rightness', (Fenna, 2006; Kaiser, 2013; Danforth, 2014). By contrast Chinese maps traditionally used South as the top of the map and cardinal direction because they had much earlier discovered the magnetic attraction of the poles and had, equally arbitrarily, chosen South as the end of the needle they would orientate toward, (Wood, 2010; Danforth, 2014).

Arabic map makers such as Muhammad al-Idrisi who produced the much copied 1154 Tabula Rogeriana map of the Mediterranean for the Norman king Roger of Sicily, were influenced by the Chinese tradition of cartography and hence the top of their maps was usually south, (Danforth, 2014). Prior to the introduction of the compass (probably from Chinese or Arabic sources), in the 14th century European navigators relied more on the astronomical stability of the Pole Star as a directional indicator, (Fenna, 2006; Wood, 2010). Since then, the majority of western maps have been orientated toward Magnetic North at the top of the map and this choice appears to be simply a case of continuing to look northward when thinking about fixed points for navigation, (Wood, 2010; Kaiser, 2013; Danforth, 2014)

It is explicitly noted here, that many well-known historical maps of cities such as the 1485 map of Constantinople by Cristoforo Buonodelmonti, the 1575 map of Rome by Pirro Ligoria and 1720 map of Venice by Matthaus Seutter, all use isometric depictions of buildings within an overall orthogonal image. Therefore, we must remember that the use of entirely orthogonal images is only about 200 years old and that maps are a purposive utterance to convey information which the creator thinks is relevant to themselves and to the reader. We should therefore be careful of underestimating children's knowledge based upon their use of isometric depictions of buildings in their maps.

In cartography however, even when the same symbols are used to depict the same feature there may be significant differences in the meaning ascribed to the object through the scale used to depict it, (Fenna, 2006; Wood, 2010; Brotton, 2012) . This is because of subjective differences derived from the level of individual interaction with the object, (Dewey, 1915), For example, to both a fighter pilot and an infantryman, a mountain will appear on their maps as a collection of concentric contour lines with the spot height at the top. The pilot moving above the ground at several hundred miles per hour requires only the general shape and the height of the hill plus its proximity to other hills. The infantryman however, is deeply concerned at how close together the contour lines are as this indicates the steepness of the slope up which he must walk or fight. Therefore, as Jackson (1989) and Golledge (1991) point out, individual experience of the physical environment will always be mediated by cultural context and constructs. In particular, Jackson (1989) argues that cultures themselves might be considered cognitive maps, as they are ways of making the experienced world intelligible to those within that cultural group. So, if Gillespie (2010) is correct that culture is transmitted inter-generationally through the socialisation processes of family school, religion etc. then it seems automatic that children's artefact maps will reflect the psychosocial barriers created by the cultural norms and expectations that arise through that socialisation, (Smucker,1988).

The work of Harley and Woodward (1987) and Brotton (2012) asserts that the desire to order and depict information about their physical environment is a universal human trait. This seems supported by the work of Blaut, Stea, Spencer and Blades (2003) who found that the selective ordering, storage and recall of such information does occur even in young children. Indeed, the creation of map-like artefacts appears to be the most efficient means of depicting truly large-scale space and that such behaviour occurs across cultures even amongst pre-literate children, (Harley and Woodward, 1987; Woodward and Lewis, 1998). This finding is consistent with Hart (1981), Matthews (1984) and Huynh and Davis (2005) who all found that the strict chronological and linear development of these skills proposed by Piaget and Inhelder (1967) is not supported where children have had early access to model materials such as blocks and cars, (Blaut, McCleary and Blaut, 1970). It is theorised by all of those researchers that building a town from blocks and driving a car or walking a figure through it teaches the young child, (almost by default), how to adopt a 'Plan View' of a physical environment, (Gibson, 1979; Blaut, Stea, Spencer and Blades, 2003). It appears that such types of early play 'may' allow even very young children to be able to demonstrate sufficient understanding of Piagetian space to enable an adult to recognise the physical artefact as a 'map'.

However, the work of Pocock (1975) and Matthews (1992) questions the existence of mental versions of the artefacts we call 'maps'. Similarly, the work of Evans (1980), and Downs and Siegel (1981) suggests that even adult mental 'maps' of large scale space are much more like approximate metaphors than objective depictions of physical space. This is important, as Thommen, Avelar, Zbinden Sapin, Perrenoud and Malatesta, (2010) remind us that all maps are constructed as aids to convey information for understanding about a real physical environment. That is to say, all maps are created implicitly as artefacts for the transmission of knowledge and as Dewey (1915) points out, that transmission will only succeed when supported by shared cultural experiences of making and using the object or concept in question.

2.2.5 How adults make and use maps

In 1908 Eckert and Joerg asserted that it was possible to classify all artefact maps into two categories but these are not mutually exclusive and a given artefact map may contain elements belonging to both categories. The proposed categories are based upon what information the artefact map depicts. The first category is comprised of Chorographic, Topographic and Survey maps which primarily depict observable physical features of the Earth's surface such as locations of mountains and rivers and show types of landforms such as deserts and jungles. These are considered 'geographically concrete' maps.

The second category is comprised of maps that depict the spatial distribution of information such as population density, literacy, infant mortality etc. which has been generated by a reasoned process either of induction or deduction. The purpose of this second type of artefact map is to render this deduced information into a visual form to make it more readily intelligible.

This is why Eckert and Joerg (1908) considered the two categories to be necessarily fluid rather than rigid. Because just as information about population density becomes concrete when scaled to a particular point on a map (e.g. a larger dot for a bigger town), so too physical artefact maps become abstractions when drawn at too large a scale (e.g. smaller bays disappear into a general coastline). As a historical sidelight, these authors are notable as being among the few geographers to place, (an admittedly somewhat pedantic), caution on the use of contour lines in relief maps as they felt the exactitude suggested by such lines gave a false impression of scientific accuracy. Their objection is that a contour line is an approximate depiction linking points of equal measured height rather than a line actually measured on each slope with a theodolite.

With such cautions in mind, both the original authors and I would explicitly make the point that both types of artefact map are constructed through a cognitive process by individuals, making choices about what is depicted and the scale at which it is shown. A view supported by Trieb (1980) and Matthews (1992).

2.3 Children's cognitive and physical development

Research on how adults cognitively mapped and depicted their cities in free recall sketch maps led Lynch (1960) to conclude that people's spatial understanding of a large scale physical environment begins with an understanding of the city as a collection of *districts* with visually definable *edges*. Both within and between those districts people mentally map out networks of *paths* and *nodes* upon which *landmarks* are then identified. He theorised that this spatial typology led people to use the *paths*, *nodes*, *landmarks*, *edges* and *districts* as aids to both spatial organisation of cognitive mapping and navigation in the physical world.

However, in terms of child cognition this seems inconsistent as children do not appear to process or organise the same environmental stimuli in the same ways as adults, (Siegel and White, 1975). Those researchers argue that children identify visible landmarks along a route and thereafter recall the route through successive recourse to those landmarks. This is important as it was identified by Lynch (1960) and Appleyard (1970) that people with greater levels of personal mobility tend to construct more coherent overall maps of a large scale physical environment. Their work also indicated and that people with lower mobility tended to construct maps featuring islands of detail linked by main transport routes with sparse detail along them as cited in Andrews (1973), Pocock (1975), Spencer, Blades and Morsley (1989) and Matthews (1992).

It also appears that children attend to environmental cues and markers at different levels to adults both in terms of height of gaze and of types of objects considered worthy of attention, and this affects their recollection of paths and landmarks, Darvizeh and Spencer (1984). More recent research with, rather than upon children, shows that children experience the environment through all their senses because they have not yet become task-focused like adults. To a child, the experience of walking to the shop is just as important as the purchase of groceries and so constricting the former for the sake of the latter lessens their learning about the world, (Reggio Children, 2000; Gopnik, 2016).

The work of Pocock (1975) suggests that it is unlikely that most people, including adults, carry around a detailed map of their town in their heads. Instead it seems that as Trowbridge (1913) suggested, their cognitive map is a much more a general layout of the area which is understood in terms of previously absorbed principles. Pocock argues that when people are asked to construct an artefact map they appear to recall and depict only those objects which they deem relevant to the stated purpose for the map. He further argues that asking a person to produce an artefact map causes them to privilege spatial knowledge over environmental knowledge because the former is easier to represent graphically than the latter. Such a view, and the work of Neisser (1976) and Spencer and Darvizeh (1983) with children, supports Polanyi's (1966) 'tacit knowledge' view of broader cognition by demonstrating that quite young children can both walk a route and successfully describe it orally to a stranger even if unable to draw a recognisable map of it.

2.3.1 Piaget, children's cognitive capacity and maps

As he is considered to be one of the key thinkers of research on and with children, no discussion of such research would be complete without reference to the work of Jean Piaget. In the context of my research, his contribution was a view of the capabilities of children to understand, describe and use physical space. His views here however, align with his broader views about children developing in an average way through a range of age-related stages and in some ways he underestimates the capacities of young children, (Donaldson, 1978; Gopnik, 2016; Reggio Children, 2000).

The work of Piaget and Inhelder (1956) and Piaget and Inhelder (1967) showed that children between four to eight years were capable of understanding and depicting a known route in a familiar large-scale environment through the use of models. That research echoed Dewey's (1915) view on education as communication, by concluding that to communicate information about an environment in a way that is useful to another person, the maker and the user of the map must share systems of common cultural understanding. Piaget and Inhelder (1967) argued that to be able to accurately construct a usable 'map', the maker must be able to convey Euclidian, Projective and Topological space. It is necessary here to briefly explain those three terms:

- Euclidian Space is the understanding by the person constructing the artefact map that a depicted object should be proportional to the length of the real object when drawn to a chosen scale. (E.g. 1:25,000 for Ordnance Survey maps). This suggests that the person will, (or should), adopt a single scale within any given artefact map.
- Projective Space is where a perspective or point of view is taken (e.g. Mercator's Projection of the Earth). All artefact maps are drawn from single perspective which is normally 90 degrees vertical rotation above the ground depicted.
- Topological Space is where objects depicted occupy the same proximal relationships to each other on the map that the real objects occupy to each other in the real world. This quality suggests that the person constructing the artefact map understands that in order to be useful to other people for navigation the image depicted must be a coherent and unified whole. Simply stated, it must be possible to stand facing North with the map similarly orientated and reliably expect that an object depicted as being to your East on the map will lie to your physical right.

Such a view agrees with Eckert (1908), Dewey (1915), Mead (1938) and Blaut (1991) in saying that in order to construct an artefact that an adult will recognise as a 'map', the child must employ certain spatial and graphic conventions. Even if these conventional symbols are not formally cartographic they are at least sufficiently common as to be intelligible to an adult looking at the artefact. This is somewhat problematic as Pocock (1975), Lilley (2000) and Brotton (2012) remind us that a person creating an artefact map is necessarily required to transfer the three dimensional physical landscape onto a two dimensional surface through a process of cognitive choices about what to include and how to represent it. This is why this original research sought to have children construct their artefact maps without knowing the proposed use of those maps. By the researcher not specifying a future use of the artefact maps, the children had to decide which objects to depict in order to graphically represent their town.

This difficulty of rendering the three dimensional physical landscape onto a two dimensional surface is compounded when we consider that the cognitive map of any landscape is a geographically grounded mental frame through which objects and events in a specific area are assigned coherent meanings based on individual experience of them, (Pocock,1975 and Bruun,1996). That is a position on purposive utterances and the filtering influence of culture on all spoken words, written texts etc. which Dewey (1915) explored at some length and through several analogies. It also suggests that contrary to the views of Piaget and Inhelder (1967), the drawing of ego-centric maps is common to humans rather than confined to children.

2.3.2 Problems with Piagetian constructions of children and maps

Piaget does however pose a problem for my research, in that his findings were used as a starting place for researchers from disciplines other than education and were often taken at face value. This led to some conclusions that might today, be regarded as unsound. As early as the 1970's the work of Dale (1971) with primary school children showed them as having considerably more competence in interpreting both aerial photographs and maps than Piaget and Inhelder (1956) and Piaget and Inhelder (1967) suggest they ought to possess. By 1978, Margaret Donaldson was suggesting that the experiment design and the nature of the question used in Piaget's famous 'mountain' experiment was flawed because the artificial question that it posed would make limited sense to a child of the age being tested. This is an observation echoing the view of Parker (1942) about why people make and use maps.

It was argued by Donaldson (1978) that young children without experience of formal education would respond to adult questions by attempting to use common sense reasoning based on their own life experience. Her research also led her to conclude that the lack of exposure to formal classroom behaviour tends to permit younger children to be more honest in their answers. More recent research such as that by Bonawitz, Van Schindjel, Friel and Schulz (2010) and Buchsbaum, Gopnik, Griffiths and Shafto (2010) on how formal schooling shapes learning seems to support her view.

For these reasons, Donaldson (1978) argued that Piaget's conclusion about the alleged ego-centricity of the children in his 'mountain view' experiment was overlooking the influence of schooling as a factor in shaping how children answered the question. She argued that a child who had not yet been to school might respond to Piaget by saying that they didn't know what the mountain looked like from the far side as they had never seen it from that angle. But, a child who attends school knows that when an adult in a classroom asks a certain kind of question in a certain kind of way then it is 'better' to give a wrong answer than to either admit not knowing or to challenge the nature of the question. Donaldson's views appear to be borne out by the work of Reggio Children (2000) on children's exploration and understanding of large-scale environments and Gopnik (2009, 2012) on how children learn to reason and problem solve.

The work of Bluestein and Acredolo (1979) with three to five year olds may provide us with a clearer example of how uncritical acceptance of Piagetian construction of child capabilities may lead to misinterpretation of child behaviour in mapping tasks. In their study a 'large-scale' space (indoor and roughly classroom sized), was created and children were asked to locate a toy hidden in a box within the space after being shown the toys' location on a map of the space. The majority of unsuccessful children in this task were unsuccessful because they (particularly the younger children) were searching for the toy directly opposite its actual location.

It is noted here that Stea and Blaut (1973) criticised many studies of children's mapping abilities precisely because they did not test the child in a truly large-scale space – instead using artificial indoor laboratory environments or small outdoor playground ones. Indeed, it seems that 'mapping' behaviour is a response of humans attempting conceptualise an environment which is too large to be experienced from a single viewpoint, (Wood, 1992; Cosgrove , 2007) and Brotton, 2012). The ability of young children to independently use maps in a genuine large-scale environment appears to remain an area of potentially useful inquiry even forty-three years later.

In their study, Bluestein and Acredolo (1979) found that the age of the child was a strong predictor of successful search and they ascribed this to Piagetian ego-centricity in the younger children. However, if we examine the conduct of the experiment more closely an entirely different explanation suggests itself. Their experiment was conducted with 3 – 5 year olds and each age group of children was divided into four groups and shown the map in different ways as follows:

- Shown map inside room with map correctly orientated to ground.
- Shown map outside room with map correctly orientated to ground.
- Shown map inside room with map orientation rotated 180 degrees to ground
- Shown map outside room with map orientation rotated 180 degrees to ground

Almost all the children of all ages who were shown the map inside or outside the room and correctly orientated were able to easily locate the toy, but only the five year olds (and not even all of them), were able to locate the toy when shown either of the incorrectly orientated maps. This suggests that the children were taking the map as a purposive utterance, by the adult researchers, (Schiller, 1929). This is supportive of the conclusion drawn by Donaldson (1978) that the children were treating the research task as if it were a concrete real world problem. This error is consistent with the adult research conducted by Levine, Marchon and Hanley (1984), demonstrating the importance for successful navigation of correctly orientating a map to ground prior to commencing movement. It is noted that work of Blades and Spencer (1986), and Blades and Spencer (1990) found that the majority of four year olds could also successfully complete the task if they were first shown how to orientate map to ground.

This is where the underestimation of general child cognitive capacity by the previous researchers, both Piaget and Inhelder (1956) and Bluestein and Acredolo (1979), appears to have caused them to unintentionally 'wrong-foot' the children in their experiments. It would be the assertion of Donaldson (1978) and Spencer, Blades and Morsley (1989), that the children responded to the research task as if it was a genuine request (or at least a genuine game), in which an adult asked the child to go and find something. It appears that the children logically assumed that since the adult was sending them to search for something, then the adult would provide information to maximise the child's chance of success. This would be logical because the work of Donaldson (1978) suggests that this is how children are likely to have previously been dealt with by adults in similar real world situations. So it would be unsurprising that the children in all groups should accept the map as a correctly orientated purposive utterance and search in the area 180 degrees from the actual location of the toy.

This is consistent with what was demonstrated by Gauvain and Rogoff (1986) and supported by Spencer and Blades (1993), namely that goal is a key determinant in children's ability to recall and depict both layout and route information within large-scale space. These views support the findings of Matthews (1980) and Brotton (2012) that the construction of an artefact map is always understood as a purposive utterance by the constructor, who intends it to have a practical use, (Schiller, 1929; Dewey, 1938). Consequently, the production of any artefact will unavoidably involve the suppression or exclusion of information that the constructor deems irrelevant to their perceived end use of the artefact. This is consistent with Polanyi (1966) who argued that in any situation people always possess more information than they are able to convey in a given medium and finite time period. It also highlights the findings of Orleans and Schmidt (1972) '*home area*' and Klein (1967) '*central area*', about the importance of any discrepancies between the terms which researcher and subject use about the nature and extent of the area to be mapped. This is a significant issue in its own right as the work of Hewitt (2010) shows how such semantic differences delayed and distorted the creation of the famed series of UK Ordnance Survey maps, (a purposive utterance par excellence), across a period of 80 years.

2.4 Children and maps

2.4.1 Two schools of thought about children and maps

It appears that the research on children and their ability to understand, make and use maps, may be broadly divided into two groups. In the first group are the researchers like Robinson and Petchenik (1976) Boardman (1983) and Acredolo and Boulter (1984) who accept Piaget and Inhelder's (1956) view. In the second group are those researchers such as Martin (1976), Donaldson (1978), Blaut, (1997a), Blaut,(1997b), Spencer, Blades and Morsley (1989), Geeslin and Shar, (1979), Karsten (2005) and Huynh, Ball, Doherty and Smith (2008) who do not.

In their review of the then existing literature, Spencer, Blades and Morsley (1989) suggested that some significant issues existed with the research on children and maps, and I will now present the four main criticisms which they identified.

Firstly, much of the research, especially that of the non-educationalists Robinson and Petchenik (1976) and Boardman (1983), used an uncritical and fairly basic understanding of Piaget and Inhelder's (1956) work in constructions of children and their cognitive capacities. Importantly, the work of Presson and Somerville (1985) actively discounted ego-centrism as the cause of the errors described by the above researchers.

Secondly, the work of Acredolo and Boulter (1984) took a deficit view on children's capacity to perform navigation tasks using maps despite Stevens and Coupe (1978) having already found that adults performing similar tasks experienced similar problems. This raises some wider questions about how people, rather than just children actually use maps, because both Tversky (1981) and Blades and Spencer (1986a) found that the ability of the general adult population to reliably use maps appears to be markedly lower than is commonly assumed. Possibly this explains the old military adage that the most dangerous thing in the world is a newly commissioned Lieutenant armed with a map and compass.

However, this does not suggest that as researchers we know nothing about how children make and use maps, merely that there is room for more research into '*how we think we think*' Dewey (1910). On a brighter note, the work of Ottosson (1987) tested 5-12 year old Swedish children on real streets by giving them a starting point and a destination to reach on a map (which was not always correctly oriented to ground when presented). Then Ottosson walked with the children on their route and asked them to verbalise their reasoning each time they changed direction or made a decision affecting the route. His study found that the only children who failed to reach their destination were the ones who failed to correctly orientate the map to ground before moving off.

This is entirely consistent with the work of Levine, Marchon and Hanley (1984) who studied how adults in shopping malls used wall-mounted '*You are here*' maps. Their work found that unless the maps were correctly orientated to ground (i.e. that objects depicted at top of map lay to the direct front of the subject) then the majority of adults made an erroneous assumption as to the correctness of the map orientation and began to navigate based upon that erroneous assumption. A recent conversation with a friend who has high functioning Autism suggests that even common symbols and conventions such as a directional arrow are not clear as we may assume. He argued that such arrows, pointing up so as to symbolise "Go straight ahead", can be interpreted by more literal-minded people as indicating a need to go up to a different floor. Such alternative interpretations of common signage are also a potentially interesting future research direction.

Thirdly, it is difficult to extrapolate reliably from much of the pre-1990's research because often there is insufficient methodological detail available in the public domain to permit valid replication. This is particularly the case with information regarding materials and instructional sets provided to child research subjects, (Atkins, 1981; Spencer Blades and Morsley, 1989). My own research encountered this difficulty in that it was necessary to make interpretations of the theorist descriptions regarding their map classifications in order to generate exemplar images of each level.

Fourthly, much of the research on children's mapping ability focuses on the average performance of a group of children in a specific task, which is often divorced from concrete real-world activities for the children. This is significant as the work of Donaldson (1978), Gauvain and Rogoff (1986), Ottosson (1987), and Reggio Children (2000) strongly suggests that tying the required activity to concrete goals familiar to the children from everyday life will greatly improve their tested performance. Much of this sort of research also fails to explore the strategies of recall, interpretation and navigation that were actually used by either successful or unsuccessful children and so it is difficult to say either how or why the children performed as they did.

This original research however meshes with that of Hart (1981) in actively seeking to learn what the children know about the artefact map with which they are presented and then having the children 'think aloud' while constructing their own artefact maps. Having children interpret the unlabeled map of the fictitious area engages with the research of Blades and Spencer (1987c) on how children were able to interpret standard cartographic symbols on a map of such a fictional area. It is noted here that their successful research was conducted with children three years younger than those in my own research. This supports the view that the acquisition of mapping knowledge by children is "Early and Easy", as argued by Blaut and Stea (1997) rather than "Late and Difficult", (Liben and Downs, 1997)

2.4.2 Children's cognition and maps

Although some research was conducted between 1960 and 1989 on children's free hand mapping of known routes, much of it was about exploring the Piagetian construction of aged-based linear development of child cognition about space and way-finding. Some of this research mirrored findings with adults but often there appeared to be anomalies in depiction and description of physical environments which could not be accounted for via simple causes like age-based cognitive abilities or distraction from task.

Much of this research on both children and adults suggested that Piagetian views were an incomplete understanding of these phenomena. Both Bronfenbrenner (1977) and Moore (1986) argue that this may be because much of the early research such as Gump (1975) and Weinstein (1979) tended to be focused on cognitive differences between individual children to the exclusion of environmental factors which may exert strong influence in creating those differences.

The gradual change of focus to include firstly human factors such as parental presence and activity and later to include environmental variables such as noise, space, greenery etc. is thoroughly described by Moore (1986). Some crucial studies in this growth are Ittleson et.al (1970), Hart and Moore (1973), Acredolo (1976), Donaldson (1978), Gauvain and Rogoff (1986) and Ottosson (1987), which all found that young children are quite capable of acquiring, ordering and utilising spatial information when it is related to a concrete goal that the child understands as valid in a 'real world' rather than 'laboratory' sense.

It was these findings, combined with those of Spencer and Darziveh (1983), Matthews (1992) and Gibbs Jnr, Costa Lima and Francozo (2004) that caused me to actively discount any attempts to investigate my research questions through either actual or virtual models of towns. My study was however, conducted with the awareness that both of those methodologies represent some interesting future research directions within the field. Especially interesting is the ability of information technology to construct immersive virtual environments that could easily be navigated for extended periods by children or adults using haptic interface devices and virtual reality goggles. It was noted, that much of the existing research has focused on sequential knowledge of specific aspects of a given environment known to both the researcher and child such as routes, typically those between home and school. My research is more open-ended in simply giving children a blank sheet of paper and a chance to talk while drawing an environment known to them but not necessarily to the researcher. This is because the purpose of this research is to see what the children will choose to draw, in what order, and to have them articulate why they do so, when given the opportunity via an open-ended task.

It is acknowledged that the information elicited by this particular instruction set (*Draw me a map of your town*), may yield a greater number of what Matthews (1984) terms 'Plan rather than Pictorial artefact maps', than the instruction set "*Draw me your neighbourhood*" used by Lehman-Frisch, Authier and Dufaux (2012). This is not however necessarily an impediment, as one of the interests of this research is actually to see which kind of artefact maps are produced by the children.

In his two-year field study Hart (1981) examined a wide range of children's exploratory behavior, spatial behavior, place knowledge, and feelings about place. Among his many other findings, Hart concluded that the development of a child's spatial ability to navigate in, and to represent information about, their everyday physical environment is related not only to the physical extent of their free play range space but also to the independence of their spatial activity within it. Further, he found that child memory for places appears closely related to their ability to modify their environment. In his 1978 study of the New England town of 'Inavale' Hart found that boys generally enjoyed much greater freedom of movement and were permitted to travel unsupervised much further afield, including to a much wider array of places. In addition to being more restricted at the same young age, Hart (1979) found that as girls grew older their increased participation in the daily household routines of family life meant that there were even greater constraints placed on both their amount of spatial freedom and the amount of time in which to explore.

In his research Hart was able to distinguish the following three categories of parental control which were influential on child range and behaviour. In ascending order of spatial extent these are:

- *Free range* - places to which children may go at any time without specific permission or other persons.
- *Range with permission*, these are places where the child may go alone, but only with explicit parental permission.
- *Range with permission, in company other children*, which means that not only is explicit parental consent required, but that gaining it at all is contingent on the child being with other companions.

Consistent with the unrelated work of Ward (1978), Hart (1979) found that the spatial and temporal limitations on boys were much looser than those of equivalent age girls and that transgressions tended to be dealt with through guidance rather than withdrawal of privileges. These findings were still broadly accurate in research by Karsten (2005), Thommen et al. (2010) and Lehman-Frisch et al. (2012). However, all three strongly suggest that the reality of lived experience, at least for urban Western European children, is considerably more complex and fluid.

These are important issues because Lynch (1960) and Moore (1973) found that even adults draw artefact maps which are better organised and more spatially accurate when they are more familiar with the area being described. Similarly, Murray and Spencer (1979) found that geographical mobility is a significant variable on the accuracy of construction of both mental and artefact maps for both adults and children and this was supported by Matthews (1980) study in Coventry. This issue showed up strongly in the work of Karsten (2005), Thommen et al. (2010) and Lehman-Frisch et al. (2012) who found that ethnicity, social class and parental concerns were all significant variables.

This research sought to examine contemporary children's representation of their local physical environment in terms of Lynch (1960) spatial typology via the medium of free-recall hand-drawn maps of a known physical environment. These artefact maps were compared to the typologies of children's maps proposed by Ladd (1970) Moore (1973), Hart (1981) and Matthews (1984). Those authors were chosen because their work all strongly supports the findings of Siegel and White (1975), Neisser (1976) and Spencer and Darziveh (1983). Those three studies all found that children under 10 years of age possess, use, and can articulate large amounts of complex information about their known large-scale physical environments despite their imperfect inability to convey that information graphically.

As such, it was necessary to draw upon literature about the ways that humans make, interpret and use maps both as cognitive process and as physical artefacts. This involved literature on how children and adults understand maps as methods of storing and communicating information and of ordering the experienced world, (Piaget and Inhelder, 1967; Robinson and Petchenik, 1976; Gerber, 1981).

These discussions will examine categorisations of space and the diverse skills required of a child (or adult) in order to construct a two dimensional representation of three dimensional space in a comprehensible form, (Ward, 1978; Beck and Wood, 1976; Downs, 1985; Matthews, 1992; Gauvain, 1992).

This will require a more general discussion about the nature of the world as rational and knowable, which is to say predictable rather than arbitrary as a set of experienced phenomena, (Nichols and Yaffe, 2014; Joshi, MacLean and Carter, 1999; Blaut et al. 2003; Blades and Spencer, 1990). It will also be necessary to draw on literature about children's performance of drawing tasks in general, especially within a school setting and to consider the effects of age, gender, class and ethnicity upon their performance, Kulhavy and Stock (1996), Mitchell (2006), Lehman-Frisch et al. (2012), Elden (2012).

2.4.3 The role of language

The construction of any map then, either as mental construct or physical artefact requires the individual consciously as well as unconsciously to make selections about what they observe, how they arrange the information mentally and how they will graphically convey it to individuals. The work of Bowerman (1989) and Choi and Bowerman (1991) examined the ways in which spatial relationships are classified in different languages and their findings raise questions about Lynch (1960) assertion of the existence of a universal spatial typology. In her study Bowerman (1989) found that the use and meaning of spatial predicates such as 'on', 'in' 'under' etc. varies considerably across languages which leads her to conclude that "*semantic categories cannot be viewed as a direct reflection of the structure of non-linguistic thought*" Bowerman (1989, p. 150).

If Bowerman (1989) is correct, and there is no reason to doubt her data or logic, then this finding is significant to this research. She argues that although universal perceptual and cognitive faculties may exist, it is clear that children acquire particular spatial predicates as *cultural amplifiers*, Berland (1977), Cole and Griffin (1980) within a given language, by routinely attending to the spatial configurations to which they refer.

The basis of this claim is that different languages appear to divide and order the spatial world in quite different ways. In the initial research Bowerman (1989), examined linguistic differences between English and German while in the subsequent research Choi and Bowerman (1991), they considered the differences between English and Korean. In the former case it was found that the 'supporting' relationship of the English predicate 'on' e.g., "*The book is on the table.*" "*The painting is on the wall.*" "*The ring is on the finger.*" is much less definitive than in German where such relationships have three distinct categories with separate predicates. The first predicate is where two objects are in contact horizontally, the second is where the objects are in vertical contact and the third is where one object encircles or encloses the other.

In the latter research, it was found that Korean not only mirrors German in the use of separate predicates of relationship, it also possesses separate verbs for when one object is placed tightly in another e.g. "*Put the pencil into the pencil sharpener*" and another for when the object is loosely fitted e.g. "*Put the paper into the basket*"; Choi and Bowerman (1991). These two studies collectively suggest that English tends to use coarser descriptors, Hayward and Tarr (1995), than either German or Korean and is more interested in their physical proximity than in the nature of their relationship.

These findings are cited by Choi and Bowerman (1991) as supportive of the latter's hypothesis that, rather than objectively reflecting the structure of non-linguistic spatial relations, spatial predicates differ precisely because languages are a cultural construct just like artefact maps. Which means that they represent the collective results of choices about inclusions and omissions by the individual who constructs them.

2.4.4 The role of children's independent mobility

Many studies such as Gaster (1991), Hillman, Adams and Whitelegg (1990) Valentine and McKendrick (1997) and Pooley, Turnbull and Adams (2005), have been conducted since the 1960's on the decline of children's independent mobility and these tend to focus on the distances travelled between home and school and the means by which children undertake this most common of childhood journeys. It is argued by Hart (1981), Matthews (1992) and Kegerris (1993) that being able to make independent journeys is very important for children's emotional and mental development. This is because without an adult/parent present to mediate or interpret their experiences the child start to function in an autonomous way. Independent journeys require children to utilise both previous adult advice and their own resources in order to process experiences and respond to situations. Such encounters with the world provide children with opportunities to experience the wider adult world and develop skills for physical, mental and emotional navigation. The hypothetical story of a single boy's school day which Kegerris (1993) uses to illustrate the diverse range of learning which occurs simply because the child travels through their town alone, is consistent with the findings of Reggio Children (2000) and Karsten (2005).

2.4.5 The role of gender

The findings of Spencer and Weetman (1981) as reported by Matthews (1984 a), suggest that men and women construct both mental maps and physical artefact maps of the same space in quite different ways. This could be due to innate perceptual differences, but the work of Tindal, (1971) and Saegart and Hart (1979) suggests they are more likely the result of strongly gendered restrictions on the parameters allowed for young people and children to encounter the physical environment without adult mediation. It was speculated by McGuinness and Sparks 1983) in Huynh Doherty and Sharp (2010), that the apparent female predilection for landmarks may be because they create their sketch maps by grouping proximal elements, such as organizing landmarks that are in front of, behind, and next to each other, and creating a map from part to whole. Additionally, since females generally have better visual-item memory, they may be better able to recall solitary entities or objects like landmarks.

In contrast, Galea and Kimura (1993) in Huynh Doherty and Sharp (2010) suggest that generally males tend to focus on establishing a set of co-ordinates to form a geometric framework before drawing landmarks. Conversely, male participants rely on orientation and direction, with the aid of paths, to create sketch maps (McGuinness and Sparks 1983), Galea and Kimura (1993).

It is argued by Eals and Silverman (1994) and Geary (1995) in Huynh Doherty and Sharp (2010), that the evolutionary division of labour may have an important role in shaping storage and recall of spatial and environmental knowledge. They argue that the cognitive demands of hunting and warfare may have privileged those males with greater ability to use geometric relationships in space. On the other hand, female food gatherers were more successful if they possessed skills related to recognising and recalling landmarks, particularly with regard to memory of the specific location of fixed objects. Interestingly the work of Vanselow (1974) and Hart, (1981), and Hart, (1984) suggests that these gender-based differences may disappear amongst children who have had opportunities to play with blocks and trucks. It is my suspicion that these differences may reflect the gendered nature of early years play due to the kinds of games played by boys and girls. To confirm this hypothesis though further research would be required.

2.4.6 Children's understanding of orthogonal depictions of the physical environment

The work of Blaut, McCleary and Blaut (1970), Dale (1971), Stea and Blaut (1973), Spencer, Harrison and Darvizeh (1980) and Plester, Richards, Blades and Spencer (2003) all found that children as young as three years can fairly easily identify aerial photographs as representations of the physical world. Those children were also able to identify common objects such as roads, rivers, railway lines and houses without much difficulty. In their research Spencer, Harrison and Darvizeh (1980) found that children between six and eleven years were able to identify a specific location such as their school and trace a route to another location such as the railway station. The work of Blades and Spencer (1987b) showed that children four to six years of age could identify common objects on an unlabelled cartographic map of a fictional urban area through the recognition of conventional symbols for those objects.

This was an aspect of children's understanding of the physical environment which my research sought to directly address as it appeared to me that the Piagetian foundation of many previous studies was causing the researchers to underestimate child capabilities.

2.4.7 How children use maps

There is considerable evidence, Matthews (1992), Blaut and Stea (1997), Liben and Downs 1997) to suggest that although children's understanding of space is not as rigid and linear as Piaget and Inhelder (1967) suggest, it is different in important ways to that of adults. The work of researchers from Reggio Children (2000) and Buchsbaum, Gopnik, Griffiths and Shafto (2010) suggests that the spatial knowledge and understanding of children does alter with increasing age and largely comes to mirror that of adults by the late pre-teen years.

A series of studies by Ottosson (1987) with Swedish children aged five to twelve years found that they can usually successfully utilise an artefact map to navigate in the real world (as opposed to in a laboratory or other artificial indoor maze), from one specified location to another. Those studies also support the finding of Levine, Marchon and Hanly (1984) that failure to orientate the map to ground correctly before moving off is a major determinant of consistent error types.

The work of Presson, (1982) and Blades and Spencer (1986a) both suggest that the errors encountered by Bluestein and Acredolo (1979) may be indicative of how children utilise landmarks depicted on maps in order to orientate themselves to ground in performing actual navigation. Both studies found that children aged six to eight years had difficulty with tasks when presented on the ground with maps that had been rotated either 90 or 180 degrees from correct orientation.

It appeared in both studies that the children fell into error through accepting the present map orientation as being accurate to the ground depicted. These findings are entirely consistent with the research of Levine, Marchon and Hanly (1984) on how adults in shopping malls use 'You-are-here' maps and with the work of Stevens and Coupe (1978) and Taylor and Tversky (1981). They also seem supported by the work of Bryant (1991).

It appears that the work of several researchers, Blades and Spencer (1987a), Presson (1982), Blades and Spencer (1986a), Bluestein and Acredolo (1979) and Gauvain and Rogoff (1986) on children's ability to navigate through applied interpretation of a map have to common characteristics.

That is, the 'large-scale space' is in fact usually an indoor and comparatively 'small-scale' space, often no larger than a tennis court and involves an artificial task. It appears that such tasks may constrain the actual abilities of the children to navigate successfully in the real world because no such problems were found by Spencer and Darvizeh (1981), Matthews (1992) or Holloway and Valentine (2000). Similarly, neither Ward (1978) nor Hart (1981) found children getting lost in the course of their outdoor play ranging.

2.4.8 How children draw physical spatial environments

The work of the four selected theorists (Ladd, Moore, Hart and Matthews), and others has examined the artefact maps produced by children in response to instructions to map a familiar environment and a caution needs to be placed here about the adult assessment of child artefact 'maps'.

Any map is a substitute for the physical space it claims to show, constructing what it represents, and organising the infinite sensuous variety of the Earth's surface according to a series of abstract marks, the beginnings of borders and boundaries, centres and margins. A map always manages the reality it tries to show. (Brotton, 2012 p. 7).

What this suggests in practice is that whenever an adult says that a child's artefact map is '*inaccurate*' or '*wrong*', they are to some degree actually saying nothing more than "*This environment has been depicted in ways which neither I nor other adults would have depicted it.*" This is not an insignificant point as the work of Downs and Siegel (1981) explicitly cautions against an uncritical acceptance of Piagetian 'progress' in examining either the cognition or the artefacts of children.

The work of Downs and Siegel (1981) suggests quite strongly that the adult-perceived competence improvement may simply indicate greater acceptance by the child of adult-centric cartographic conventions in respect of the selection, depiction

and arrangement of elements depicted. Their work builds on the research of Ladd (1970) who worked with 12-17 year olds in Boston, Massachusetts and graded the resultant artefact maps according to the level of adult perceived accuracy discerned. The instructional set used deliberately avoided using the term 'map' and was for the child to produce something which could illustrate the child's understanding of the elements comprising their neighbourhood. Ladd's (1970) findings were consistent with those of Lee (1964) and are supportive of the main argument of this research. Namely that children's knowledge about their local large scale space is often more elaborate than traditionally assumed by adult researchers. The research by Lee (1964) with eight adults who lived within 100 yards of each other in a dense urban residential neighbourhood, produced artefact maps with almost no coinciding features when overlaid together. This suggests that adult's cognitive maps of their neighbourhood are also highly subjective, fluid, use egocentric landmarks and are generally of roughly half a mile (800 metres) radius from their residence.

2.4.9 The voice of the child

In the past decade we have seen global research and policy attention, driven by the United Nations Convention on the Rights of the Child (1989), focused on ways to capture or include 'the voice of the child' in any matter affecting them or research involving them. Before proceeding further however, I wish to highlight some concerns raised by previous researchers. The first concern is that mapping is a behavioural adaptation of humans to convey information to others, Blaut (1991) and therefore 'voice' is not a position but a process that occurs between the child and the researcher:

Meaning comes into existence when two or more voices come into contact: there has to be a speaker and a listener, an addresser and an addressee and there will also be multiple voices and multivoicedness.

(Komulanien, 2007 p.23)

This echoes the views of Alanen (1992) and Mayall (2002) that rather than seeking a single 'authentic' voice of the child (or children), researchers should instead seek to capture the multiple voices of a child about the same situation even though it will be a messy and at times ambiguous process, (Spyrou, 2011).

The second concern is a widespread belief that information or 'voice' extracted through drawings is somehow more inherently honest, (presumably due to being a less conscious utterance), than actual speech, (Leitch, 2008; Thomson, 2008). It is argued by Elden (2012) that children's drawings and their talk with the researcher whilst constructing them should be understood as an integral whole which allows the child to both feel relaxed and in control of their participation, and which also allows the child to express greater complexity, understanding and messiness about the topic being researched.

This is extremely important when trying to examine children's understanding of the large-scale physical environment as both their spatial and environmental knowledge is likely to exceed their graphical representational ability, thus exemplifying the problems of 'knowing more than we can tell', (Polanyi, 1966). It was noted by Murray and Spencer (1979) and Spencer, Blades and Morsley (1989) that even adults often struggle to accurately convey all that they know of an environment.

The final concern is that children, (like adults), understand maps to be a purposive utterance, Schiller (1929) and hence they modify the objects that are depicted, as well as the symbols and language used depending on their audience, (Spencer and Darvizeh, 1983; Wallace and Almy, 1999). This is why any post-factum attempt to interpret the children's artefact maps is likely to significantly underestimate the children's knowledge of their large-scale physical environment.

2.4.10 Children and indoor artificial tasks

Much research such as, Hazen, Lockman and Pick (1978), Bluestein and Acredolo (1979), Herman, Miller and Heins (1987), Liben, Moore and Golbeck (1982) and even Myers and Liben (2012), has focused on whether or not children can interpret maps of an artificial indoor environment and perform basic navigational tasks within it. This type of research still misses the point made by (Catling, 1979), that although many young children may struggle to use a map to locate a toy hidden in a strange room, they are all usually quite capable of getting off their parent's lap, going to another room, searching cupboards or bags and retrieving something that they actually want. Neither do children seem to get lost with any notable frequency in their daily lives despite their limited ability to construct adult-like artefact maps, (Spencer and Darvizeh, 1981a, Spencer and Darvizeh, 1981b).

2.5 Spatial Typologies for classifying children's artefact maps

A caution is necessary before starting the discussion of map classification systems of the four selected theorists, Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984). Because of differences in how research has historically been reported in the public domain and how it is reported now, it has been necessary to turn those researchers' verbal descriptions of map types into visual images for the sake of clarity. Any errors arising from such extrapolation are due to interpretation by me.

2.5.1 Ladd (1970)

The research of Ladd (1970) worked with 12-17 year olds in Boston Massachusetts and graded the resultant artefact maps according to the level of adult perceived accuracy discerned against a street map of the area. Her research was part of a larger study and the first task asked each child to "*Describe Verbally your Neighbourhood*" and their answers were tape recorded. The instructional set for the second task asked each child to '*Draw a map of your neighbourhood*'. The results of the first task were used to generate qualitative data about the child's views on their locality in terms of liveability. The artefact maps from the second task are what is of interest to my research.

The following four stage system was used by Ladd (1970):

1. Pictorial Drawings – street scene that does not permit the area depicted to be specifically identified with few or no reliable spatial qualities. See Figure 1
2. Schematic drawings – streets and objects labelled but layout is disorganised and unstructured to a degree that identifying the specific area requires intuitive leaps by a strange adult. See Figure 2
3. Images resembling a map – area depicted in a way that is sufficiently organised and labelled to permit the map to be orientated to the ground by a strange adult and it 'could' be used for crude wayfinding within the depicted area. See Figure 3
4. Maps with specific landmarks – the area depicted can be easily identified and the map orientated to the ground by a strange adult who could then use it reliably to navigate within the depicted area. See Figure 4

Figure 1

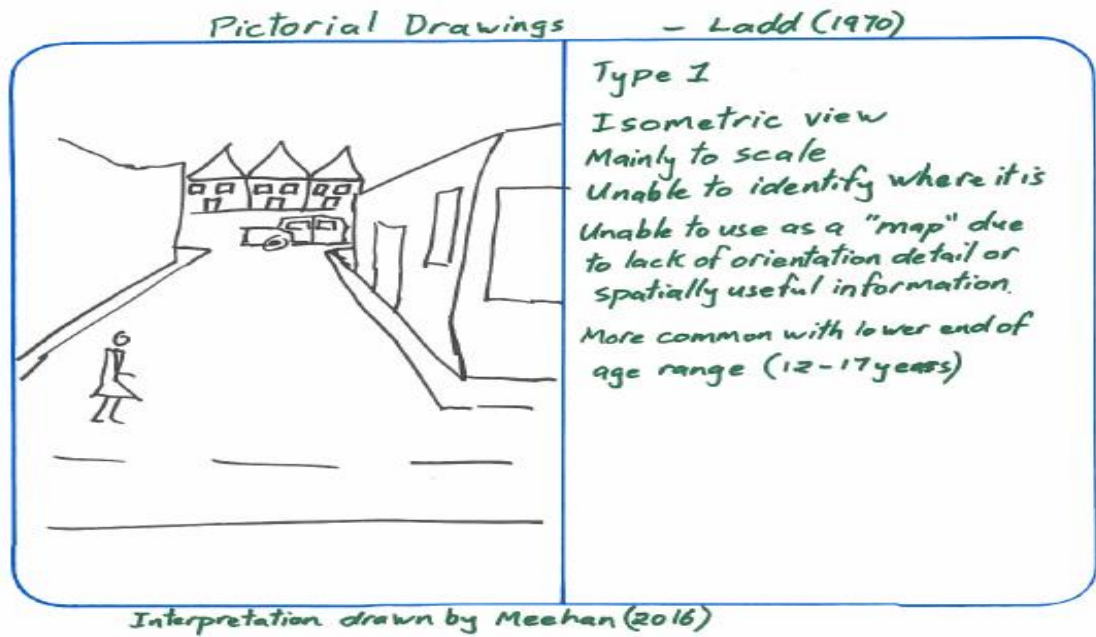


Figure 2

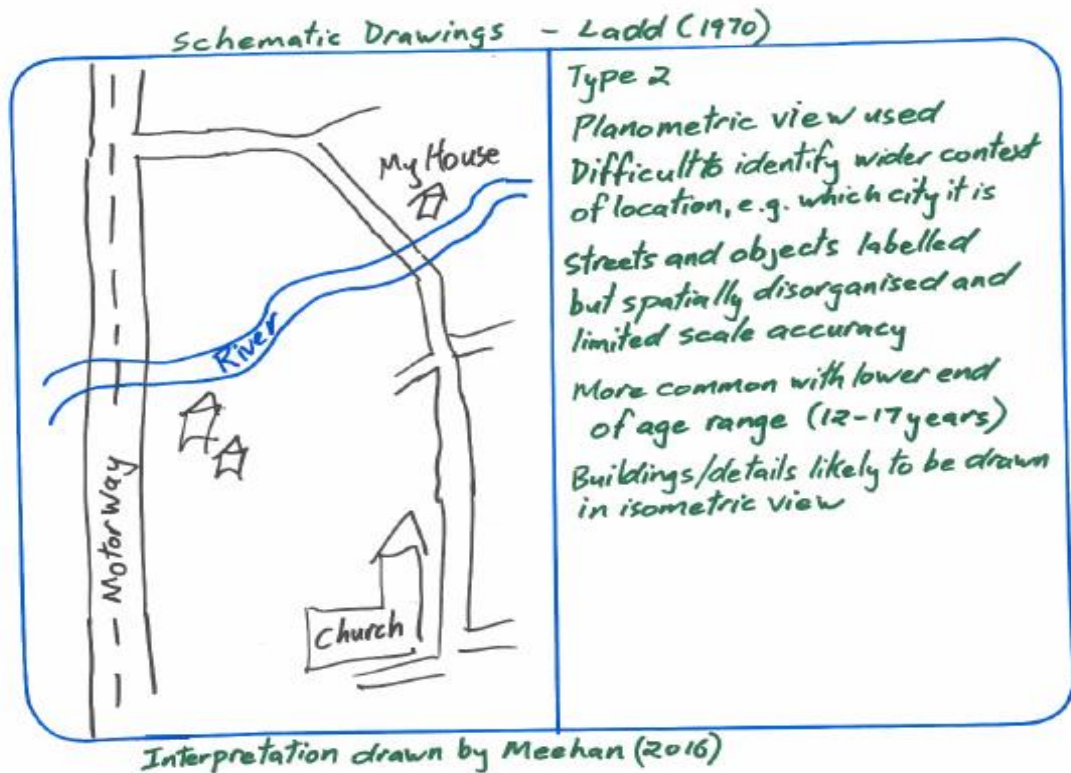


Figure 3

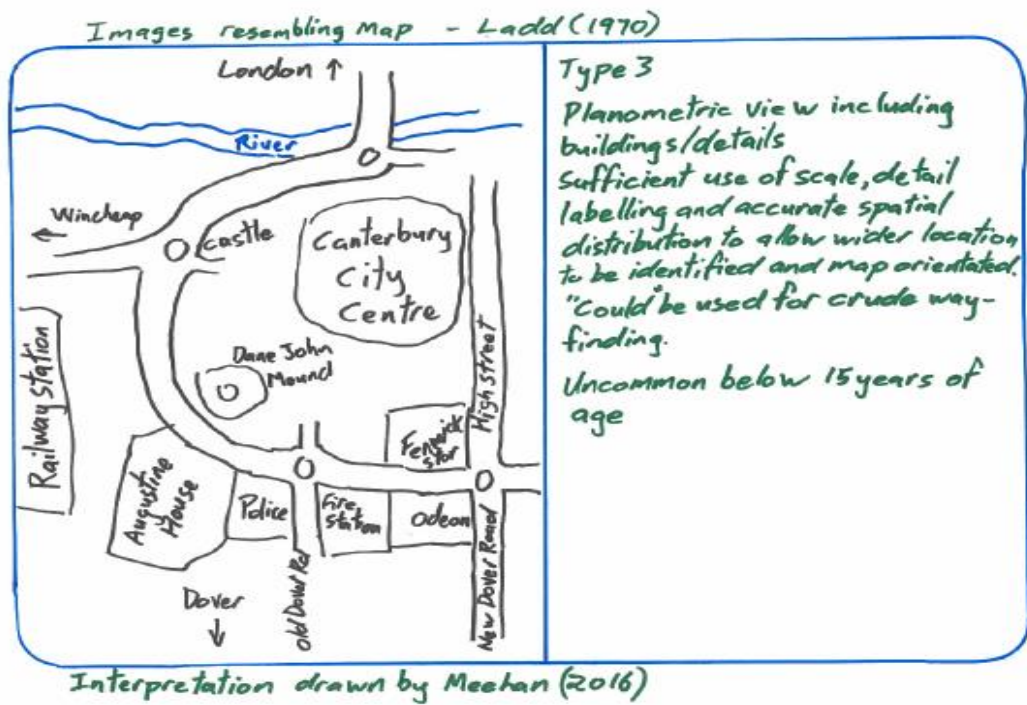
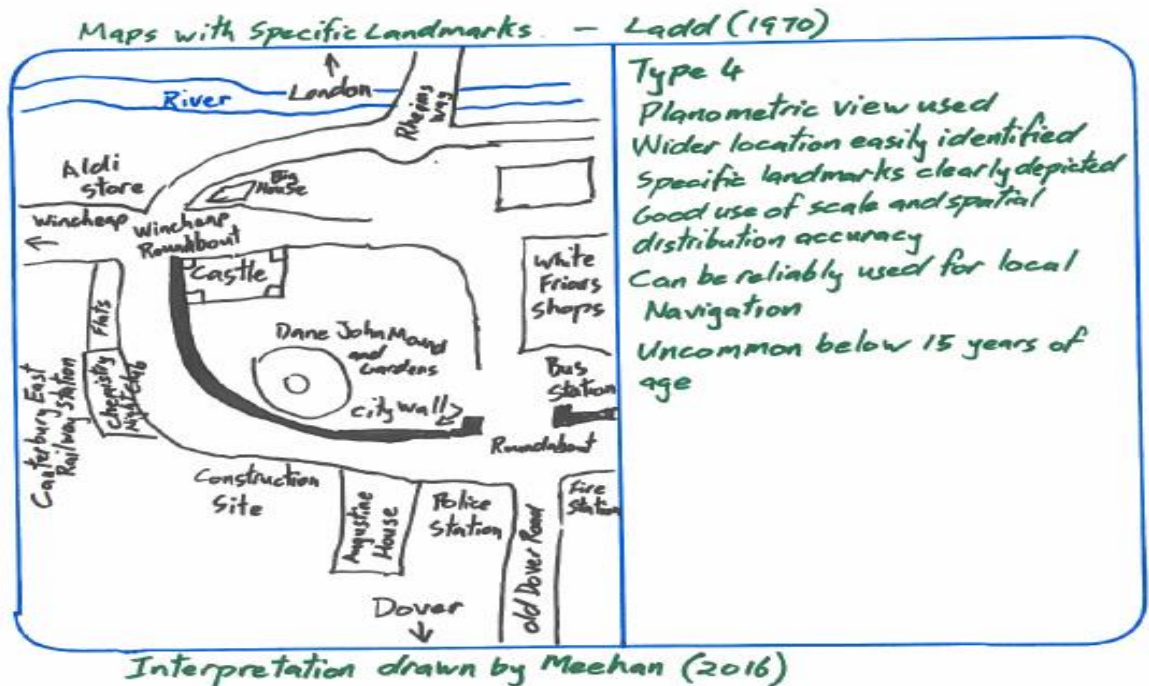


Figure 4



However, despite the comparative robustness of Ladd's model, the importance of the point raised by Downs and Siegel (1981) and even by Eckert and Joerg (1908) about adult-centric notions of 'objective accuracy' in depicting objects cannot be overstated. As discussed previously maps are a cultural artefact which reflect the background mental frameworks of their creators and the purpose for which they were created. The research by Ladd (1971) involved African-American boys aged 12-17 years living in a comparatively dense urban environment three years after a major series of civil rights related riots. These teenaged boys were asked to produce maps of an urban area as part of a wider study on their understanding of the urban fabric. My research on the other hand is with predominantly White British 7-9 year olds of both genders living in semi-rural and suburban East Kent in the United Kingdom and no purpose was specified for the creation of these maps.

2.5.2 Moore (1973)

In 1973 the architect and psychologist Gary Moore conducted a study with teenagers in Worcester, Massachusetts, USA. This study had considerable conceptual reliability as it contained three tasks, each of which generated a separate data set that could be used to deduce conclusions about the subjects' cognitive competencies with respect to the familiar large scale environment.

The first task tested the subjects' ability to "*Draw a map of the city of Worcester and mark in as many places as you can.*" The children were asked to verbalise their reasons for object selection and spatial arrangements as they drew. Resultant artefacts were sorted into the hypothesised three levels of accuracy against specified criteria by three independent judges. This task involved 51 students of both genders aged 15-19 years who attended a single high school.

This research generated no isometric views of the environment which suggests that the teenagers all understood the term 'map' to require them to represent the physical environment through the adoption of an orthogonal perspective.

In the second part, a subset of 32 of the students assessed as producing Level II and Level III maps were asked to perform some tasks to assess their verbal ability to apply geographical and cognitive competence. Specifically, they were tested on their

associative ability and their capability to reverse geo-spatial information in familiar environments and conceptually 'concrete' tasks. In this case the students were asked to give two sets of alternative directions between specified points (two of the points were likely to be familiar to students and two were likely to be unfamiliar). Then the students were asked to reverse the route directions for those destinations.

Finally, the students were given a list of 22 objects or places within the city that were assumed to be familiar to them and to draw a map depicting those objects and places. This final stage was to allow the accuracy of the spatial sequence and distributions of their first maps to be evaluated against a similar artefact of presumed greater objective accuracy.

The first set of artefact maps produced were classified by Moore's judges into three levels based upon the presumed greater appreciation by the subject of Euclidian spatial relationships shown.

Each level was simple in form and Moore (1973) was operating from a Constructivist position drawing on Piaget for his chronological and sequential view of child learning and spatial understanding.

Classification levels proposed by Moore (1973) were as follows:

Level I – Undifferentiated Concrete Egocentric. These maps had elements arranged topologically in accordance with an egocentric perspective. This means that the elements are organised in groups possessing cognitively important connections for the subject even if the elements depicted are not so objectively located in the actual physical world. For example, the shop where the family always stops for an ice cream when driving to the grandparent's house may be drawn as if it is close to that house, even if it is in fact some distance away. See Figure 5

Level II – Differentially and Partially Organised, with clusters of depicted elements topologically arranged correctly but the relationship between the clusters may be inaccurate or missing entirely. For example, the child may construct a map of the town which depicts a cluster arranging the elements the areas of the town immediately adjacent to their house, their school and grandparents house correctly, (from the perspective of resembling an adult-centric plan view), but they may have either blank space or inaccurately depicted elements between the clusters.

See Figure 6

Level III – Abstractly coordinated and hierarchically coordinated. These were the most objectively accurate maps wherein the elements within clusters are topologically arranged correctly, the distance between clusters and elements linking them are fairly accurately depicted. These ‘maps’ are constructed in such ways that the elements collectively allow a reader to form an impression of the entire area which is (from the perspective of resembling an adult-centric plan view), objectively accurate both in terms of scale and topological arrangement. See Figure 7

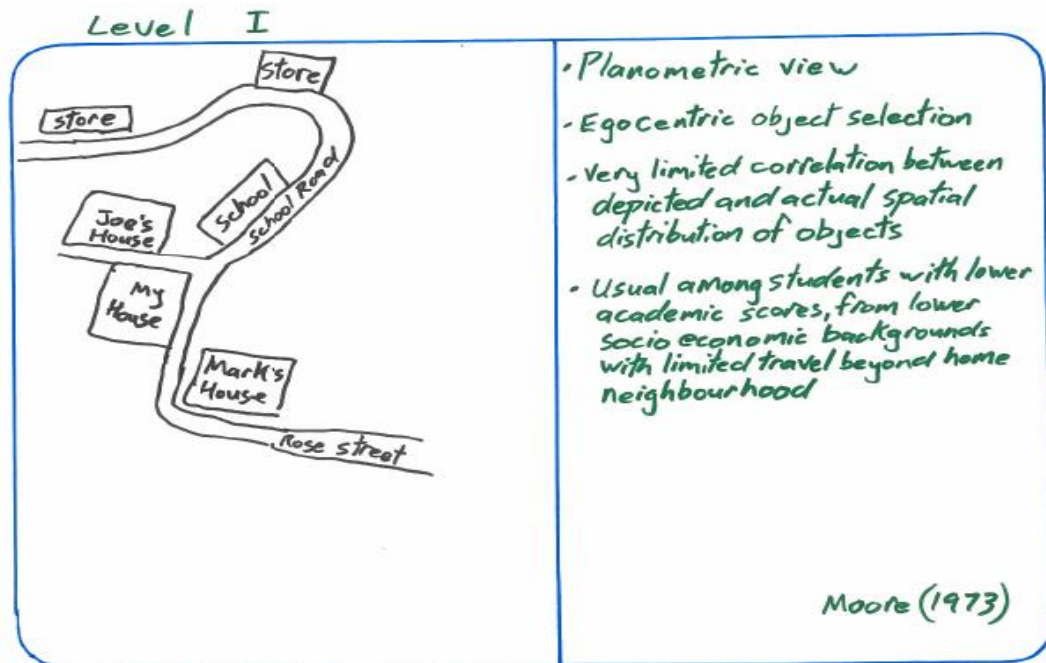
It was found by Moore (1973) that significant differences in objective sequential and distributional spatial accuracy occurred within the close age and developmental range of his subjects. He found that greater accuracy and complexity were positively correlated to higher formal academic grades but not necessarily to general intelligence or to chronological age of the subjects.

He therefore theorised that individuals within the group had differing abilities to interpret and apply geo-spatial information and that these differences were not strongly correlated to either age or gender. Instead they appeared to derive from individual familiarity both with parts of, and the whole of, the given large scale environment.

This is consistent with the work of Vanselow (1974) who found that the inability to mentally rotate the experienced environment seems to preclude, or at least strongly inhibit the creation of plan-view ‘maps’. The work of other researchers, including Lynch (1960) himself suggests that this difficult in mentally rotating experienced environmental information may not be confined to children as it is also sometimes discernible in differences between adult males and females.

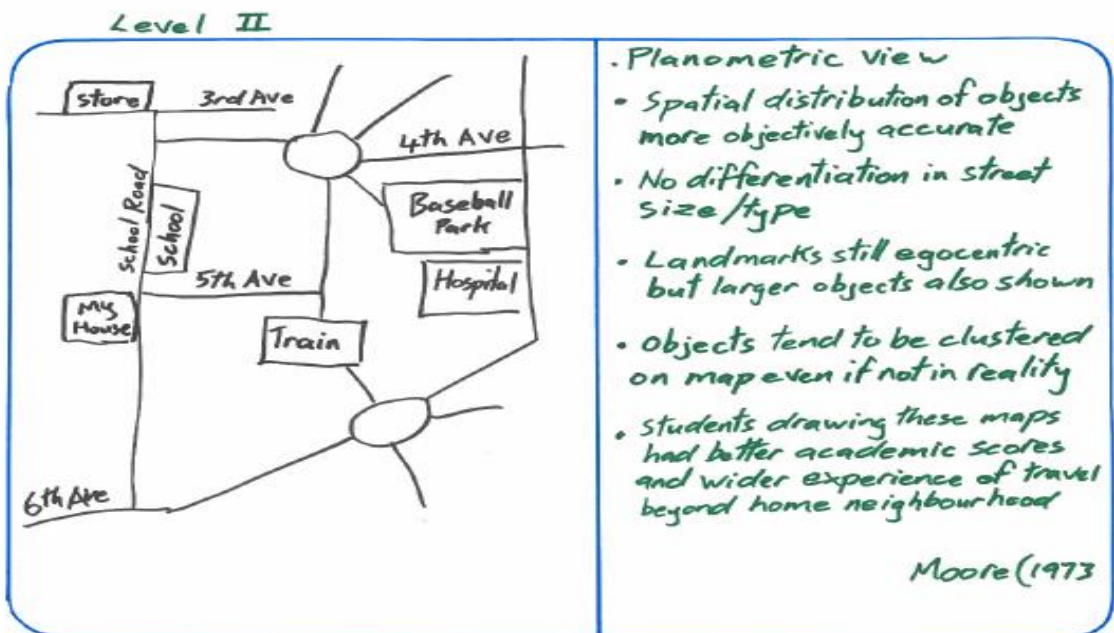
Both Vanselow (1974) and (Matthews, 1980, 1984) suggest a possible correlational link to the fact that early years play forms of boys tend to utilise blocks and toy cars more extensively than play forms used by girls of equivalent age. Whether such differences in play forms are innate or social constructions is intellectually interesting but not of sufficient direct relevance to this work for further pursuit here.

Figure 5



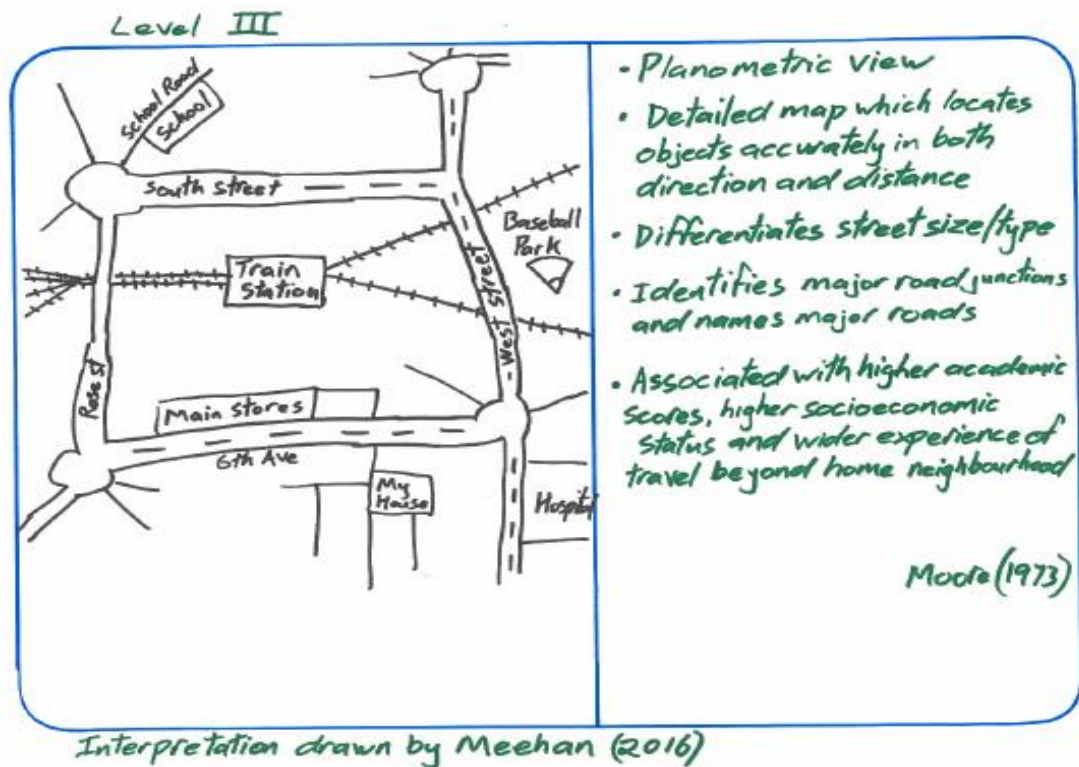
Interpretation drawn by Meehan (2016)

Figure 6



Interpretation drawn by Meehan (2016)

Figure 7



2.5.3 Hart (1981)

In 1979-1980 the Psychologist and Geographer Roger Hart performed a series of studies with 7-11 year old children in several rural New England towns in the USA. His study was aimed at examining the extent and type of physical space utilised by the children in their normal daily play ranges. The study involved asking children to show him their favourite places to play within their local physical environment and then discussing why these places were significant and how the children used them.

Then Hart (1979) had children physically construct their artefact maps by placing model cars and buildings on large sheets of paper on the ground, tracing around them and labelling the object outlines. He then graded these artefact maps according to structural layout and objective accuracy compared to aerial photographs of the relevant portion of the town.

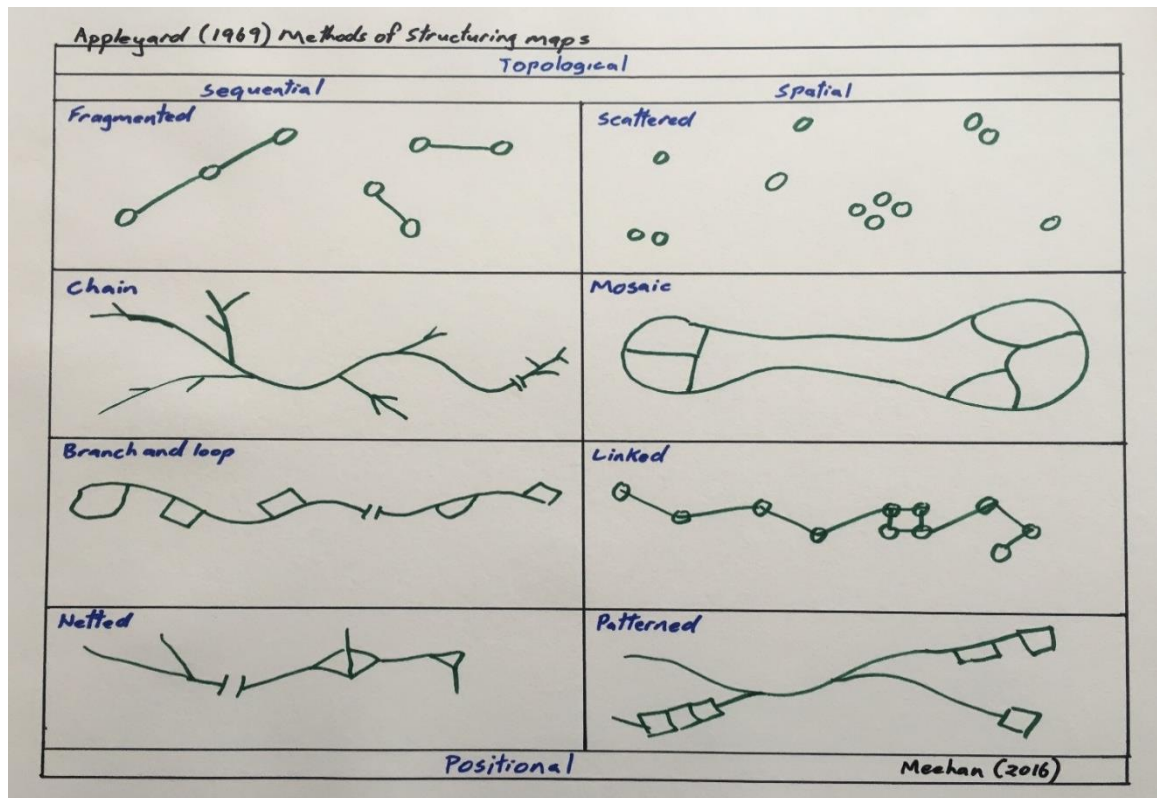
Central to his grading system was his belief that 'maps' depict clusters of elements whose scale and accuracy of object placement were the most important indicators of advanced cognitive development. His classification system has five grades as follows:

1. No spatial organisation - clusters not coherent either internally or collectively
2. Linked - some related elements or clusters are linked by a known route
3. Spatial Proximity - elements are clustered close or far from each other according to the relationship between them
4. Spatial Order – related elements are clustered and clusters are positioned correctly in linear terms
5. Positional – elements within clusters and clusters collectively are positioned accurately in terms of left/ right, front/behind.

In making such classifications it appears that Hart was broadly following the mapping categories proposed by Appleyard (1969), (See Figure 8 below) and it is noted that the concurrent use of these two models does provide a robust analytical frame for the artefact maps.

It is noted that despite sustained searches it was not possible to locate a public domain copy of Hart's diagrams and therefore I have been unable to offer examples for this classification model.

Figure 8



2.5.4 Matthews (1984)

The Geographer Hugh Matthews performed a series of mapping exercises with children in the UK Midlands between 1980 and 1984 in order to investigate the processes behind how children constructed artefact maps of a known environment. This research was firstly aimed at testing Lynch's (1960) broad hypothesis that there was universal spatial typology which caused people to conceptualise (or 'image' as Lynch put it), their city as a collection of discrete parts collectively comprising a whole. Secondly however Matthews was investigating a point raised by Saarinen (1976) that the work of Lynch (1960) had not then (or indeed much since), been specifically tested with either elderly people or children. Therefore, Matthews (1984a) tried to investigate Lynch's work across a range of child ages. In doing so he sought answers to two main questions and he addressed them by classifying the children's artefact maps in accordance with the graphical typology proposed by Moore (1973).

The first question Matthews sought to answer was about whether or not chronological age was a significant variable on children's perception and his findings support Ladd's (1970) conclusion that younger children tend to respond to the instruction by drawing isometric views of their town. This is also consistent with the findings of Karsten (2005) and Lehman-Frisch et al (2012).

In 1980 Matthews gave the children a blank A4 page and asked them to draw a free-recall sketch map of the familiar environment, the city centre of Coventry. His subsequent research in 1984 involved two mapping exercises using unlabelled base images (Ordnance Survey maps, or orthogonal plans or aerial photographs), of their portion of the city as the basis for a sketch map drawn on tracing paper placed over the base image. Each group of children was an entire class at a one of three primary schools for similarity of demographic composition and location within the city. Each subject group used only one kind of base image for the completion of both tasks

The first task required children to map a regular journey through a familiar environment by having them draw their journey from home to school. The second task required children to produce a sketch map to assist the researcher who was described as coming to visit the neighbourhood near the child's home. In each case the child was given the base image with the tracing paper overlay aligned so that an "X" marked the child's residential address

In the Grade I artefact maps the children appeared unable to transform their actual live interaction with the environment through rotating the view into a form which adults would recognise as a 'map'. Instead these children who were usually six years or younger, would draw a picture of a street scene as in Figure 9 below rather than a plan view which adults usually equate with the term 'map'.

Figure 9

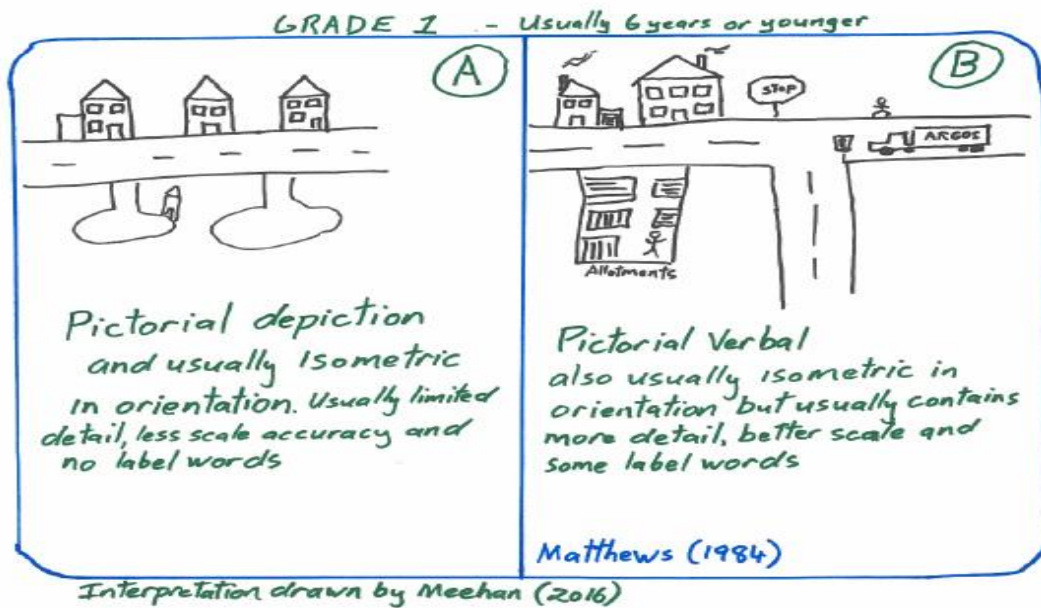


Figure 10

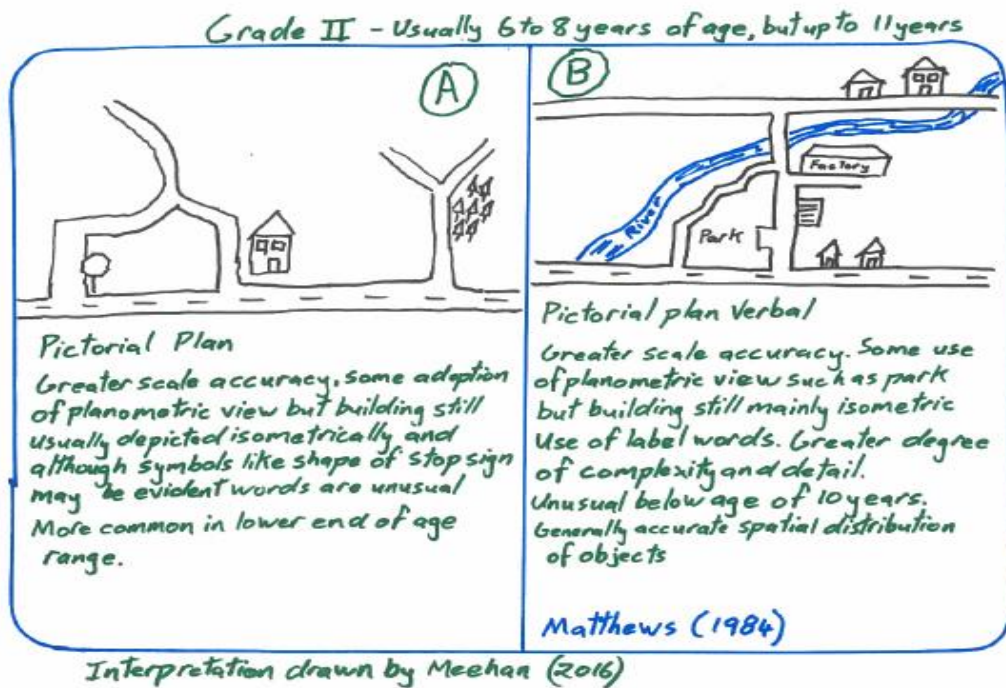
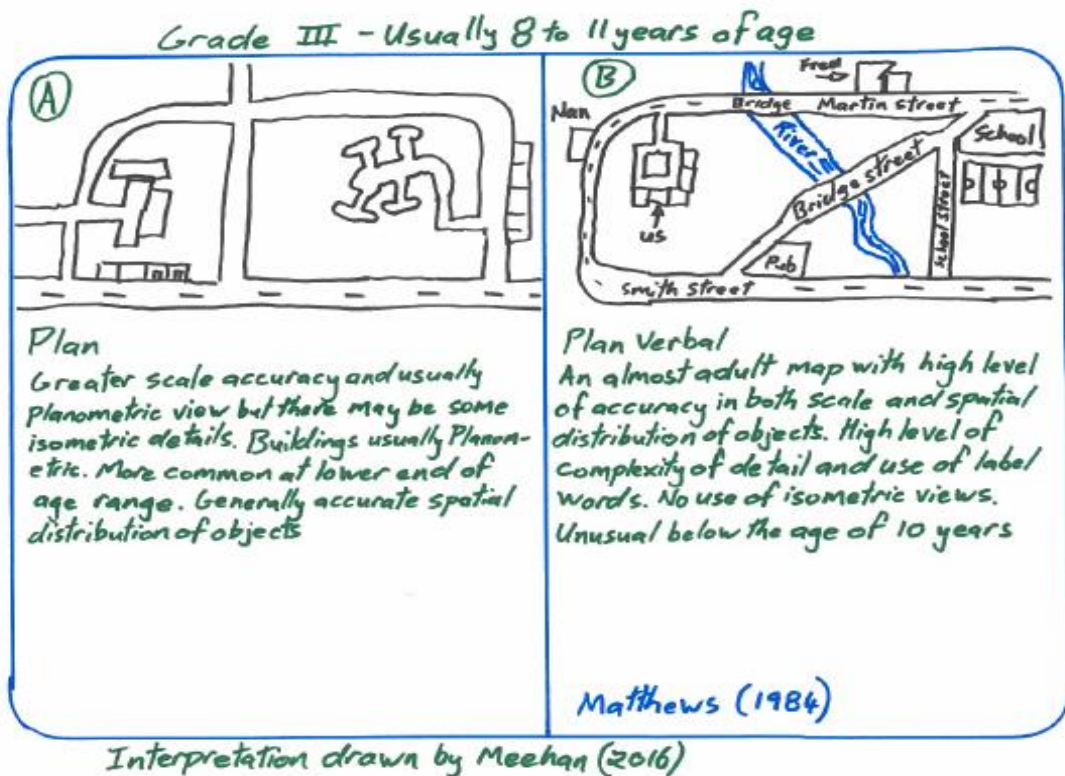


Figure 11



However, despite the legibility of the above models as spatial typologies the point raised by Downs and Siegel (1981) about adult interpretation of child accuracy is worth restating as it involves the sort of subjective decisions made by even the most objective researcher that Onwuegbuzie and Leech (2005) discuss. Also both Hewitt (2010) and Brotton (2012) provide a rich and detailed narrative of the fluid, arbitrary and often downright capricious process by which the 'conventional' symbols upon which modern western cartography rests, were actually chosen. This again echoes the point of both Kuhn (1962) and Onwuegbuzie and Leech (2005) about subjectivity always intruding at some level into even the most carefully designed experiment or instrument.

2.5.5 What the existing typologies show

Although the above models were suitable at their time of use, it now seems that a more nuanced typology which reflects contemporary views of children's cognitive abilities may be required. In particular, it would be desirable to develop a new typology which captures the voice of the child as they produce the artefact maps.

2.6 Summary of Literature Review

This original research seeks to investigate several things about how children understand existing maps and how they make their own maps of a large-scale physical environment which is known to them. Specifically the research seeks to :

1. Obtain an understanding of whether children recognise an unlabelled depiction of an urban area as a conventional map without prompting, and what understandings they possess of the conventional symbols used within it.
2. Have children construct free-recall hand-drawn artefact maps of a known large-scale space in order to examine what objects they choose to draw, in what order, and how spatially accurately they arrange those objects when asked to construct a map of their town without a specified purpose for the map.
3. Classify the children's free-recall hand-drawn maps of a known large-scale space using the four main systems of classification for child maps, namely Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984).

Given the passage of time and more detailed understandings of children's competence which have evolved since these spatial typologies were initially investigated, it is suspected that changes in child cognition may be discernible in their artefact maps. It is surmised that these cognitive changes may be visible in the degree to which the children's drawings still conform to the classifications proposed by Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984). As such, the research will be cognizant of debates in several disciplines regarding child cognition, and representational abilities, object selection, spatial distribution, orientation and scale.

Before moving on to the Methodology of this research it is worth restating the research questions for the purpose of clarity and understanding.

2.6.1 Research questions

Primary:

What physical objects and spatial relationships do children aged 7-8 years include in their map when drawing a free-recall map of a known physical environment?

Sub-questions:

- 1. To what extent can children interpret a map of a fictional location through understanding of cartographic conventional symbols?*
- 2. To what extent do these artefact maps of contemporary children conform to the spatial typology models from the literature, for example Lynch (1960), Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984)?*
- 3. To what extent are existing models sufficient for the classification of children's artefact maps today?*

Chapter 3 Methodology

3.1 Introduction

In this chapter the ontological and epistemological basis of my research will be explained and the research methods enunciated. In it I shall touch upon diverse fields such as Education, Ethnography, Human Geography, and Philosophy in order to situate my own views on truth, which will be applied to my research.

My acceptance of an eclectic and pragmatic approach plants me with Reid (1764) and Kuhn (1962) in viewing the universe as a whole, as something which is rational, predictable and amenable to understanding via systematic observation. Whilst important differences exist for researchers in the physical and the social sciences the point is, that systematic observation should enable us to predict a range of potential outcomes reliably. This means that a valid process should allow some degree of reliable replication provided that the observation or experiment can be conducted under the most similar conditions. In order to be valid as replication in the social sciences care must be taken when seeking to quantify the degree of influence exerted by potential intervening variables such as class, gender and culture.

In my view, sound research rigorously applies a scientific method such as articulated by Whewell (1847) wherein knowledge is constructed both from careful observation and reasoned analysis. Within this research I use the term to mean, the systematic use of observation and experimentation, using inductive and deductive reasoning in the formation and testing of hypotheses and theories, Anderson and Hepburn (2016). Following Whewell (1847) and Bacon (1620 cited in Anderson and Hepburn, 2016), such research forms hypotheses, designs experiments and derives conclusions which should answer specific questions within a particular field under certain conditions and subject to the interplay of specified variables. Ideally, the specific answers so generated will also contribute in some way to the overall state of human knowledge even if only by demonstrating the need for researchers to employ greater rigour in constructing questions and data collection instruments, (Kuhn, 1962; Onwuegbuzie and Leech, 2005)

Clearly, there are limitations to such a view when moving from the physical to the human sciences and these are succinctly summarised in 2016 by US Astrophysicist Neil DeGrasse-Tyson, *“In science, when human behaviour enters the equation, things go nonlinear. That’s why Physics is easy and Sociology is hard.”*

This greater degree of unpredictability need not however disqualify the application of Positivist scientific methods such as observation, measurement and replicability as incompatible with the investigation of social science problems, (Howe, 1988). Indeed it appears today that the Paradigm Wars between qualitative and quantitative researchers were largely a matter of the position staking which Kuhn (1962) discussed and they were usually seen only within the social sciences, (Sechrest and Sidani, 1995; Onwuegbuzie and Leech, 2005). The fact that both approaches have inherent weaknesses and strengths mean that researchers should utilize the strengths of both quantitative and qualitative techniques in order to understand better social phenomena, (Sieber, 1973). Such a pragmatic view accepts that both quantitative and qualitative data are capable of generating new insights in many fields and that the most appropriate focus for researchers is what works within the context of answering the particular research questions, (Howe, 1988).

With that in mind, my research rests on the pragmatic view that the research question should determine the method(s) utilised to investigate it because '*epistemological purity doesn't get research done*', Miles and Huberman (1984, p. 21). My research seeks specific answers to particular questions about children's understanding and depiction of the physical environment but it also seeks to understand how those answers are derived.

This chapter will outline my definition of paradigms and how these will shape this study. Section 3.2 will define the general nature of paradigms before Section 3.3 discusses my position as a researcher. Section 3.4 examines my ontological position on 'truth' and Section 3.5 sets out the particular paradigm (Pragmatism) within which this research will be undertaken. In Section 3.6 I will discuss the rationale for adopting this position in order to research the chosen topics. In Section 3.7 I will discuss the conduct of the proposed research and explain my anticipated research outcomes in Section 3.8. In Section 3.9 I will discuss the specifics of the proposed data collection tasks and in Section 3.10 I will explain my proposed methods of data analysis. Section 3.11 addresses ethical issues arising in the course of the study and Section 3.12 discusses the logistics of the data collection before Section 3.13 provides a conclusion this chapter

3.2 What is a Paradigm?

The problem of selecting a single 'appropriate' paradigm within which to conduct one's research is a significant one as it determines from where the researcher speaks and with whom they ontologically and epistemologically agree as a researcher. This will determine what the researcher considers legitimate questions for study, what are considered valid methods for the investigation of those questions, and what constitutes reliable data about them. Therefore, prior to selecting the one which the researcher deems 'appropriate' to their own research they must first generally understand the nature of paradigms and then consider in which one (if any), their work will fit.

The following definition of a paradigm proposed by Efland (2004) is attractive to me as it is entirely consistent with that proposed by Kuhn (1962).

A paradigm is a conceptual system of ideas shared by a community of practitioners, but it is a social construction as well. In fact, one might say that allegiance to a particular paradigm is what creates a community of practitioners, and that by implication, the lack of a paradigm makes the formation of coherent policies and practices difficult or impossible..... Moreover, paradigms are not permanent or absolute. (Efland, 2004, p. 692).

A significant factor in my acceptance of those definitions is that they reflect my view that research does not occur in a vacuum either as process and outcome. Hence, in order to be valid, research must generate knowledge, which can be tested, or methods which can be utilised, by other researchers without generating markedly different outcomes unless intervening variables can be identified.

Six major paradigms operating within the social sciences were identified by Crotty (1998) and these were *Positivism, Post -Positivism, Constructivism, Interpretivism, Critical theory, Feminism* and *Postmodernism*. However, even within the primary initial paradigm of Positivism, Kuhn (1962) identified major ontological and epistemological disagreements which were only resolved through time and research. So it is unsurprising that Guba and Lincoln (2005) should point out how the initial deliberately oppositional stances asserted within Critical theory, Feminism and Postmodernism made cross-disciplinary research difficult and controversial.

Partly, this reflects genuine paradigmatic shifts in epistemology, but also the nature of contemporary academic activity demands that researchers create 'fractal distinctions' from their intellectual forebears even if a truly novel point is not being made, (Petrovski, 2011; Bustamante, 2011). These difficulties mirror those described by, Kuhn (1962) whereby each new paradigm must first carve itself a place of difference before it can begin to integrate its original insights with those of existing paradigms. It is equally unsurprising then that the Paradigm Wars of the 1980s appear now to have been replaced, as predicted by Howe (1988), by a form of cross-pollination whereby "*two theorists previously thought to be in irreconcilable conflict may now appear, under a different theoretical rubric, to be informing one another's arguments*" (Guba and Lincoln, 2005, p.183).

This original research will utilise Pragmatism to re-examine work previously done by Interpretivists, but it is not necessarily less reliable simply because it proceeds from a different paradigm. The work of Janesick (1994) supports this position by arguing that insistence upon identical research methods to study the same phenomena is:

Methodolatry, a combination of method and idolatry,..a preoccupation with selecting and defending methods to the exclusion of the actual substance of the story being told. Methodolatry is the slavish attachment and devotion to method that so often overtakes the discourse in the education and human service fields (Janesick, 1994 p. 215).

Any attempt to collect data or to articulate theories requires the researcher to situate themselves within a particular discipline or paradigm. This is because without being so situated it is unlikely that the researcher will be able to filter relevant information from the sea of 'mere facts' which surround them, (Kuhn, 1962). Research in any field requires the researcher to accept as given the epistemological assumptions common to those who share his or her discipline. This also means an acceptance by the researcher that their selection of a particular instrument or apparatus and their use of it in a particular manner will produce a range of potential outcomes. In short, those particular methodological choices constrain what the researcher is then able to conceive of as expected outcomes. This is why Howe (1988) and Onwuegbuzie and Leech (2005) argue that the inherently subjective nature of those choices must always be acknowledged.

In this context 'normal science' as conceived by Kuhn (1962), involves working within a particular field in ways that are cumulative, rational and seeking to extend the precision of understanding within the field. Such 'normal science' is not necessarily or even primarily, concerned with identifying novelty either of fact or of theory. It is more concerned with exploring some particular anomaly within the existing paradigm of the field and as such, it may be legitimately and effectively explored by researchers from different disciplines or epistemological positions. This is because I accept Kuhn's (1962) assertion that if a fact or theory is objectively 'true' then it will remain true regardless of how it is examined.

Consequently then, a rejection of the assertion (Kuhn, 1962), that application of scientific method can yield objective truth seems to be to engage in a logic of infinite regress as practiced by theorists like Foucault, (1970), Lyotard (1984) and Derrida (1997). However, it is conceded that all knowledge exists to some extent within a social discourse which situates the particular knowledge as primarily valid within a given context, Foucault, (1970). For example, in order for the statement "*The Mona Lisa is on public display at the Louvre*" to make sense, the hearer must understand that it means there is a specific famous painting available for viewing in an art gallery in Paris which allows admission to any person who pays the entrance fee. However, the assertion of Foucault (1970) that language itself is a form of oppression makes it difficult to conduct 'normal science' Kuhn (1962) as a form of rational structured inquiry.

Foucault (1970) does however have a valid point about the role of language in shaping the construction of research choices about methodology and method. For this reason the distinction made by Lyotard (1984) between real knowledge and mere data is important and it is a point pursued at length in a discussion of thinking versus mere calculation (Weizenbaum, 1976).

Therefore, in the context of children and education about their world it is important to consider how and why humans produce maps as well as how we extract and utilise data from them.

My original research concurs with Hart (1981) that in order to deduce accurate meaning from the artefact maps produced by the children we must engage with the child during the production of the map. Accordingly any attempt to derive a valid meaning as Derrida (1997) does, from any text, be it a painting, book or an artefact map, without regard for the intended meaning of the original author is likely to yield erroneous conclusions. This original research explicitly seeks to examine whether or not the spatial typology postulated by Lynch (1960) will be discernible in the artefact maps of contemporary children. Further, it seeks to examine the temporal order of artefact construction, object selection and objective accuracy of spatial distribution of the contemporary artefact maps in comparison with the artefact maps produced in the research of Ladd (1970), Moore (1973), Hart (1989) and Matthews (1984). As such, the research requires an acceptance of the concept of objective truth and the ability of humans to locate it. Equally, it requires an acceptance of the validity of specific meanings being intended by authors of texts and shared by readers of those texts. That in turn requires an acceptance of the idea of children as competent and capable creators of knowledge about their physical environment.

It is again worth stating that the model proposed by Lynch (1960) for obtaining insights into how adults form a coherent overall image of a city-sized physical environment remains robust and valid. This original research however proceeds from the hypothesis that Lynch's model is insufficient to enable us to classify children's artefact maps. The new model for classification of such maps is proposed because the data gathered supports that hypothesis.

Much of the initial research in the field of children and mapping derives from a Constructivist position which is represented by Werner (1957), and Piaget and Inhelder (1967) and specifically within this research by Moore (1976) and Matthews (1980). Collectively those authors argue that humans are born into the world with innate abilities and desires to understand the environment in which they live. Consequently, the developing child does not merely react to stimuli but applies a reasoning ability that is constantly evolving to the formulation of both the structures that it uses to understand the environment and also to the responses which it uses to react to that environment.

According to Moore (1976) this evolutionary process can be understood with reference to six principles:

1. Environmental Knowledge is more than simply acquiring sensory stimuli from the environment. It involves the individual creating cognitive structures in which to organise and subsequently utilise those collected stimuli in a coherent ontological view of the world. Generally speaking, people who have had similar developmental experiences might reasonably be expected to construct similar cognitive structures based on similar ontological views but wide variation is possible between individuals.
2. Environmental knowledge is the result of the constant interactions between individual internal variables such as motivation, personality and needs and the external variables pertinent to that environment such as accessibility, and societal or cultural circumstances. These interactions are therefore purposeful as the individual evolves an ontological view of what is desirable and what is possible for someone like them.
3. Homo-Sapiens as a species are both adaptable and naturally highly inquisitive, constantly seeking novel environments and experiences beyond their immediate needs. This appears to have been a successful evolutionary combination of cognitive traits as collectively they maximise the likelihood of the individual gaining broad environmental experience upon which to base future environmental behaviour.
4. The interactions that the individual has with their environment are mediated by the effects of existing cognitive structures which means that (ideally), new environmental experiences are tested against existing knowledge before a response is attempted. At the lower end of cognition Levi-Strauss (1966) argued, there is the individual type called a Bricoleur who is able to use existing tools and materials to devise a 'good enough' solution to environmental changes.

5. At the upper end of cognition however, lies what Levi-Strauss (1966) terms an Engineer. By this he means an individual who is capable of looking at new environmental stimuli and creating an entirely new response or artefact to deal with it. Where the Engineer is superior to the Bricoleur is that the former is capable of creating new processes, tools and materials if they are required.

6. Environmental knowledge is an evolving aspect of individual development which has recognisable stages where qualitatively different spatial understandings will be visible.

In shaping my ontological pragmatism it is necessary to acknowledge the contribution of Interpretivism which derives initially from the work of anthropologists like Boas (1911) and Malinowski (1967) and sociologists of the Chicago School in the period 1900 to 1939 such as Park (1921) and Mead (1932). Interpretivism is a relativist form of ontology which assumes that reality as we understand it, is constructed not only from personal experience but also from the meanings which a particular society places upon those experiences, Boas (1911). Epistemologically it assumes that the researcher can never fully separate themselves from the object of their research to the degree asserted by Positivists, (Park, 1921). It also assumes that meanings will emerge from data during the analysis phase rather than existing as a priori truths. To an Interpretivist 'good' research is that which carefully considers the relationships between the researcher, the research and the well-being of the object of the research. It leaves open the possibility of additional interpretations of findings to the ones proposed by the researcher and actively asks the question of whether the conduct of the research has helped or hindered the progress of the person/s who were the objects of it.

My original research sought to explore children's understanding of the nature and purpose of maps and provided them with the opportunity to represent their understandings through the objects that they chose to depict as comprising their town. Similarly I must acknowledge the contribution of Positivist ontology to my thinking. According to Morgan (1989), positivist research proceeds from a Newtonian assumption that objective knowledge can be generated by observation or prediction of regularly occurring patterns or events whose regularity derives from compliance with a logical set of discernible principles and relationships.

For example, I think that it is likely that a night will occur at the end of today because reliable authorities report, and personal experience confirms, that this is a normal sequence of events. This view is consistent with the ontological positions of Reid (1764), James (1907), Goldthorpe, (2007) and Reed (2008).

It is argued by Onwuegbuzie and Daniel (2002), that purist Positivists derive their authority from their claim of scientific objective verification. Their analysis however suggests that this rests on an unproven assertion that the scientific methods in question are in fact objective. This position is consistent with the argument of Howe (1988). It is supported by the discussion by Kuhn (1962) about the common misperception of single date/event great 'discoveries' such as oxygen and x-rays which in fact are more often the result of chains of related events and subjective researcher decisions.

As Pragmatists then, we must question the validity of the purist Positivist assertions about objectivity because there are usually numerous research decisions made during any research process that precede objective verification decisions. This was a point pursued by Hicks (1997) in the critique of the amounts and types of uncertainty present in most macro-level statistical analysis of human socio-economic development. For example, the development of instruments to generate empirical data requires researchers to identify aspects for study in an attempt to gain representative data across their chosen domain, Onwuegbuzie and Daniel (2002). However, each of those aspects is in fact a subjective choice, which then exerts influence on the development process for that research instrument.

Therefore, even though the final version of the instrument generates objective scores, the inherent subjectivity of its development, means that any interpretations of the scores produced will themselves be subjective. So simply stated, Subjectivity + objectivity = subjectivity, (Onwuegbuzie and Leech, 2005).

In the natural sciences, the physical properties of objects are measurable with high levels of reliability, subject to specified environmental conditions (e.g. heat and humidity). The very nature of the social sciences however means that regardless of the form of measurement adopted it is unlikely to generate data of similar reliability.

This is because the things that constitute research interests within the social sciences are frequently abstractions such as achievement, intelligence, motivation, which can only be measured indirectly (Onwuegbuzie and Daniel, 2002).

It was argued by Huitt (2003), that irrespective of whether the researcher is using a quantitative or qualitative methodology there are three principal types of scientific research. These are, Descriptive, Correlational and Experimental, and the selection of a particular type will reflect both the overall aim of the researcher and nature of the proposed research task. That selection however will always be a subjective decision by the researcher, (Onwuegbuzie and Leech, 2005).

When undertaking Descriptive research the researcher simply observes and documents a phenomenon in order to draw post- factum (subjective) conclusions about causation and effects, (Kuhn, 1962; Onwuegbuzie and Daniel, 2002),

In Correlational research, the researcher who has identified the level of one variable (e.g. unemployment), attempts to predict the level of a second variable (e.g. homelessness) because of a presumed causative relationship between the variables, (Huitt, 2003).

Experimental research seeks to establish levels of causation between two examples of similar phenomena by manipulating selected variables between them. This is done while holding their general state as constant as possible in order to draw conclusions from the observation of the effects of the variation, (Heisenberg,1930). For example, to test the hypothesis that plants require sunlight to perform photosynthesis the Experimental researcher might have two sets of the same type of plant and will expose one set to sunlight while denying such exposure to the other set.

Ideally, they would at the same time ensure that humidity, temperature and soil type are as identical as possible. Therefore, through their measurement of the plant growth and condition after a finite period they will be able to say whether sunlight appears to be the significant variable. As Onwuegbuzi and Leech (2005) point out though, the selection of plant and soil type, humidity and temperature levels as well as the duration of the period of darkness are entirely subjective decisions reflecting researcher beliefs and preferences.

3.3 Positionality

It is important for researchers in any field to consider what assumptions and beliefs they will bring to their research as these will affect both the design of the research and the conclusions drawn from it. This is called positionality, and it may be defined as *“your own moral, ethical, political or emotional position about the research question”*, which I take to mean *“recognising and acknowledging where you stand on an issue”* because this will provide substantive reasons for the pursuit of a particular direction of your research, (Smith and Bowers-Brown, 2010, p.113).

Indeed, Kuhn (1962) would argue that even the most positivist research is always positional, because:

It is imbued with the perspective of the researcher.... and is derived from a set of circumstances where a problem was defined necessarily from a particular viewpoint or position (Burton and Brundrett, 2005, p16).

This is no small matter because as Clough and Nutbrown (2002) point out:

Research which did not express a more or less distinct perspective on the world would not be research at all; it would have the status of a telephone directory where data are listed without analysis. (p. 10)

This is a position that both Kuhn (1962) and I would agree with because in order to distinguish research from mere speculative inquiry the activity must be systematic and proceed in accordance with norms of its paradigm. With the above statements as point of departure, I will commence my discussion with a pragmatic construction of truth.

3.4 What is Truth?

To explore the question “What is truth?” is important in this section because what constitutes truth derives from one’s own paradigm. In my case, this is Pragmatism. The *Pragmatic Theory of Truth*, James, (1907) synthesises Correspondence Theory and Coherence Theory. This theory appeals to me as it proceeds from the assertion that truth is a quality whose value can be assessed in respect of its ability to effectively apply abstract concepts to concrete situations or practice. Postulating that truth begins with an element (text, utterance, work etc.) whose veracity is to be examined via a rational process of inquiry, it considers all truth provisional until tested against a specific situation or practice.

Although criticised (and with some validity), by Russell, (1956) as risking falling into meaningless relativism, the work of James, (1907) and Schiller, (1910) is useful because it is built upon by the work of Dewey, (1938). In his application of logic to the physical world, Schiller, (1929) argued that for the element (text, utterance or work etc.) to have meaning in the physical world then it must be written, uttered or done with a view to being a cause of something. For example, to say that “*It is raining*” implies that this occurrence requires some alteration of dress or activity by those hearing it. The work of Schiller, (1910) is also important for his criticism of the habit of Hegel, (1817) for constructing abstractions, which fail to survive the sort of rational inquiry process later proposed by Dewey, (1938).

Here the definition of pragmatic truth used by James, (1907) and Schiller, (1910) diverges from the narrower definition of Peirce, (1906). It was claimed by James, (1907) that truth is to be determined on its’ ability to survive a Kantian process of rational inquiry which holds ‘truth’ to be a concept to be fundamentally different to ‘the truth’ of particular propositions.

Certainly this constitutes an arguable position outside of traditional physical sciences such as chemistry or physics, and even there it is not irrefutable. Simply stated, under Kant’s model *Truth* is a journey as well as a destination because it represents a desire of humans to construct accurate means of studying the physical world and thereby to develop models of its operation, which conform to observed reality.

Perhaps then, the more important contribution of Schiller (1929) is to illustrate the importance of context in assessing the truth of an element. He illustrates this by demonstrating that although the proposition “ $1+1=2$ ” is valid in the context of sticks or stones, it is not necessarily valid in the context of drops of water. A pragmatic theory of truth as distinct from a consensual one can be summarised as follows. It is a rational process undertaken collectively by a group of people in respect of observations and inferences, which all parties accept as accurate within agreed parameters even if not generally applicable in the world. That is to say as Kuhn, (1962) does, that in order for something to be considered ‘true’ the underlying premise, the method of investigation and the conclusions drawn, must all be accepted as valid and reliable by the majority of members of the paradigm in which the researcher claims to operate.

Although more contemporary writers such as Rorty (1979) and Putnam (1981) concur with the views of Russell (1956) on relativism, a philosophical bridge is provided by Dewey (1938) between the Pragmatic and Consensual theories of truth of James (1907) and Schiller (1910, 1929). This step of Dewey’s does however carry a contextual assumption. It presupposes that the ultimate version of *truth* will be consistently arrived at by all persons investigating the abstract concept of truth.

Arguably this assumption is invalidated, (at least in the human sciences), due to the individuals proceeding from completely different ontological explanations of the world which they may cling to even when presented with contrary evidence. For example, fundamentalist Christians who readily accept the validity of ‘scientific method’ in regard to designing car engines and yet dispute the evidence of fossils as proof of natural evolution. This point returns us to Kuhn (1962) and the ‘normal science’ paradigm.

3.4.1 Paradigmatic and Narrative ways of knowing

Humans understand the world in two complementary ways and that both must be engaged with in order to sufficiently understand ‘truth’, Bruner (1986). The first of his conceptions, the paradigmatic, is about how humans seek to measure, quantify, categorise and explain their observations of the world. The second conception, the narrative, is about how humans use analogy, story and metaphor to understand both their observations about, and their interactions with, the world.

My research gathers narrative data from the children as well as requiring them to construct the artefact maps. This is because I am using the paradigmatic method of ‘normal science’, Kuhn (1962), to test some hypotheses about both Lynch (1960) spatial typology and about the artefact maps constructed by children for the selected previous researchers. In my research the children have to recall and represent information within a common conceptual framework – an artefact map. That requires them to translate their lived three dimensional (or isometric experience) of the world into a two dimensional (orthogonal or planometric) representation of the world. So although the interaction with the children is a narrative process within a broadly social constructivist paradigm, it is being undertaken as part of an experiment which uses deductive reasoning to test an existing hypothesis and inductive reasoning to formulate a new one, Thomas and James (2006). By that I mean a process of reasoning like this;

“For all x and some y if x has property φ , then y has property ψ ”
(MacIntyre, 1981, p. 91)

The spatial typology proposed by Lynch (1960), holds that all people, (including children), will construct artefact maps by first drawing paths and nodes and then assigning landmarks. Although the literature suggests that some gender differences exist, overall it appears that children may construct artefact maps by first drawing landmarks and then connecting them with paths and nodes. Therefore the aim of my research is to learn;

- Which particular objects the children chose to represent,
- Which order the selected objects were drawn in and
- How spatially accurately the objects were located on their artefact map.

By conducting this experiment I am accepting the 'uncertainty' (Heisenberg, 1930) of outcome due to the differences in children's experiences of storing, ordering and using spatial information and also of their graphic representational abilities, (Pocock, 1975).

These differences will provide me with a range of possible forms of the artefact maps which is why I have chosen to compare my artefact maps with those of Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984). Through this data analysis of environments depicted I will aim to construct one or more new hypotheses.

I have chosen the Pragmatist paradigm because I agree with Evens and Handelman (2006) that analysis can be grounded and truth produced provided the researcher has a nuanced rather than binary ontological view of the social phenomena being examined. This is where my views coincide with the constructions of child capability which are found in the theorists of Reggio Emilia. That is because my research seeks to generate empirical data about how children construct mental and artefact maps and this must be understood as a process in order for the artefacts to be sufficiently understood.

Returning to Bruner (1986) and the need for narrative as well as paradigmatic ways of knowing, my choice is consistent with the view of Glaeser (2005) that

The reason to tell a tale is interest. That interest can attach itself to three different aspects of process. There is first its concrete embodiment in particular people, their actions in concrete time-space in all its singular curiosity. The second is the social formation as the effect of process, its becoming, maintenance, or disintegration understood as a case standing for a class of phenomena. Finally, interest can attach itself to the patterns, principles, or regularities underlying the very dynamics of process. This is the realm of theory proper. (p. 18)

The use of Pragmatism then allows me to construct experiments and test hypotheses in a manner which is internally and externally valid. It enables me to analyse my data in reliable ways and to objectively generalise my findings from these children to similar children performing similar tasks under similar conditions.

My ontology is based upon Reid (1764) that the universe must be knowable to human beings by virtue of predictable patterns which is consistent with Goldthorpe's (2007) Rational Action Theory

Any theoretical approach that seeks to explain social phenomena as the outcome of individual action that is construed as rational, given individuals' goals and conditions of action, and that is thus made intelligible (verständlich) (2007, p.117)

My ontological path to Pragmatism is via the uncertainty, Heisenberg (1930) about human behaviour which DeGrasse-Tyson (2016) identified and I am comfortable with the idea that although human beings are rational, they do not always behave rationally

It is necessary at least to begin with an idea of rational action, since it seems only by reference to this that other kinds of action can be usefully identified (Goldthorpe, 2007 p.128)

This is because I agree with Goldthorpe (2007) that although individuals do often act irrationally, it is nevertheless still possible to make pragmatically reliable predictions about phenomena by using triangulation and aggregating the behaviour of multiple individuals. For this reason I examined the methods of selecting sample groups and designing tasks and also the findings of other researchers who have investigated how children and adults draw maps. This examination led me to design specific tasks to answer my particular questions in a situation using direct observation by me and also interaction with the children. So if I observe the majority of the 40 children in my research drawing landmarks before they draw paths and being able to extract specific data from the supplied maps then I will consider this a reliable outcome within the context of primary school children in East Kent in 2016. Such an outcome would also be consistent with other research conducted with children by Karsten (2002) and Lehman-Frisch, Authier and Dufaux (2012). It is also supported by the research of Huynh, Hall, Doherty and Smith (2008) with adults and their creation of artefact maps.

3.5 Paradigm adopted for the study – Pragmatism.

My research examines whether children's artefact maps constructed at one point of time might be considered sufficiently similar to those constructed at other times as to allow reliable conclusions to be drawn from them.

In conducting this research, I have chosen to situate myself within the paradigm of pragmatism because of my belief in methods and solutions which are viable and defensible, as opposed to perfect. By both personality and life history I am inclined to apply the dictum of General Patton that "*A 'good' plan energetically executed now is better than any number of 'perfect' plans next week.*" to any task before me, including this research about the children's cognitive understandings of the physical world.

By that statement, I mean that all the forms of research paradigm identified by Crotty (1998) possess sufficient amounts of validity and reliability in some circumstances, and with regard to some topics for me to concede their utility. However, the one that I am personally most comfortable with, in regard to this research is Pragmatism.

Ontologically I could begin my research journey in Quantum Physics, with the 'Uncertainty Principle', (Heisenberg, 1930). This questions the absoluteness of Positivism through recognition of the constant discovery of statements appearing to contradict earlier findings. It therefore requires any assertions of 'truth' to be the product of multiple measures, observations and forms of triangulation, including statistical measures, methods and documents, (Denzin and Lincoln, 2003). This is utterly consistent with the scientific method utilised successfully under Positivism Kuhn (1962), but it also recognises DeGrasse-Tyson's (2016) point about the difficulties of attempting to rigidly apply such methods within the human sciences.

As a Pragmatist I will be comparing depicted elements and spatial relationships in artefact maps produced by children in response to an open instructional set, against earlier similar maps. It is my assertion that the Interpretivist ontological position of some of those previous researchers does not prevent me from applying their categorisations objectively against my artefact maps.

3.6 Rationale for my research

My research investigates whether the universal human typology of spatial representation which was discerned by Lynch (1960) in artefact maps produced by adults is visible in the contemporary artefact maps produced by children. That investigation is driven by the evidence from research conducted between 1960 and 2012 which suggests that children do not always understand large scale space or construct artefact maps in the same ways as adults do. Prior to conducting my own research I examined the spatial typologies visible in the artefact maps produced by children aged between 6 and 16 years in the UK and USA for the research of Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984) for similarities and differences. My research then examined how contemporary UK children of 7-9 years constructed their artefact maps.

All four of these researchers were ontologically Constructivist in that they broadly accepted Piaget and Inhelder's (1967) view of children gradually coming to understand large scale physical environments through both direct experience and reasoning. At a similarly broad level I share that position. Epistemologically however, these researchers were all primarily Interpretivist and this is where my research differs. I propose to conduct my research using a mixed method approach because the work of Huynh, Hall, Doherty and Smith (2008) suggests that a gap exists in both historical and current research.

The summary of historical research in this field by Huynh, Hall, Doherty and Smith (2008) suggests that most of the work, with the notable exception of Hart (1981), had focused on the artefact map as a product without adequately examining the cognitive process that produced it. That is to say, subjects were asked to draw a map, and the resulting artefact was then assessed using classification categories determined by the researcher and conclusions were drawn about the subjects understanding of large-scale space based upon their artefact map. The uniqueness of Hart (1981) is twofold. Firstly, he was asking children to produce a model of their town rather than to draw a map. Secondly, he was interacting with the subjects during the construction of their artefact in order to gain a deeper understanding of their cognitive process in producing it.

An objection might be raised, that by taking a mixed method approach I am unqualified to draw comparison between my research and the work of my selected researchers as I am using a different method to them. It is necessary to address that objection. At a base level I reject the assertion that in order to examine or to build on the work of others it is necessary to share their ontological and epistemological positions. This objection derives from a refusal to accept a priori an epistemologically Interpretivist position on the nature of truth.

Such an objection derives from Kuhn's (1962) assertion that in order to be considered scientific rather than merely speculative research, the researcher must possess an overall desire to understand the broad nature of the world. This desire must sustain a singular desire to improve the precision with which some particular aspect of the world is ordered. It derives from a prior acceptance that the world is not in fact a mere arbitrary collection of chance occurrences. Instead it must be assumed that the world is in fact a system which operates with sufficient predictability to enable its' workings to become known by humans. From such a construction of the world there comes both a desire for more detailed knowledge and a commitment to pursuit of knowledge via a scientific approach (Reid, 1764).

I further agree with Kuhn (1962), that although a person may be ignorant of a specific discipline they may nonetheless apply a process of deductive reasoning to their observations within said discipline. By doing so they may legitimately arrive at any of a number of credible but incompatible conclusions. The reason for this variance in potential conclusions is that the conclusions will be derived from the individuals' prior experience in other fields. It will also, be affected by their existing individual characteristics (e.g. diligence, persistence etc.) and to some degree by random occurrences within their investigations.

3.7 Conduct of research

Success in this investigation required me to possess clear understanding of Lynch (1960) spatial typology and of the characteristics of the categorisations of artefact maps used by Ladd (1970), Moore (1973) Hart (1981) and Matthews (1984). This understanding permitted me to draw conclusions from the research of those authors about whether or not Lynch's (1960) spatial typology is in fact visible in the artefact maps produced by the children in each case. I was then able to use that understanding to assess whether, or to what degree the spatial typology of Lynch (1960) is visible in the artefact maps produced by the eight year old children in my own research.

This pragmatic approach was chosen as it will enable me to examine why the universal spatial typology proposed may or may not be present during the production of the artefact as well as simply looking for it in the artefact itself. This is significant as Lynch's (1960) typology rests on the artefact being constructed in accordance with a hierarchy of depicted elements, Appleyard, Lynch and Myer (1964) Lynch (1981), beginning with outlining major paths and then assigning landmarks. The work of Siegel and White (1975) however suggested that children do not seem to construct their artefact maps using such a hierarchy to arrange their chosen elements. The review of historical research by Huynh et al. (2008) suggests that insufficient attention has been paid by researchers to the process by which the subject produces the artefact map due to taking Lynch (1960) at face value.

Therein lies a problem, which Stubbs (1999) identified in her examination of cross-cultural research. She found that research, especially the kind which involves hard to reach places and groups, can too easily become dependent on a small range of uncritically used sources and can thereby easily perpetuate fallacies and biases either consciously or unconsciously. Her conclusion is supported by the work of Laws, Harper, Jones and Marcus (2013) about the nexus between effective research and appropriate development activity.

Both of these studies highlight the need to constantly seek contemporaneous sources whose biases can be identified, quantified and if necessary challenged. This is important, because three of the selected researchers, (Hart (1981) being the exception), asked their subjects to produce an artefact map and then drew adult-centric post-factum conclusions about the spatial information depicted in it.

These researchers were selected because I appreciate how the work by Golledge (1978) proposed a more nuanced understanding of how subjects constructed an artefact map. He found that subjects 'anchored' their map with points of detail and then drew additional information with reference to those points. This is broadly consistent with Siegel and White (1975) who contradict Lynch (1960) by suggesting that for children at least landmarks appear more significant than pathways. Despite some studies by Stevens and Coupe (1978) and Hirtle and Jonides (1985) it was not until the work of Taylor and Tversky (1992) that serious attention was paid to the order in which subjects drew the chosen elements of their artefact maps. That latter study clearly suggested that elements are selected and depicted according to a perceived hierarchy of importance to the producer of the artefact map. Significantly, the hierarchies identified in these studies appear to be based upon landmarks rather than paths. Therefore, it seems that the assertion of Piaget and Inhelder (1967) about children adopting landmarks/anchor points for ego-centric reasons could legitimately also be applied to adults.

This is why my instruction set is '*Draw me a map of your town*' as I wish to examine:

- What spatial elements the children consider significant?
- What sort of hierarchical importance they ascribe to those elements?
- How those elements are spatially distributed in the production of their artefact maps?

Like Stevens and Coupe (1978), Hirtle and Jonides (1985) and Taylor and Tversky (1992) I recognise two inherent difficulties with the use of drawings as primary data and these are articulated in this section. The first difficulty is that although both speech and drawing are forms of linear discourse, in former case the meaning must be apparent to speaker and listener from beginning to end. In the case of drawing however the viewer may only fully comprehend the intended meaning upon completion of the artefact. This is significant as my research sought to examine whether the children drew paths first as asserted by Lynch (1960) or landmarks first as claimed by Siegel and White (1975). It was therefore considered desirable to watch the children draw their maps and seek clarification from them about the nature of depicted objects.

The research conducted in 1992 by Taylor and Tversky required separate groups of undergraduates to use either oral description or artefact maps to reproduce previously seen maps. They found strong positive correlation with their subjects between the first mentioned or first depicted element being a landmark rather than a path. They also found positive correlation between largest landmark on original map and first object mentioned or depicted by subjects. Both findings echo those of Ladd (1970), Moore (1973) and also strongly anticipate my hypothesised research outcomes with the children.

The second difficulty regards scoring the artefact in some way, usually based upon spatial distribution of depicted elements. This is where Appleyard (1970), Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984) are useful in providing several examples of such scoring of artefacts in terms of the selection and spatial distribution of elements. This too is significant as my research also investigates what elements the children choose to depict when given an open instruction set. The work of Taylor and Tversky (1992), suggests strongly that the artefact maps produced by the children will be affected by such things as time available for construction of artefact, limitations of media (number/colour of pens etc.). It is also expected that children will display the common conventions of written communication such as working from left to right and top to bottom for English speakers. This would be supported by Donaldson (1978) who argued that formal schooling serves to form a cognitive range of 'acceptable' answers that children have learnt that they can provide to adults in a classroom situation. It was found by Taylor and Tversky (1992) that the artefact maps may also show evidence of subjects reducing mental and physical effort through drawing similar elements in proximity to each other even if this is not objectively so. Here again Ladd (1970), (Moore (1973), Hart (1981) and Matthews (1984) will provide framing for the analysis of the artefact maps produced by my study.

3.8 Anticipated research outcomes

My research anticipates that the artefact maps produced by the children will display a hierarchical organisation in the temporal and spatial depiction of the elements selected by the children.

By hierarchical organization, here we mean the reliable tendency of subjects to subdivide the environments and to draw or describe one set of features prior to another. (Taylor and Tversky, 1992, p. 494).

In the course of my research it is expected that:

- The hierarchical organisation seen in artefact maps produced by the children will be based upon landmarks rather than paths.
- The temporal construction order (which object is drawn first), and the spatial distribution (where elements are placed), on the artefact map will be consistent with one or more of the categorisations of my selected theorists – Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984).

3.9 Specifics of the proposed data collection task.

It was decided to conduct this research in three (3) primary schools in east Kent in the United Kingdom as this enabled me to examine the artefact maps of children in a variety of locations. In order to facilitate the investigation of their spatial knowledge through the chosen tasks, it was decided to use an urban school and also a school in a rural village and one in a coastal town. The reason for the variety of location types was that it was expected to generate a range of spatial recognition and recall among the children in the study. The coastal town was specifically selected as no previous similar research has been conducted in such a location and it was hypothesised that the boundary between land and sea would be a strongly recalled element for the children.

With regard to the first task it was expected that there would be a difference between the urban children and the children in the other two sites as the latter will possess more visibly distinct elements (e.g. the coastline and the boundary between village and the surrounding agricultural land), in their daily environment. This is important as the study deliberately utilised the open-ended instruction set *“Draw me a map of your town”* with the second task because I wished to see where children at each site conceived the boundaries of their town to be.

This was expected because the work of Dupre and O’Neill-Gilbert (1985) found significant differences in how urban and rural children constructed artefact maps of their physical environment. Rural children consistently depicted clear boundaries and to emphasise dwellings while urban children tend to depict areas of varying size radiating outward from their own dwelling. The urban artefact maps tended to emphasise commercial premises and large infrastructure such as hospitals, railway stations etc. These differences in artefact maps may reflect the impact upon children’s conceptual abilities which derive from the extent of their independent range within the physical environment, Hart (1981), and Matthews (1992). They certainly appear consistent with the ideas of Lynch (1960) and Appleyard (1970) about people’s cognitive maps of a whole area being ultimately the sum of their cognitive maps of smaller parts of that area.

We now move on to the specific research tasks for the collection of my data namely the description of the process. There were two data collection tasks, firstly the child using adult maps to investigate their ability to interpret an artefact map. Secondly there was the creation of a free-recall sketch map by the child to investigate their ability to graphically depict a known large-scale physical environment.

3.9.1 Task 1 – Artefact interpretation

This task seeks to explore:

- The existing level of cartographic knowledge of the child to see whether they know what artefact maps are,
- Whether the child can mentally rotate their personally experienced environment from isometric to orthogonal view and interpret the two dimensional image as representing their three dimensional environment.
- The level of understanding by the child of how common elements such as major roads, large buildings, rivers/sea, open land and schools, are depicted on maps via the conventional cartographic symbols,
- The understanding of the child about how maps are used by human beings.

The task also seeks to explore what the child knows about these things and how they know it, in order to assist subsequent correlational analysis of the artefact maps constructed by them.

Materials - Each child was given:

- A colour image of a fictional town roughly 400 metres in diameter which employs conventional cartographic symbols.
- A pen

Originally it was intended to utilise a Google map image because it is the current market leader in provision of free overhead imagery with 65% of commercial market versus its nearest rival Yahoo with just 15%, (Brotton, 2012). By utilising the same imagery found in most SATNAVs and mobile phone applications it was reasonably be presumed to be a 'map' format that is broadly familiar to most people today including children. However, obtaining such an unlabeled image of the desired areas proved logistically impossible and therefore it was decided to show the child a generic map of a fictional urban area which employed standard cartographic symbols, and to amend the questions and interpretation task to allow the generic map to be used. See map below :

Map of fictitious town, used for Task 1 child interpretation



<https://jamescook8.files.wordpress.com/2013/03/map-otenjo.jpg>

This map was obtained by using a search of Google Images with the search term '*fictitious town map*'. It was selected as it depicted a large and a small river and several canals, a particularly large individual building, numerous roads and different kinds of open space such as fields and forest. It was felt that these elements would be sufficiently identifiable to children in order to address the research questions about their ability to extract information from a map by interpreting conventional cartographic symbols.

Instruction set – orally provided by the researcher

“Thanks for taking part in my research today. May I record us talking or would you rather that I just wrote down your answers? (Wait for and comply with child response).

I am interested in finding out what children about your age know about the world they live in. To do that, I need you to look at this coloured piece of paper and answer some questions about it for me. Please take a few moments to look at the paper and then tell me when you are ready to start”

Proceed with structured questions once child has indicated that they are ready.

Interpretation Questions

What is this piece of coloured paper?

How do you know what it is?

What does it show?

How do you know?

What could you use this piece of coloured paper for?

How do you know?

In asking these questions I specifically avoided using the terms, *map*, *picture*, *image* and *area*. My reason is that I wished to know whether or not the child recognised the image as (a) a map, and (b) knew that a map can be used for navigation. The final two questions sought to explore what the child understands about artefact maps as purposive utterances, Schiller (1929) and Dewey (1938), and how they know this.

The explanatory answers given by each child to both the initial interpretation questions and the subsequent interpretation task, were recorded on a video-audio recording device (subject to parental consent and child assent). The video camera was always aimed at the drawing and care was taken to avoid accidental inclusion of children’s faces.

It was decided that if it was established that the child recognised the coloured image as a map then the additional interpretation task could be conducted. This would involve the child being asked to make marks on the image indicating depictions of nominated conventional cartographic symbols for common physical elements. Each image map had the child's first name, school and gender recorded on the back for later analysis, but all final references to individual data were rendered anonymous with children referred to by a code based on school location and gender. The schools were called S1, S2 and S3 and the children referred to as B for boys and G for girls and given a number representing the order in which they participated in the study. Using this method the first child at the first school is S1B1 and the last child at the third school is S3G8.

If it could not be established that the child recognised the coloured image as a map then it was decided to place their copy in a separate category for later analysis. Although the additional interpretation task would still be attempted with them, their copy was to be denoted on the rear with a large asterisk to indicate that their response fell outside the expected range.

Interpretation Task

Put an "A" on the biggest road – How did you know that was the biggest road?

Put a "B" on the biggest building – How did you know that was the biggest building?

Put a "C" on a river if you can see one – How did you know what that was?

Put a "D" on some open land – How did you know what that was?

This first task tests the child's level of general cartographic knowledge and their ability to interpret standard cartographic symbols as well as their ability to mentally rotate their largely isometric mental image of the environment into an Orthogonal view. That means – The child can recognise a two dimensional image as a map of a particular area and they can identify some of the main elements depicted on topographic maps through the use of conventional cartographic symbols. All of my chosen theorists Ladd (1970), Moore (1973), Hart (1981), Matthews (1984) and also Piaget and Inhelder (1967) suggest that the majority of children of this age (eight years), should have 'some' level of cartographic knowledge and hence be capable of performing this sort of mental rotation without too much difficulty. This is consistent with the findings of Blades and Spencer (1987b) who found that children aged 4-6 years can fairly easily identify common objects like houses, roads and rivers from an unlabeled cartographic map of a fictional urban area through the child's ability to recognise their conventional cartographic symbols. The use of cartographic maps of fictional areas utilising conventional cartographic symbols was also employed successfully by Spencer, Blades and Morsley (1989) to answer similar questions to those in this research.

In the late 1990's the age at which these abilities become consistent, and the ease with which they develop were key debates between Blaut and Stea (1997a, 1997b) and Liben and Downs (1997) with their respective positions being termed '*Early and easily*' versus '*Late and with difficulty*'. My position is broadly with Blaut and Stea (1997a, 1997b) although both arguments are tenable. However, I would assert that age and ease of acquisition of these abilities are highly variable between children and that they will be strongly affected by individual intelligence, gender, social class, and social capital, (Hart, 1981; Matthews, 1992; Reggio Children, 2000; Edwards, Gandini and Forman, 2012). Therefore, I expect that by the age of eight years the average child attending a mainstream school, should have little difficulty with the proposed tasks as by then they will have seen maps used at school in several contexts..

Note on using fictional area maps

Due to the difficulties in obtaining a local map it was decided to use a fictional map for this task. It was accepted that because the area is not the neighbourhood of the school, or indeed a real place, it will be unfamiliar to the child and so they may have initial difficulty in orientating their view of the map, (Hazen, Lockman and Pick, 1978;

Bluestein and Acredolo, 1979). However, this problem could be overcome by presenting the map to all children on the same orientation, (Presson, 1982; Blades and Spencer, 1990). The advantage of a fictional map is that because the area is unfamiliar to the child they will be totally reliant upon their ability to interpret the document as a map and to understand its content through conventional cartographic symbols, (Catling, 1979). Therefore, any answers they provide to the interpretation questions will be the result of their ability to articulate existing knowledge of such conventional symbols.

3.9.2 Task Two – Production of artefact map

This task seeks to explore the *Spatial Thinking* abilities of the child to retrieve from their *Spatial Storage* impressions of their isometric experience of the three dimensional world and to graphically represent it as a *Spatial Product*, (Liben, 1981 cited in Spencer, Blades and Morsley, 1989). That is to say, I am asking them to produce a two dimensional Orthogonal image of their experienced three dimensional environment, namely a hand drawn free-recall sketch map of their town.

This task seeks to explore:

- What elements, in which order, the child chooses to depict when asked to produce a map of their town without an adult specifying a purpose for the subsequent use of such a map.
- Whether the elements depicted and their spatial distribution is consistent with any of the potential typologies identified by Ladd (1970), Moore (1973), Hart (1981) or Matthews (1984).
- Whether or not the child is capable of performing the cognitive spatial tasks identified by Liben (1981).

By not specifying a potential purpose for the artefact map I am seeking to extract those elements identified by the child as being of major importance in their physical environment. This is being done so as to enable the subsequent attempt to discern the *Paths, Nodes, Landmarks, Edges* and *Districts* which Lynch (1960) postulated as representing a universal spatial typology.

This is an area where my thinking shifted because initially I had intended to conduct research at a single school in a small village as it was thought that this might exert a stronger influence on the children in creating mental boundaries of what is or is not a part of that physical environment. However I adjusted my view after Literature Review and decided that in order to examine Lynch's (1960) assertion it was desirable to conduct the research in three (3) visibly distinct physical environments. Therefore, the research was conducted at three different schools using children of similar ages. Fortunately, an inner suburban, rural village, and coastal town school were found. These provided sufficiently different mental boundaries of the urban versus rural landscape for the children to exhibit some variation in their maps, (Dupre and O'Neill-Gilbert, 1985).

The instruction set for this task is deliberately vague, being simply, "*Draw me a map of your town.*" There were two reasons for this decision. Firstly, because Orleans and Schmidt (1972) found that using the term '*home area*' yielded different results to Klein (1967) who used '*central area*'. This suggests that an important distinction exists in the minds of children about whether their home or some nominal central area is considered to be the nucleus of their physical environment. Secondly, my research was specifically interested in the children's selection and spatial distribution of elements which *they* deem significant without adult input. That is to say, I wished to know:

- Where the child considers the boundaries to their '*town*' to be
- What elements the child chooses to depict in '*their*' town
- Whether the child's spatial distribution of those elements conforms to any of the selected theoretical typologies.

Materials

Each child was given:

- A blank A3 sheet of paper (with their school, first name and gender on the back)
- Set of 12 x coloured felt pens

Instruction set

“Thanks for taking part in my research today. I am interested in what children your age know about their town. Please use these pens and paper to Draw me a map of your town. Because of what I am trying to find out I would like to talk with you while you draw so that I can be sure that I understand the things you are drawing in the way that you meant. I would like to record us talking so that I can listen to it again later but if you don’t want me to record you then I will just write instead. Is it okay for me to record us talking? (Pause for and comply with child response)

Okay you can start now. We have about 10 minutes.”

During this task I deliberately avoided asking ‘Why’ in regard to any object drawn by the child and instead asked ‘what’ each object was so as to facilitate children providing explanations of their depicted objects. This was done because it was desired to avoid the implied adult judgement of the child’s choice of object which the use of the word ‘Why’ might entail.

3.10 Data analysis

This research utilised the classification systems for child artefact maps which were proposed by Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984). It is noteworthy that all except Hart worked with children older than 10 years and that only he engaged in any sort of contemporaneous analysis. The other three theorists all used post-factum adult interpretation to analyse the children’s maps. The purposes of the tasks in each study were explained to children in limited ways and a purpose for the subsequent use of the maps was usually explicitly given or strongly implied. In this research, the children were not given a subsequent purpose for their artefact map and there was constant interaction between the researcher and the children during production of the maps so as to be clear on what each depicted object represented. Each of the resulting artefact maps was assigned a grading level based upon where it might have scored under the criteria of each of the four theorists.

The initial hypothesis that none of these classification systems would truly reflect children’s levels of knowledge about their environment was borne out and the need for a new classification system for children’s maps was reinforced.

3.11 Ethical Considerations

3.11.1 General research issues

Any research with people, especially with children raises issues of power differences between researcher and subject and control and use of information gained through the research. As an adult (and a university lecturer), entering a primary school classroom I am afforded a privileged status even beyond the normal deference of children to adults. The problems of negotiating such status into a true research partnership rather than a 'data-mining' expedition are well examined by Hursh-Cesar and Roy (1976), Sidaway (1992), Madge (1992) and Scheyvens and Story (2009). Those authors were specifically discussing cross-cultural fieldwork but most of the same issues of power and information use pertain within my research. (Einarsdottir, 2007; Elden, 2012)

With those issues in mind I decided to produce a child-friendly version of the final research and to present it to the schools, and to have it include scanned images of the artefact maps of all children who consented. The challenges presented by the *Hawthorn Effect*, Parsons (1974) are numerous especially in 21st century UK schools where assessment is an end in itself and shapes daily classroom practice. This issue is important here as I am working with children in a classroom and therefore am at risk of any task being perceived by the children as assessment, (Donaldson, 1978). Given the nature of the research tasks I do not anticipate this adversely affecting the artefact maps but to exclude it from my thinking would be a mistake. Although it does not matter for the outcome of my research, I still must be mindful of the assertion by Findlay (2002) that the individual researcher co-constructs the research with their subject and that a different researcher would invariably construct a different account of similar things. This supports the findings of Robins, Spranca and Mendelsohn (1996), who identified the way even stable situations and relationships are invariably changed during, and because of, each interaction between the same researcher and subject. That is to say, by conducting these research tasks with the children about maps and their towns I am potentially altering their views about those things and hopefully making the children more curious about the world.

3.11.2 Issues for male researchers today

In conducting this research I was acutely conscious of being an adult male researcher trying to work with children individually against a national background containing numerous historical and current investigations about sexual abuse. With that background in mind I explicitly suggest that repeating the work of Ward (1978) and Hart (1981) would now be impossible in the UK as no parent or teacher is likely to permit an unknown man to simply follow their children around as they engage in unsupervised play outside the home. Similarly the chances of a Head Teacher, parent or classroom teacher consenting to male researchers being alone with children while they draw their artefact maps is fairly slim.

Therefore my research had to be done at each site in a hallway where there was constant auditory and visual distraction for the children and this undoubtedly reduced their levels of concentration. Given the nature of the two research tasks however, it was not expected that any discussion between children who had and had not undertaken the tasks would make a material difference to their individual production of an artefact map.

In any interaction with children it is impossible to eliminate the possibility of the child disclosing some form of physical or sexual abuse and so I structured my interactions with the children in ways which minimised it. I familiarised myself with the child protection policies for each school I worked in. It was intended to work at the back or side of a classroom but this was not possible. If a child had disclosed something or given me cause to suspect something then I would have sensitively concluded the interaction and informed the designated child protection staff at the school. No disclosures were made and no concerns were identified during data collection.

3.11.3 Adult Consent and Child Assent

The centrality of informed subject consent has been set forth unequivocally in the Nuremberg Code (1947) and for our purposes it is articulated more fully and specifically in the British Educational Research Association (BERA) Guideline 2011. Crucial to my research is an exploration of what children understand about the environment in which they live and so I was particularly concerned to ensure active assent from the children. Too often research with children, can (for no worse reasons than convenience), simply assume the cooperation of children based upon prior parental consent. I however share the view of Edwards, Gandini and Forman (2012) that the child should be treated differently to an adult research subject only in so far as the need for the researcher to step their explanation down to an intelligible level for the child.

For this reason consent was sought from the gatekeepers (Head Teachers and parents) for their children to take part in the research. Once those two layers of consent have been obtained I explicitly sought assent to participation from each child on the day of data collection. At that time it was explained to the children that they did not have to take part unless they chose to, and that they may withdraw at any time without giving a reason. They were informed regarding intended storage and use of the data, including the creation of the child-friendly research output and again their explicit assent was sought.

3.12 Logistics of the research

3.12.1 Selection of schools and gaining of consent

All three schools are located in the east Kent area of the United Kingdom within a triangle bounded by Canterbury, Ramsgate and Deal. The Year 3 class was chosen at each school as this is the upper end of the commonly used 0-8 years category which is termed 'Early Years' or 'Early Childhood'. The schools were chosen by the following method

- Conduct of an internet search using the term 'East Kent Primary Schools' which resulted in a list of sixteen primary schools located within the triangle.
- Sending Introduction letter to Head Teachers of those schools outlining nature of research, seeking consent to conduct it at their school and consent to forward a parental consent letter via the school.
- Telephoning and visiting the Head Teachers who responded to the letter and choosing three schools who were willing to permit the research to occur during July 2016. At this stage the data collection was discussed in detail and the class teachers were met.
- Each school was provided with copies of parental consent letter which were sent to parents with a cover note from the Head Teacher expressing support for the research.
- Children whose parents had consented to their participation in the research were individually afforded the opportunity to assent to participation.

After obtaining the consent of parents and teachers through the distributed letter I attempted to meet with each class teacher and to introduce myself to children but this was only possible in one school due to other time pressures on the schools.

3.12.2 Visits to the three schools

The visits to all three schools were conducted between 5th and 18th July 2016 with two days at each school. As anticipated, in all cases the researcher was not permitted to be alone with children and so the data collection tasks were performed in hallways with child-sized desks and chairs.

3.12.3 Number of children involved

A total of forty (40) children participated across the three schools, referred to as S1, S2 and S3, (S1 – 8 Boys and 8 girls, S2- 4 Boys and 5 Girls, S3 – 7 Boys and 8 Girls) ranging in age from 7-9 years.

| School | Boy participants | Girl participants |
|--------|------------------|-------------------|
| S1 | 8 | 8 |
| S2 | 4 | 5 |
| S3 | 7 | 8 |

3.12.4 Recording of data collection activities

All interactions with the children were video and audio recorded and at all times the video camera was focused on the fictitious area and artefact maps. Children were given approximately five (5) minutes each for Task 1 and approximately ten (10) minutes each for Task 2.

3.12.5 Return of artefact maps to schools

As agreed with Head Teachers, all artefact maps were scanned in colour and then the originals were returned to the children via their class teachers.

3.13 Conclusion

It was anticipated that the combination of these two research tasks with the children would generate data for analysis through the use of the above classification systems. This was thought likely to enable conclusions to be drawn regarding the cognitive environmental knowledge of the children about maps and mapping. In the final stage of the analysis, an attempt was made to discern whether or not the spatial typology proposed by Lynch (1960) was in fact present in the children's artefact maps. It is expected that this research will form a basis for further research on the major issues identified and that it will make an original contribution to a field which has gone quiet over the past decade.

Chapter 4 Findings

4.1 Spatial versus Environmental Knowledge

In this analysis, I will use two distinct terms to describe the cognitive information possessed and displayed orally and graphically by the children. In the broadest sense, these terms denote a distinction in types of information about the same physical space that is akin to the difference between physical and human geographies. The term *Spatial Knowledge* refers to the information held by the child about the physical layout of a space whether depicted isometrically or orthogonally. This would also include oral information such as the fact that the newsagent is located to the right of the butcher shop. The term *Environmental Knowledge* refers to information about the networks of human interactions and relationships that the child attaches to the objects within that space. For example, the fact that the child knows that the newsagent was sold to a new owner last year because the old owner retired.

4.1.1 Notes on content of this chapter

All artefact maps from all three schools are found in Appendix F and the same level of analysis was completed for all of them. However for the sake of brevity a number of exemplars have been chosen for both boys and girls from each school and these are shown in full within this chapter. These exemplars were chosen because they were felt to be representative of the upper, middle and lower end of the range of artefact maps produced by each gender at each school.

The exemplars chosen show a broad range of graphical representational ability, spatial and environmental knowledge from their respective schools. However, it is important to note that these artefact maps were produced in just 10 minutes by children who had never previously met the researcher. Further, they were produced in areas with numerous distractions, during the last weeks before summer vacation commenced. It is therefore noted that these artefact maps are a snapshot of what each child chose to include on that day. It is also important to see them as a response to their individual understanding of the instructional set and of the level of graphical representational ability which the child chose to apply to the task, (Pocock, 1975). It is theorised that if the data collection task were to be repeated a year later then more of the artefact maps would fit into the upper end of each of the categorisation models.

A pair of cautions are included here regarding both data collection tasks as they illustrate that there is still much unknown about the how of people (especially children) making maps. The caution for Task One comes from the work of Wiegand (1999) who argues that:

Map interpretation involves an individual calling upon prior geographical knowledge and applying it to the configuration of points, lines and patches on the map that create geographical patterns. (p.67)

It also derives from the view of Plester, Richards, Blades and Spencer (2003) that for a child to be able to interpret a map they must first understand that the map represents (while not being), a portion of the large-scale physical environment. The child must also understand that the symbols used to depict the objects within an environment orthogonally may not actually resemble their common isometric experiences of such objects. However, it was found by Dale (1971), and Blades and Spencer (1987) that although they had preferred interpreting aerial photographs, most seven year olds could easily tell roads from property boundaries and identify different kinds of buildings on maps.

The caution for Task Two comes from the work of Murray and Spencer (1979). Their research identified that although there is a correlation between an individual's general graphical skills (how well they draw when drawing anything), and the degree of complexity shown when drawing their artefact maps, the link is weak. It appears that a more significant variable is the ability of an individual to retain a mental image of the large-scale physical environment whilst drawing it. It seems from their research, and also that of Taylor and Tversky (1992), that this latter ability is closely related to an individuals' ability to recall and describe a specific object and there remain many useful directions for future research in these areas.

4.1.2 Classification of artefact maps

As indicated earlier, each of these artefact maps was produced in a period of roughly 10-15 minutes, in a hallway by a child who had usually not met the researcher before. The maps were evaluated post-factum by the researcher using the classification systems proposed by Ladd (1970), Moore (1973), Hart (1981) and Matthews (1984). These were discussed in detail earlier so I shall now examine how the data collected addressed the specific research questions.

4.1.2.1 Charts and graphs showing data addressing specific research questions

Figure 12 below shows the reasons given by children for identifying the image as a map

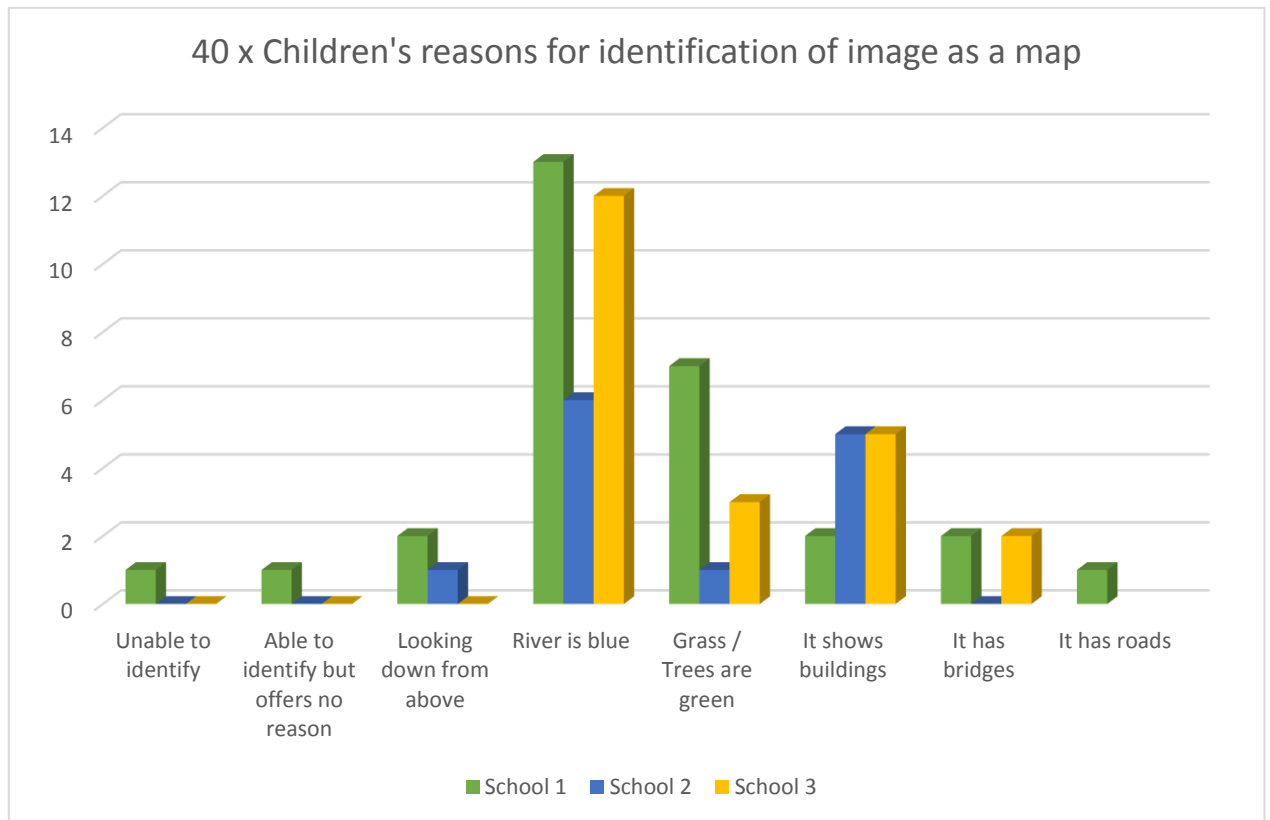


Figure 12

Several children offered additional information which led them to conclude that the image was a map and all those reasons suggested some level of familiarity with viewing orthogonal images of large-scale physical environments. One boy (S1B8) stated that it looked like a satellite image with the winding river and the straighter and narrower canal with bridges over it. Another boy (S3B6) said it was like a map from the game Minecraft and that it showed a medieval looking fortress with docks beside the river and canal. One girl (S3G7) also noted the difference between the winding river and the straight canal.

Next the children were asked what such an image might be used for and their unanimous response was either “To find your way” or “To show someone where to go” which clearly shows they understand maps to be a tool used by humans in deliberate ways to convey information about large-scale physical environments, (Blaut, 1991; Blaut, Stea, Spencer and Blades, 2003).

The children were then asked to place a designated letter on the largest road, the river, the largest building and a patch of open land and to say why they chose each one.

Figure 13 below shows some of the children's reasons for their interpretation of the common cartographic symbols on the unlabelled image.

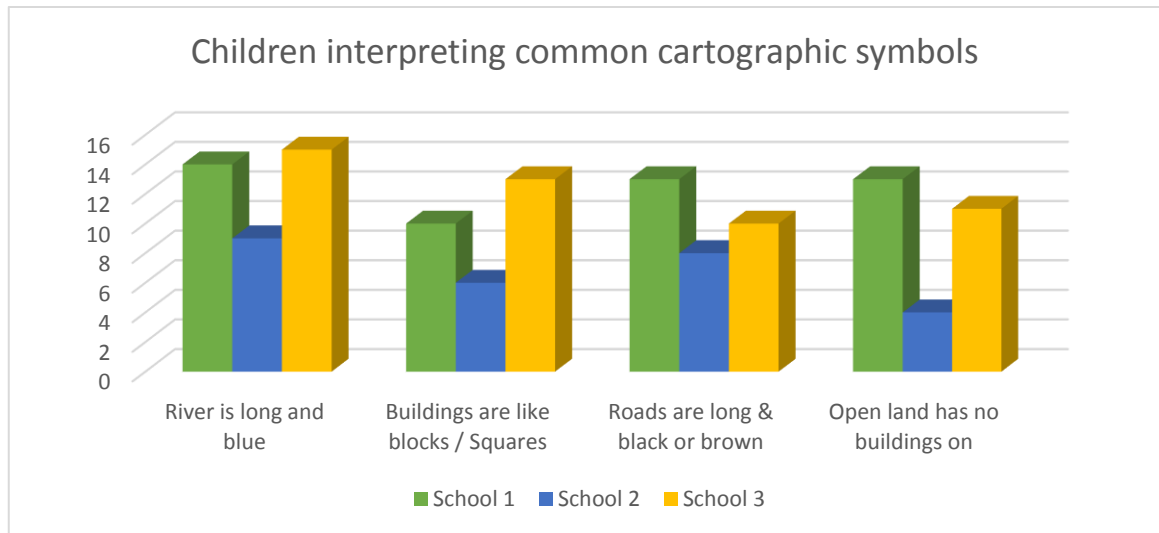


Figure 13

Lynch (1960) Classification model

The application of Lynch's model to children's sketch maps was always going to require a level of subjectivity in interpretation, (Onwuegbuzie, 2002) and Onwuegbuzie and Leech, 2005). This is because the model was intended for adults to map entire cities and it is rare that children will have sufficient familiarity with such a large scale physical environment, (Matthews, 1992; Blaut, Stea, Spencer and Blades, 2003).

Therefore I chose to apply the model in the following ways to the artefact maps:

Paths – Child depicted a road, left space for a road or used a label word for a road.

Nodes – Child depicted an intersection of roads or other paths.

Edges – Child depicted a clear change of land use either by drawing a boundary line or leaving space between objects.

Districts – Child depicted visibly identifiable clusters of objects within whole image.

Landmarks – child depicted a visually striking feature, either in shape, colour, size or use of label words

Figure 14 below, shows the prevalence of features discernible in the children's artefact maps

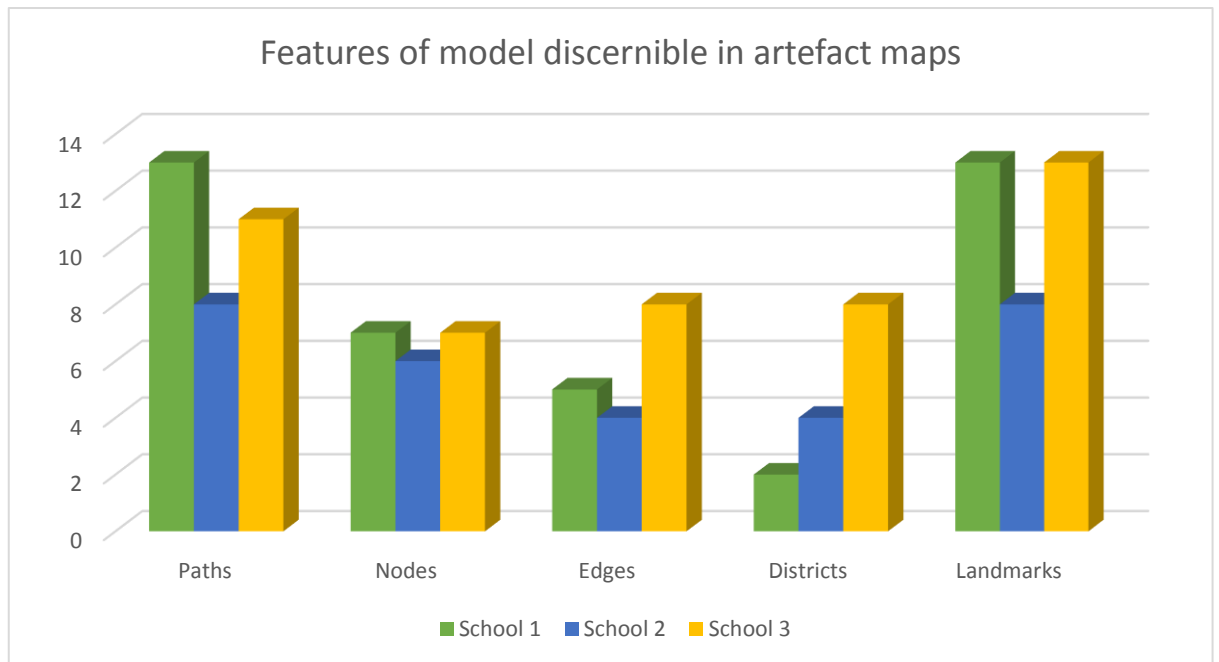


Figure 14

As the starting point of this research Lynch's (1960) model is important, but despite being proposed as a universal spatial typology it is derived from work with adults in major cities in a single western urban industrialised society. It is noted that Lynch (1960) accepted fairly uncritically the prevailing Piagetian constructions of child competence in terms of cognition and mapping ability.

As a spatial typology it remains extremely robust and useful as a base for the majority of research around the world on human cognition and mapping. The question which was asked as early as the 1970's by Blaut, McCleary and Blaut (1970) and Saarinen (1976) and pursued by this research however is; Does it reliably reflect how children collect, store, recall and manipulate spatial information?

My answer to that question is that it depends on how the model is applied. If the spatial typology were applied strictly as Lynch (1960) did, then it is naturally going to show the children performing poorly because of their reduced familiarity with maps and mapping conventions and their still-developing graphical representational abilities, (Spencer, Blades and Morsley, 1989). They will also be less likely than adults to have detailed familiarity with the layout of an entire town or city and are therefore more likely than adults to depict a familiar portion than the entire area, (Matthews, 1992; Karsten, 2005; Lehman-Frisch et al., 2012).

Appleyard (1969) Classification model

Given that this model was developed for use with adults in mapping an entire city for a specified pair of adult-centric goals (To help a tourist navigate the city and to identify sites of interest), it is unsurprisingly the least effective classification model for children’s maps which had no specified purpose. Over half the images at School 2 and approximately 1/5 of images from the other two schools were not able to be classified using this model. There was a preponderance of Positional Spatial Linked images at all three schools, (See Figure 15 below), with over half the total images from Schools 1 and 3 being in this category. It is suggested that without a purpose being specified for the artefact map many of the children did not depict a sufficiently large area of their town to permit use of this model.

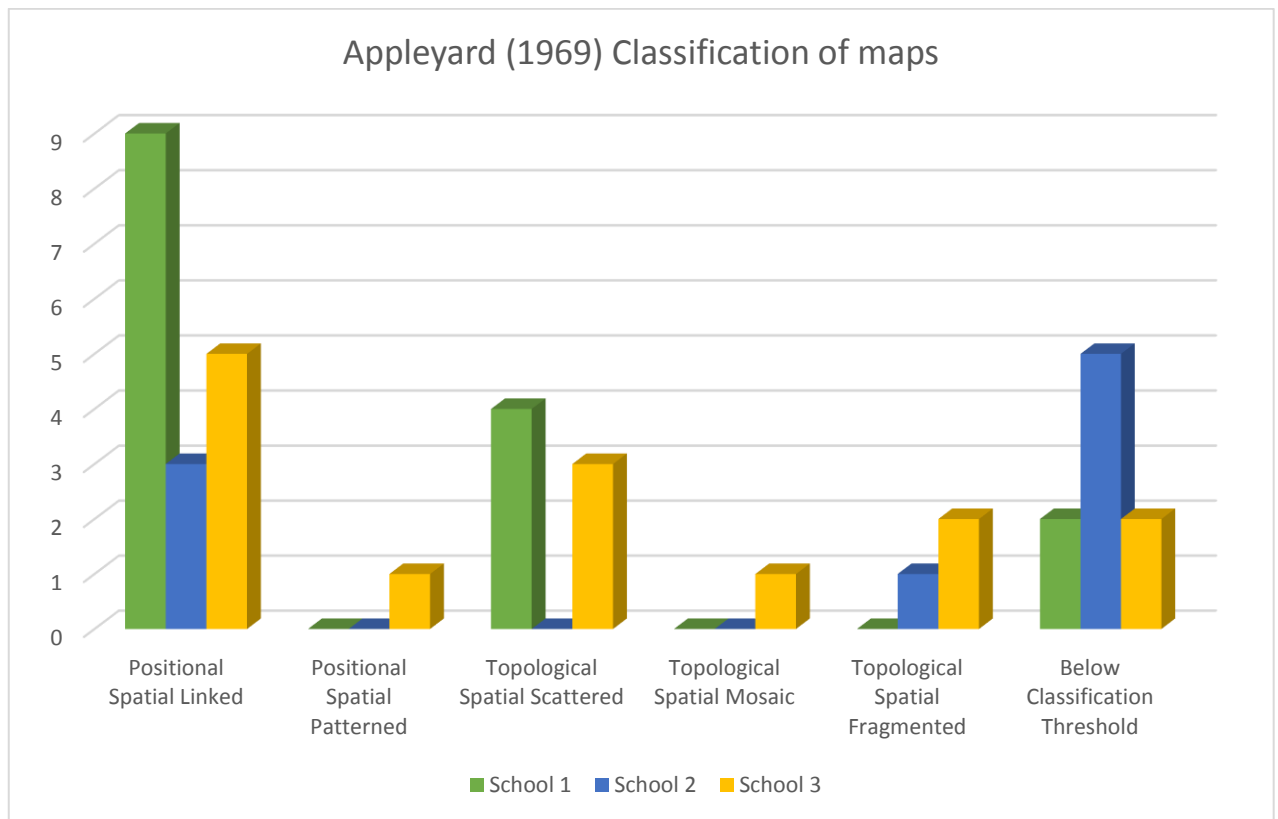


Figure 15

Ladd (1970) Classification model

This classification model (See Figure 16) was developed for use with male African-American teenagers in a dense urban environment and was part of a wider research project about their understanding of that environment. It is important to recall that Ladd’s research derives from desires for more equitable urban renewal following riots in segregated urban areas. Accordingly, it is reasonable to assume that those teenage boys may have had greater awareness of the urban fabric due to their need to avoid unsafe areas in their daily lives. Possibly this is why so many of the artefact maps in my research fall between classification categories. Interestingly, the children at School 3 produced similar numbers of Type 1 and Type 3 images. At least one child at each school produced an image that was above Type 3 despite all three schools producing their second highest numbers in the Type 1 category. School 1 produced the highest number of Type 2 images.

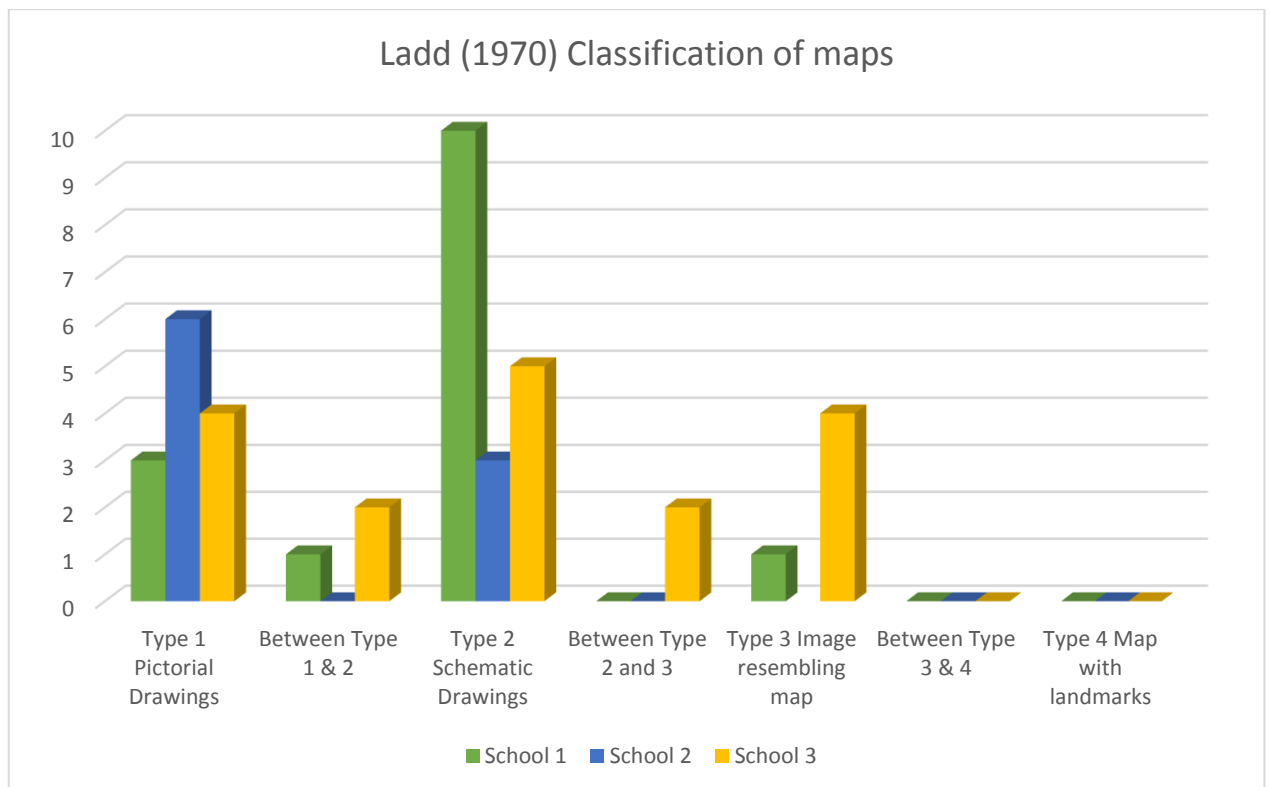


Figure 16

Moore (1973) Classification model

Use of this classification model generated the highest level of images which fell below classification threshold (See Figure 17) but this is not particularly surprising as it was developed for use with teenagers in a dense urban environment and had specified purposes for their artefact maps. The variation range amongst children within the schools was evident with School 3 producing the highest number of unclassifiable images but also producing the only Level 3 images. Similarly, School 1 produced the highest number of Level 1 images and also the most Level 2 images.

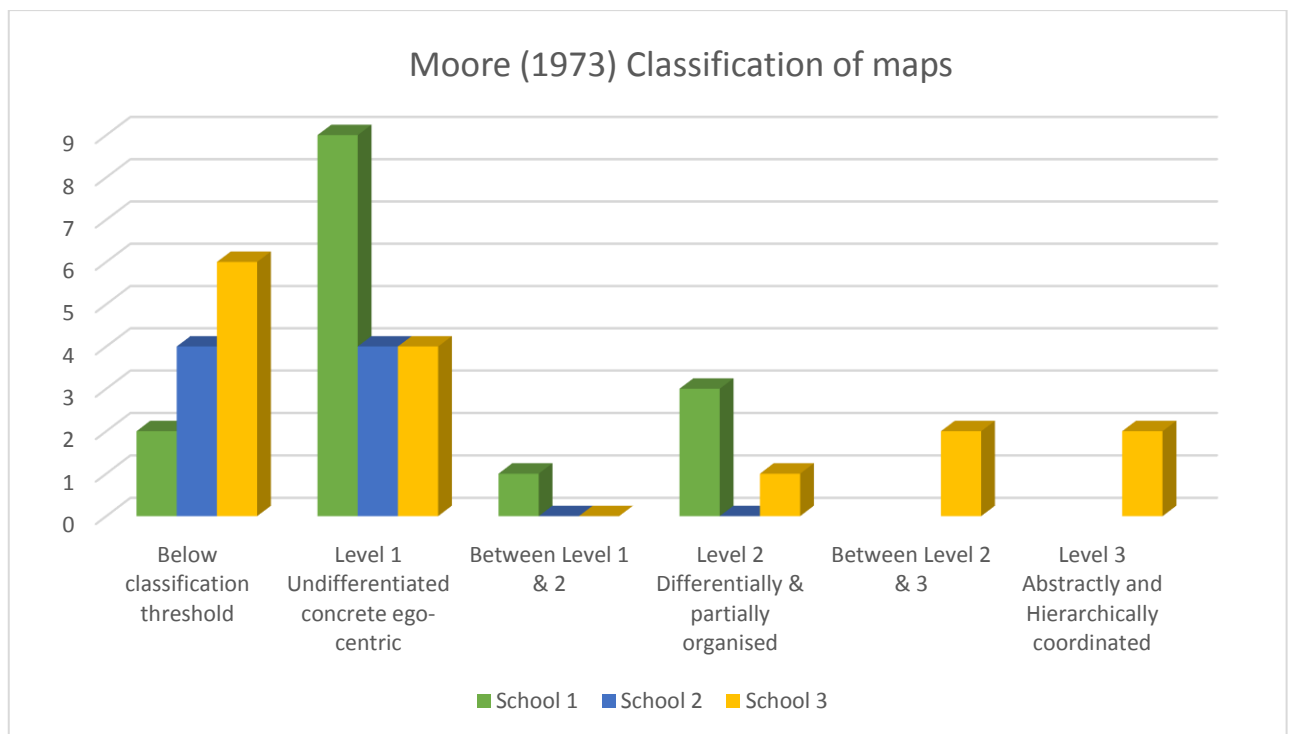


Figure 17

Hart (1981) Classification model

The classification model used by Hart (1981) shows the clearest evidence of the importance of interaction with the child during data collection as the majority of children (See Figure 18) possessed far greater environmental knowledge than prima facie suggested by their artefact maps. This was particularly evident at School 1 where a number of the children drew quite small areas but had considerable detail within them despite lower levels of route linkages. It is noted that Hart was working with children in small rural communities in the USA at a time when children’s unsupervised play range was considerably larger than today, (Karsten, 2005; Lehman-Frisch et. al.2012). This leads to the suspicion that again these children in my research who produced the Type 1 and 2 artefacts (See Figure 18 below) did not depict large enough areas of their town to permit such classifications.

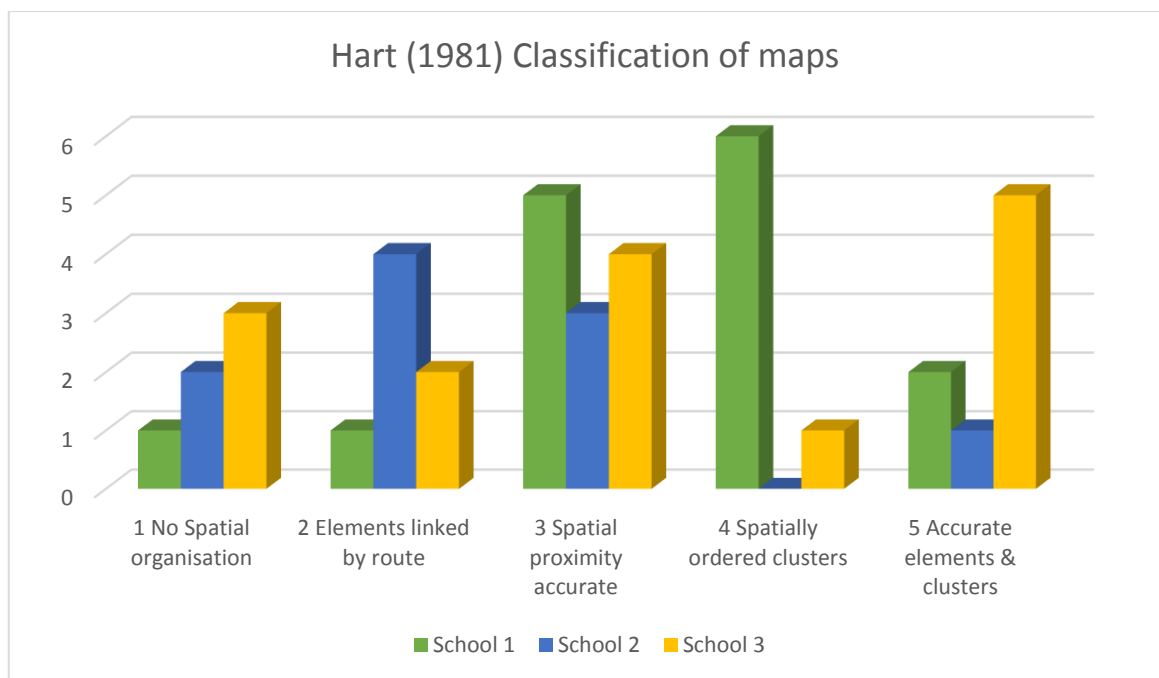


Figure 18

Matthews (1984) Classification model

Using Matthews' (1984) classification model (See Figure 19) it was found that the majority of children produced Grade 1 type images with the highest numbers produced at School 1. That school lies at the edge of a small village and surrounded by agricultural land and has basic curriculum focus on geography. School 2 backs onto agricultural land but faces a continuous suburban environment on three sides and has no particular curriculum focus on geography. The highest numbers of Grade 1B and Grade 3 images were produced at School 3 which is in an entirely suburban area and has a strong curriculum focus on local history and geography.

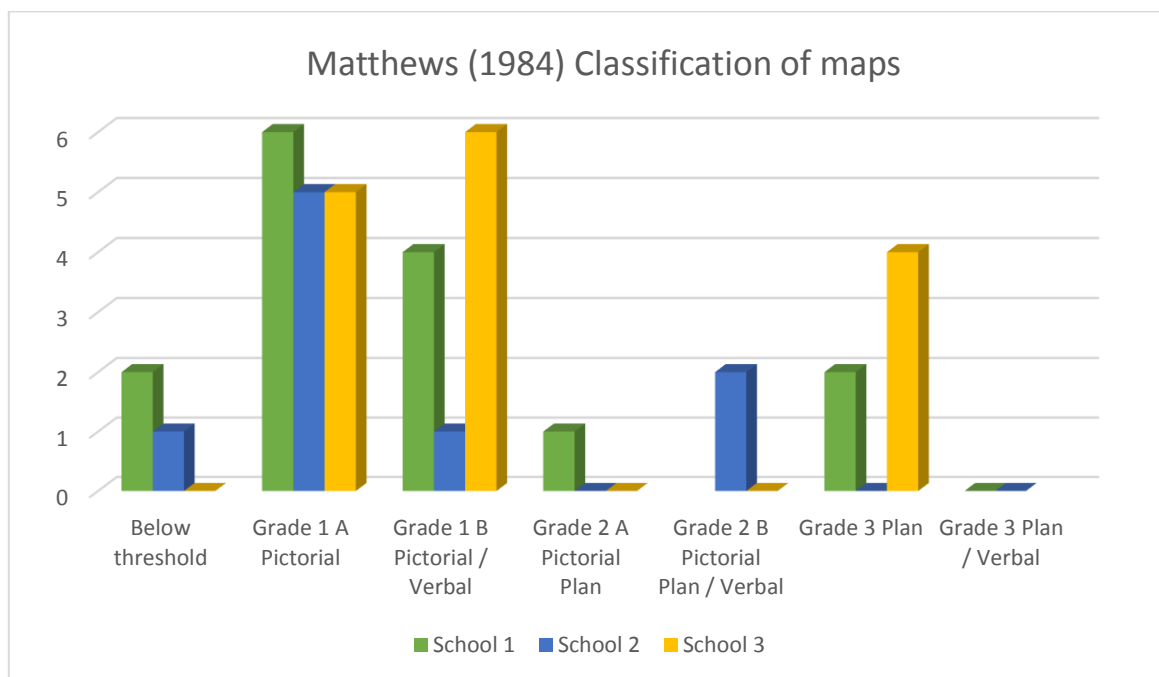


Figure 19

In terms of whether or not the temporal construction order in the children’s artefact maps conformed to the typology proposed by Lynch (1960) we have the following data

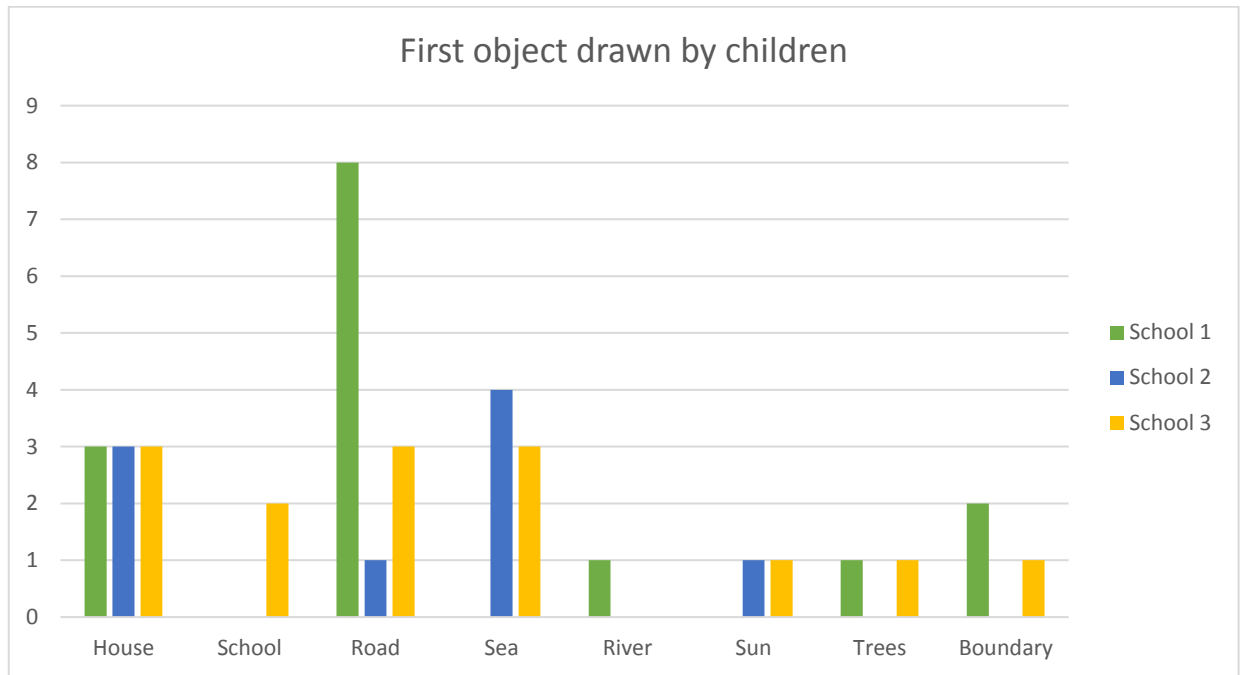


Figure 20

Although the road was most common at School 1, at Schools 2 and 3 the sea was the most common first object and at all three schools the next most common first object was a house.

In total ten (10) children left spaces between buildings and other objects but did not draw roads, See Figure 21). This style was more common for girls at all three schools, although the boys at School One did it more than the boys at the other schools. It should be noted that this group of ten children includes two completely isometric pictures (both girls), two images where the area depicted is effectively a single street (both girls) and also two images (both boys) where the spaces were explicitly labelled with names of roads. All of which supports the assertion of Elden (2012) that as researcher we need to view children’s understandings and depictions of their environment in a more holistic way.

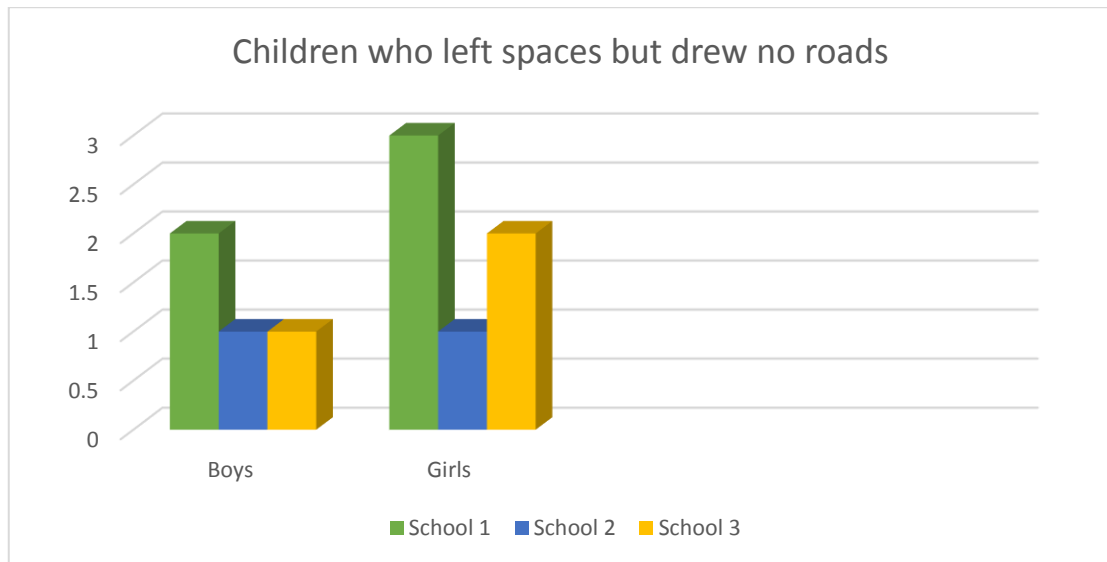


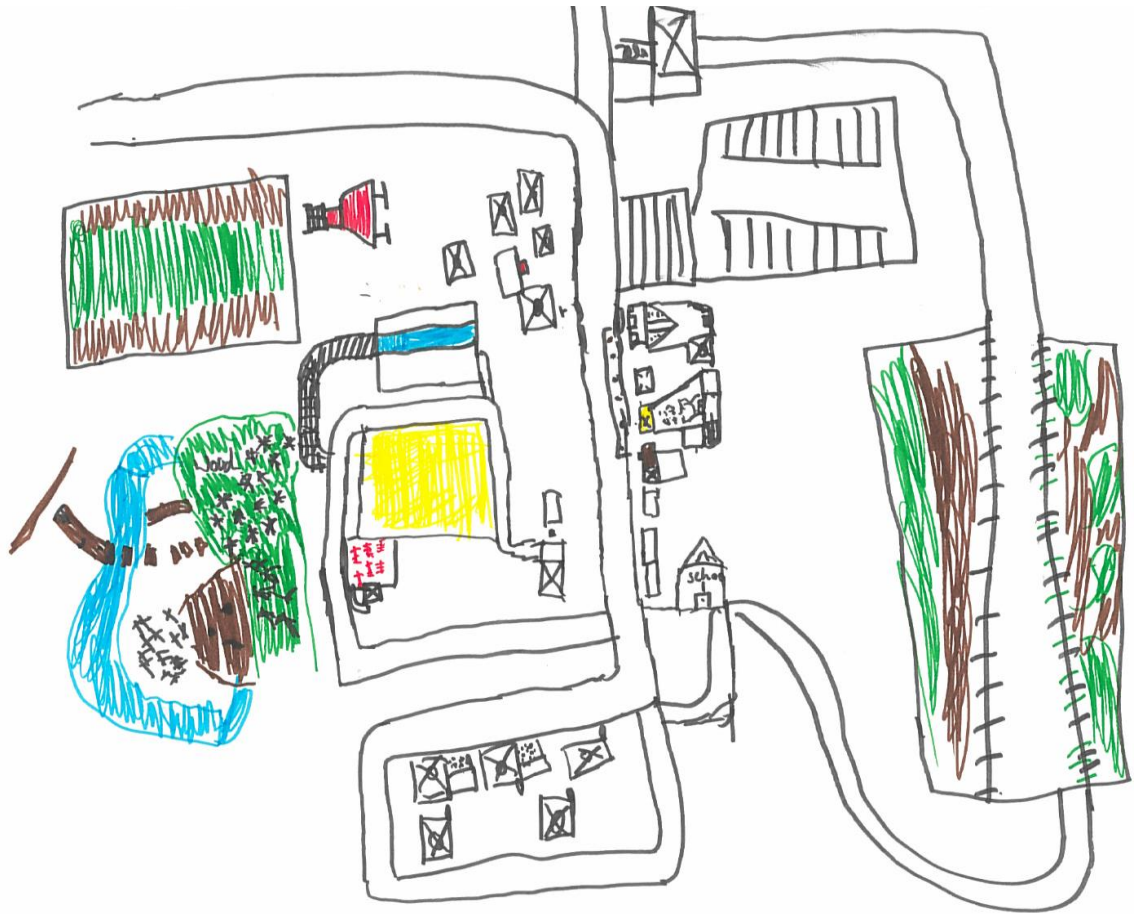
Figure 21

4.1.3 School S1

This is a small rural inland village school with approximately 140 students from Reception to Year 6. Built in early 1900's the school is approaching capacity and discussions are in progress with local authority to construct new classrooms on existing playing fields. Due to the location of this particular school, its OFSTED rating and the fact that it is not becoming an Academy, it draws pupils from as far away as Canterbury and Ramsgate as a function of parental choice. It is located down a side road from the main street of the village and backing onto open agricultural land. The village is spread along what is a comparatively narrow, but quite busy, transit route for cars, light trucks and agricultural machinery and concerns exist regarding pedestrian dangers at the start and finish of the school day. At this school, it was not possible to meet the Class teacher and the children prior to conducting the research and consequently the children were initially a little shy. The interviews with the children had to be conducted in a corner of a busy hallway due to lack of space and sometimes the children were noticeably distracted by craft activities of nearby older classes.

As stated in the Introduction of this chapter, all student drawings are referred to by the four character code that denotes the school, child's gender and their place in the order of completing the research tasks. A total of fifteen (15), students participated in the research at this site.

S1B2



Task 1 Map Interpretation – Image identified as map and no difficulty locating specified objects.

Reason – It has a river and buildings

Right Hand

Task 2 Map Drawing

First object drawn – Road

Drawing Notes – This child enjoys considerable unsupervised range with his dog in the vicinity of the village and as is consistent with Hart (1981) he displays a detailed Spatial and Environmental knowledge of the area. He has utilised a variety of colours, textures and line types to convey diverse information and he maintained a detailed oral narrative while constructing the artefact. The green and brown rectangle at upper left is a partially ploughed field and the red object to the right of it is a tractor. The cluster of squares to the right of the tractor are houses under construction at the edge of the village. Below the ploughed field is a labelled patch of woodland with a footbridge over a stream and several dirt trails. The large yellow square to the right of the wood is a wheat field and the red objects in the square below it represent hens in a yard.

At the top of the map and to the right of the central vertical road there is the garden centre and car parking represented by three large squares with vertical internal lines.

Beneath that cluster there is a quite detailed cluster of buildings and objects which depicts the immediate houses around that of the child (Yellow Square) and the parallelogram to the right of that is his back garden with black dots representing spiders which fascinate him. Below that cluster there is the side road with the school depicted isometrically and labelled. At the right hand edge of the map is another ploughed field in green and brown, and the vertical lines with horizontal bars through them in green and black are fence lines. The overall orientation of the map is orthogonal as are the majority of buildings but the school is shown isometrically and is labelled.

Classification using each model:

Appleyard (1970) - Positional Spatial Linked.

Ladd (1970) - Type 3 category as it would be entirely possible to use it for way-finding provided the name of the village were known. That is to say, it is possible to orientate the map to ground and it has a reasonable degree of accuracy in scale and spatial distribution of objects.

Moore (1973) - Level II Planometric view as it is too detailed to be in Level I and yet lacks the use of words and other details to pull it up into Level III.

Hart's (1981) – Artefact displays good Spatial Order and Proximity it is logically organised and consistently scaled. This map exemplifies the need to interact with the child during creation in order to accurately interpret the finished artefact and to avoid underestimating both the child's Spatial and Environmental knowledge.

Matthews (1984) - Grade III A Plan as it is overwhelmingly orthogonal and has reasonable accuracy of scale, spatial distribution and orientation.

S1B5



Task 1 Map Interpretation – Difficulty identifying image as map and also in identifying specified objects.

Reason – Quite shy and appeared not to have seen a map before

Right Hand

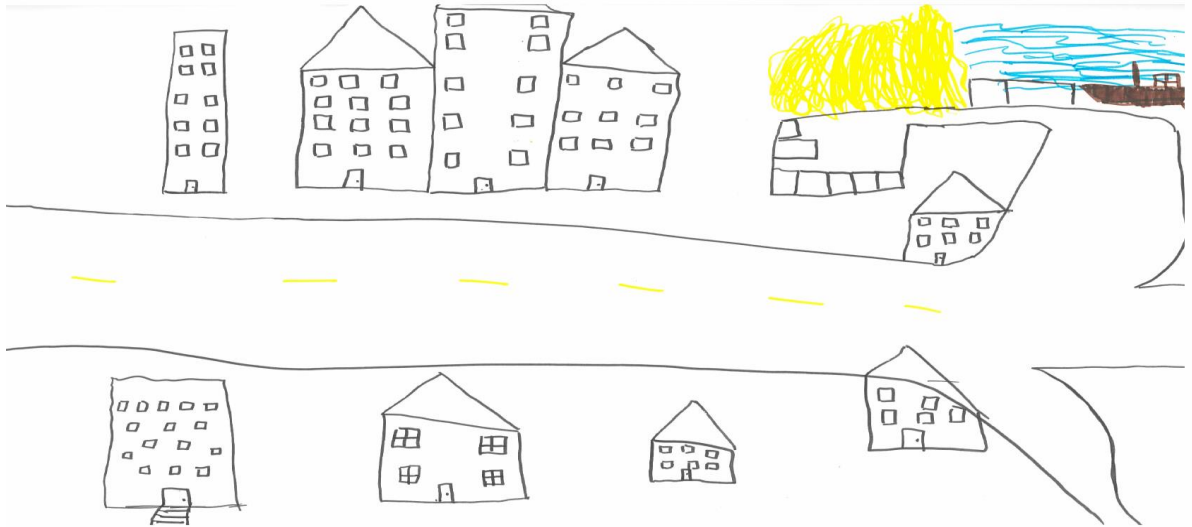
Task 2 Map Drawing

First object drawn – Trees

Drawing Notes – The central large object is the child's own house which he stated was located in a wood but he was unable to say even what the nearest village or town was. The lumps on the side of the house are windows and teachers indicated that the child is one of the youngest in the class, rarely draws and still has some difficulty with writing due to fine motor skills.

This image is used as an illustration of the difficulties of applying the classification models of the selected theorists. Owing to the nature of the image it falls below the classification thresholds of all the theoretical models. It is only just possible to call it a Pictorial Drawing, Ladd (1970), which is the lowest end of the classifications.

S1B8



Task One Map Interpretation – Image identified as a satellite map and no difficulty locating specified objects.

Reason – Looks like it was drawn from above. Has a blue river and green trees. The canal is straight and narrow not bendy like the river.

Right Hand

Task Two Map Drawing

First object drawn – Road

Drawing Notes – A good illustration of the child not drawing the conventional symbol for a house because they live in a multi-storey terrace house and choosing to represent a portion of the town rather than the whole. The yellow object at top right is the beach with the blue harbour and the brown object is the historic steam tug. The cul-de-sac below the beach is the seafront car park and when the child drew the tug they drew vertical lines on hull to show the steel plates before colouring it in. This child also gave a strong indication via verbal and non-verbal language that they were completing this task quickly so as to return to the craft activities in their classroom but they displayed much more care and attention to detail and greater Environmental knowledge than the previous child.

Classification using each model:

Appleyard (1970) - Positional Spatial Linked

Ladd (1970) - Type 2 Schematic Drawing with reasonable level of accuracy of scale and spatial distribution and overall orthogonal orientation with isometric buildings. Difficult to situate the map in a broader sense unless present at the creation and it could be used for crude way-finding.

Moore (1973) - Level I Planometric

Hart's (1981) – Shows Linked Organisation of objects, fairly consistent scale and Spatial Order and Proximity within the depicted area. Artefact supports view about need to interact in order to accurately interpret, and also Polanyi's (1967) point about knowing more than we can tell, or in this case draw.

Matthews (1984) - Grade 1 A Pictorial.

S1G3



Task One Map Interpretation – Image identified as a map and no difficulty locating specified objects.

Reason - It has a river running through it.

Right Hand

Task Two Map Drawing

First object drawn – River

Drawing Notes – Child orally displayed reasonable Environmental Knowledge despite isometrically depicting a quite small section of their village. Drawing began with the river and child talking about the qualities of the sunlight on the water. Next, she drew the bushes and trees above the river with the agricultural land behind them represented by the hashed green blocks. She was aware of the existence of roads but did not depict any as she was essentially talking about her house and three adjoining properties that share a common driveway. The house to the right has a set of stairs in the garden down to the level of the larger house at right. In terms of Environmental Knowledge, she orally identified several details which told her that the people in that house are materially wealthier but still a lower social class than her own family. She described the dog outside the large house as being ‘a bit like a Staffie’ with a chain collar, and was clear that although it raises its head and growls if people enter the garden it does not bark or leave the front porch.

Classification using each model

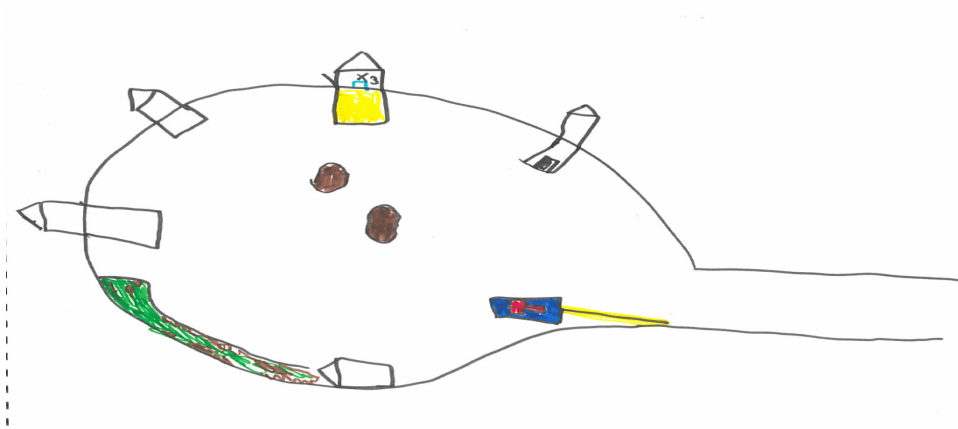
Ladd (1970) Type 1 Isometric

Moore (1973) Images falls below classification threshold

Hart (1981) Image falls below classification threshold

Matthews (1984) Grade 1A Pictorial Depiction as it isometrically depicts a small segment of space which is impossible to orientate to ground or to use for way-finding even having been present during its creation.

S1G4



Task One Map Interpretation – Identified image as map and no difficulty locating specified objects.

Reason - It has a river and grass

Right Hand

Task Two Map Drawing

First object drawn – Road

Drawing Notes – This child graphically displayed limited Spatial Knowledge and only fairly basic Environmental knowledge. She drew the cul-de-sac in which she lives and had only used black until explicitly invited by the researcher to use other colours. The objects inside the cul-de-sac are mostly driveways but at the bottom is a house and a grass footpath. The two brown objects in centre are large pot holes which interfere with skating and cycling for the child and her friends. The child thought that the red and blue ‘Terminating Road’ sign was an advertisement for the public housing association which owns most of the houses and which she named orally.

Classification using each model:

Appleyard (1970) - Topological Spatial Scattered

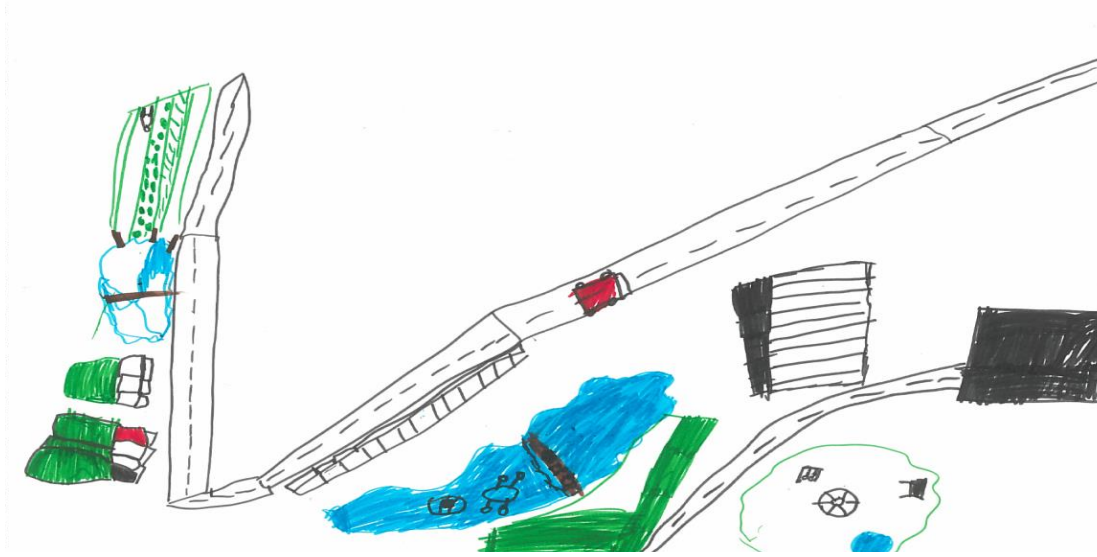
Ladd (1970) - Low end Type 2 Schematic Drawing

Moore’s (1973) Level 1

Hart (1981) Possesses Spatial Order and Proximity but inconsistent scaling. Offers implicit evidence of the impact of poverty and gender on development of Spatial and Environmental Knowledge through how those variables restrict a child’s independent play range.

Matthews (1984) Grade 1 A Pictorial

S1G6



Task One Map Interpretation – Image identified as a map and no difficulty locating specified objects.

Reason - It has a river with some bridges.

Right Hand

Task Two Map Drawing

First object drawn – Road

Drawing Notes – The map depicts a wide area of Sandwich but does not feature high levels of spatial distributional or scale accuracy though they are present. The child did however maintain a narrative during construction about local bus services and sporting activities such as rowing on the lake with older siblings. Non-verbal language from the child suggested boredom with task.

Classification using each model:

Appleyard (1970) - Positional Spatial Linked. Although the roads were all drawn as distinct blocks the girl was clear that they form the large V-shape as they are two main roads. The large red object on the right hand road is a bus.

Ladd (1970) - Type 2 Schematic Drawing.

Moore (1973) - Level 1 map due to the lack of spatial and scale accuracy.

Hart (1981) the Environmental knowledge displayed orally by this child would be overlooked if the artefact were considered in isolation. This child has depicted several parks, with footbridges and a boat rowing on the lake. She has clustered related objects according to relationship and although the scale is inconsistent it does possess Spatial Order and Proximity, it is organised and elements are linked with routes

Matthews (1984) - Low end Grade III Plan as all objects are depicted orthogonally and an attempt is made at spatial distributional accuracy.

S1G7



Task One Map Interpretation – Image identified as map and no difficulty locating specified objects.

Reason – It has a river and trees.

Right Hand

Task Two Map Drawing

First object drawn – Black circle outlining edge of village.

Drawing Notes – Possibly due to shyness, this child was initially only going to draw her house and the street sign inside the village boundary and then she coloured in the green circle of agricultural land around the outside. However as her confidence grew through talking to the researcher she gradually produced an artefact displaying much greater than expected levels of Spatial and Environmental knowledge.

Classification using each model:

Appleyard (1970) - Topological Spatial Scattered category.

Ladd (1970) - Type 2 Schematic Drawing which features isometric views of egocentrically important objects with limited use of scale or spatial distributional accuracy. Interestingly it features both road depicted as an object at top in red and also spaces for roads between the depicted buildings.

Moore (1973) – Lower end Level 1 as it lacks orthogonal views of objects and lacks scale and spatial distributional accuracy.

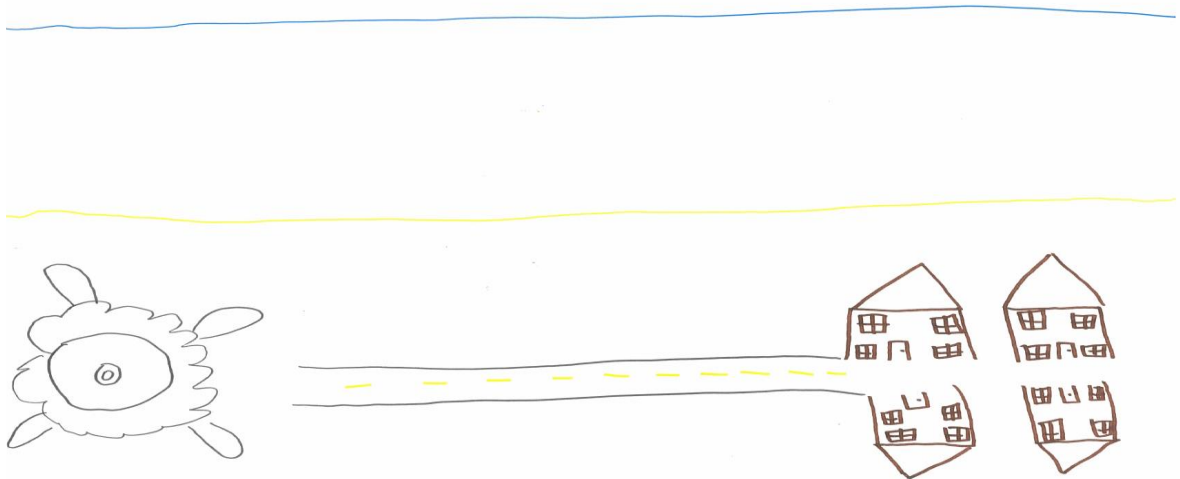
Hart (1981) – Artefact possesses in consistent scale but there is Spatial Order and Proximity and logical organisation. Again provides circumstantial evidence about the impacts of social class and gender on children's ability to experience and understand the physical environment via unsupervised play ranging.

Matthews (1984) - Grade 1 B Pictorial Verbal image. The level of Environmental knowledge orally displayed by this girl considerably exceeds her Spatial Knowledge and her graphical representational abilities.

4.1.4 School S2

This site is a small Faith school on the edge of a large town with houses on three sides and farming land behind. The sea is within one kilometre of the school but it is not visible from there. The school is located on reasonably busy back road that parallels the main road. Unfortunately at this site it was not possible to meet either the teacher or the class before the day of data collection and this led to the children being less relaxed than at the third school. At this site also the research had to be conducted in a hallway at the request of the school due to school policies on 'safeguarding' issues. A total of nine (9) children participated at this site.

S2B1



Task One Map Interpretation – Image identified as a map and no difficulty locating specified objects.

Reason - It has a river which is blue.

Right Hand

Task Two Map Drawing

First object drawn – The sea

Drawing Notes – At the top of map is the dark blue horizontal line representing the sea and the yellow horizontal line representing the beach. The floral star containing concentric circles at bottom left is the Tudor castle. In lower centre of map is a horizontal pair of solid thin black lines with a central horizontal dotted yellow line representing a road. This road leads to four houses which are all isometric in view and appear as mirror images of each other suggesting they are on opposite sides of a road. This is suggested by Lowenfeld and Lambert-Brittain (1987) as being because children of this age may recall space from the perspective of being in it rather than above it.

It is fortunate that the area possesses such visually memorable landmarks as the Tudor rose fortresses and these appear in several artefacts from both the local schools.

Classification using each model:

Appleyard (1970) - Topological Sequential Fragmented as it features clusters of identifiable landmarks linked by an obvious path.

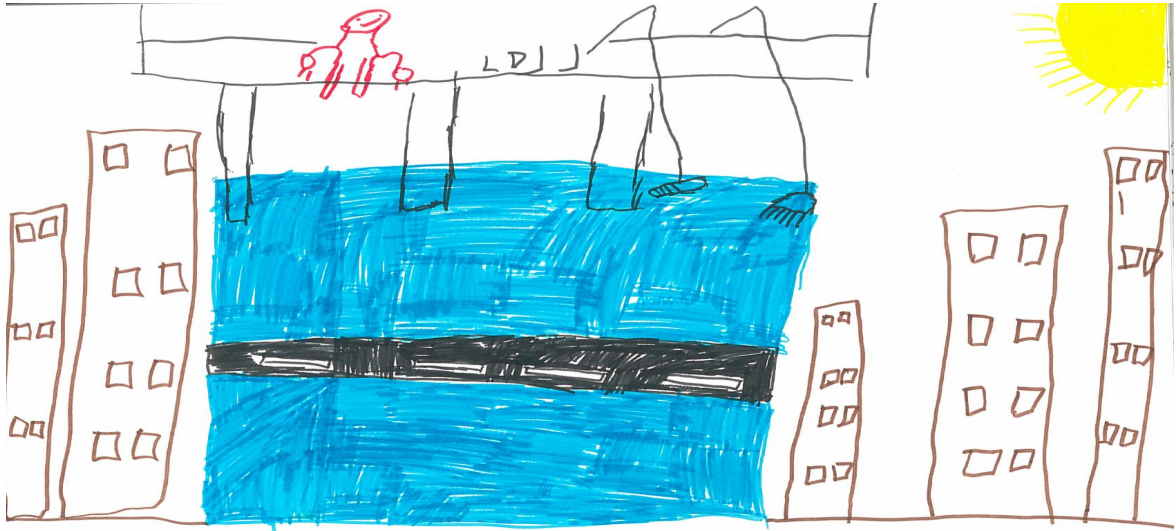
Ladd (1970) - Type 2 Schematic Drawings

Moore (1973) - Level 1 maps as it does display awareness of, and ability to represent both isometric and orthogonal spatial detail.

Hart (1981) Displays Spatial Proximity and links them with a known route but it would be difficult to use this artefact to identify the area or for way-finding unless present during its creation.

Matthews (1984) - Grade 1 A Pictorial Drawings as it features the orthogonal view of the road and the fortress.

S2B2



Task One Map Interpretation – Image identified as map and no difficulty locating specified objects.

Reason - Land is green and water is blue.

Right Hand

Task Two Map Drawing First object drawn – Sun

Drawing Notes – Despite the large central expanse of blue, this was not initially intended by the child as water. He stated that it was grass and drew the central horizontal road before colouring in the blue above and below it. The brown vertical rectangles are buildings along the foreshore of the town with the internal squares standing for windows. It was while drawing these that the child decided that the blue blocks were the sea. From that point he engaged in a detailed narrative about regular family fishing trips to the pier and has drawn himself in red at left of image and several fishing lines in the water. The rectangular striped object in the upper right of the water is a fish and the other object with the semi-circular top and descending lines is a jellyfish. He has drawn the pier deck and three pillars extending beneath the water.

Classification using each model:

Appleyard (1970) Impossible to classify due to being totally isometric except for the central road

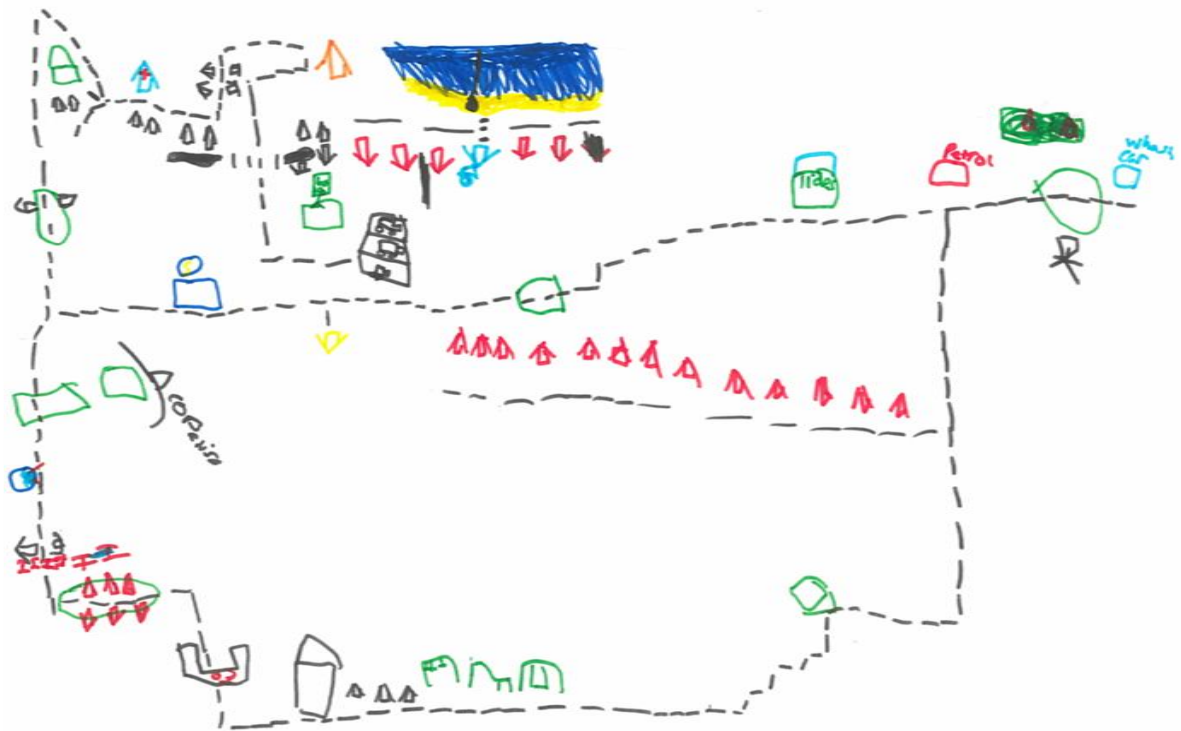
Ladd (1970) Type 1 Pictorial Drawings as it is impossible to identify the area or for someone to use it for way-finding if they had not been party to construction of the artefact.

Moore (1973) – Impossible to classify as it is almost totally isometric in view

Hart (1981) – Some Spatial Proximity and Order but inconsistent scale but child did possess higher levels of Environmental knowledge than the artefact alone suggests.

Matthews (1984) - Grade 1 Pictorial Drawings as there is limited detail, no label words and the scale accuracy between the buildings does not align with that of the child on the pier.

S2B4



Task One Map Interpretation – Image identified as map and no difficulty locating specified objects.

Reason - Because land is green and water is blue.

Left Hand

Task Two Map Drawing

First object drawn – Sea (Dark blue top centre, with beach below it and the black line is the pier. The dot at lower end of line is the kiosk for ice-creams and fishing tackle

Drawing Notes – One of the more detailed maps. Child is left-handed and talked constantly to himself as he drew, in a monologue which called to mind the next object in sequence. The entire map was drawn upside down with child sitting at top of map. The dotted lines are centre lines of roads but no edges were drawn. The light blue house beneath the beach is the ice-cream shop identified by a large ice-cream cone on its outside. The black line between the two red houses is an alleyway leading to the carpark with three cars in it. To the left of carpark the green objects are the library. The blue circle and square near there is the school.

The road continues out to the right from there over a hill and then past the indoor swimming pool, a petrol station, a pair of houses on some open land and stops at the car wash. In the lower right middle of picture is a side road with houses.

The green objects through which the dotted lines continue signify hills climbed by the road. In top left corner is a green building which is a Chinese shop and to the right of it is a blue building with a red cross which is the hospital. Between it and the beach is an orange building that is the Sainsbury's store.

The groups of dashed lines perpendicular to road lines are zebra crossings. The green rectangle crossed by a road is 'Mill Hill' and the labelled object to its right is the Cooperative store. The blue circle below Mill Hill is the water tower, whose stilts are shown in red. Beneath the water tower is the railway line in red then the road turns a corner and goes up a hill with some houses then turns again and goes under a bridge. After the bridge the road turns along bottom of picture past a tall apartment, some green playground equipment and other smaller flats. The green building at bottom right of picture is child's school.

Classification using each model:

Appleyard (1969) - Positional Spatial Linked category

Ladd (1970) - Type 2 Schematic Drawings in use of general orthogonal view with buildings mostly show isometrically and some use of label words.

Moore (1973) - Level II for same reasons and the depiction of roads only through their centre lines is interesting.

Hart (1981) There was a continuous and detailed oral narrative accompanying the creation of the artefact which displayed a considerable familiarity with the spatial arrangement of paths and landmarks across an area of several kilometres of the town area. It is highly Spatially Organised with elements showing good Spatial Proximity and Positional Order. However, despite the level of detail in this artefact it is still not possible for a person to identify the area or to use it effectively for more than crude way-finding unless they were present at the creation. But, there remains the danger that taking the artefact on its face value would gravely underestimate the Spatial and Environmental knowledge possessed by this child.

Matthews (1984) - Grade 2 B Pictorial Plan Verbal category.

S2G1



Task One Map Interpretation – Image identified as a map and no difficulty locating specified objects.

Reason – It's like a bird's eye view and the river is blue. **Right Hand**

Task Two Map Drawing

First object drawn – House at bottom left of picture

Drawing Notes – The window in each house with a cross instead of curtains is the downstairs toilet which shows an awareness that the houses are probably of identical internal layout. The horizontal road was named by the child as a major local route and both of the roads have double lines on each side to stop people parking. Artefact shows a clear desire to create a balanced image with each house having a tree and a bird depicted.

Classification using each model:

Appleyard (1970) – Below classification threshold

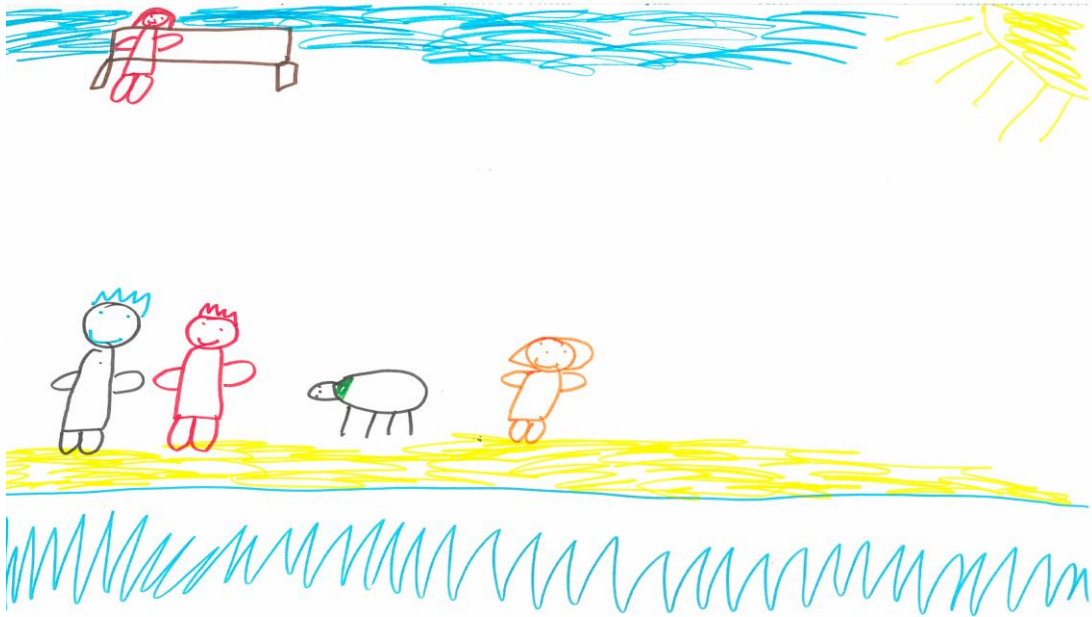
Ladd (1970) - Type 1 Pictorial Drawing. Totally isometric and impossible either to orientate to ground or to use for way-finding unless present to hear the child name the roads orally. Supports Lowenfeld and Lambert-Brittain (1987) that children recall and graphically depict the world in isometric ways at this age unless they have direct experiences which enable them to adopt an orthogonal view.

Moore (1973) – Below classification threshold

Hart (1981) – Depicted objects have consistent scale and Spatial Order and Proximity and are linked by known routes, but the child's choices of objects and style of depiction may not accurately reflect their Spatial or Environmental knowledge.

Matthews (1984) - Grade1 A Pictorial Depiction.

S2G2



Task One Map Interpretation – Image identified as a map but some hesitation in identifying specified objects

Reason - It has buildings.

Right Hand

Task Two Map Drawing

First object drawn – Sea

Drawing Notes – The town drawn was named by the child. At bottom of picture are three people and a dog walking on the beach. The person at top of picture is sitting on a bench.

Classification using each model:

Appleyard (1969) Below classification threshold

Ladd (1970) Type 1 Pictorial Drawing. Completely isometric, contains no features that would enable it to be orientated to ground or to use for way-finding. Although it is tempting to take a Piagetian view and suggest that the child has constructed an ego-centric picture rather than a map due to their age, I am of a different view. Given the socio-economic demographic for many families at this school, the pressures on schools to focus on formal learning rather than creative expression and the increasing use of colouring books rather than free sketching, I suggest the child took a rare opportunity and drew the kind of picture that she wanted to draw.

This would be consistent with a more Reggio Emilia type view of childhood in that the desires and imperatives which motivate children are usually more concrete and immediate than those of adults. The child who drew this artefact exhibited shyness and comparatively limited Spatial Knowledge but she did possess reasonable environmental knowledge about the immediate vicinity of the picture and she expressed this orally.

Moore (1973) Below classification threshold

Hart (1981) Below classification threshold

Matthews (1984) Below classification threshold

S2G4



Task One Map Interpretation – Identified image as map and no difficulty locating specified objects.

Reason - Because there is the water which is blue, and the land which is green.
Right Hand

Task Two Map Drawing

First object drawn – Sea (Light blue)

Drawing Notes – The town drawn was named by the child and Royal Hotel is the labelled building on upper side of the lower road. The red building labelled 'shop' is a greengrocer and it has a green awning. The light blue building is a shop of unknown type. Dots on seashore are pebbles. Dark blue waves were drawn last. The sign at top right is for no dogs off leashes

Classification using each model:

Appleyard (1970) – Positional Spatial Linked, but mainly isometric view.

Ladd (1970) - Type 1 Pictorial Drawings as it is mostly isometric and lacking information to identify the location.

Moore (1973) - Level 1 maps as there is a clear spatial relationship between the objects present even if scale is inaccurate and the view mainly isometric.

Hart (1981) – Artefact uses fairly consistent scale and there is reasonable Spatial Order and Proximity, use of known routes to link objects and overall organisation, we again find that an apparently simple artefact conceals the fact that the child possesses a quite reasonable level of Spatial and Environmental knowledge which would be missed if the artefact were taken prime facie. This child is aware of the rough layout of the foreshore area of her town, and has labelled several buildings indicating awareness of different land uses. Her focus on depicting the texture of the beach and the waves supports the view of Spencer and Darvizeh (1983) that children focus on aspects of a physical environment that adults might often dismiss as ephemera.

Matthews (1984) - Plan Pictorial Verbal due to several label words and the use of the beach signage, although scale accuracy and spatial distribution remain basic.

S2G5



Task One Map Interpretation – Identified image as a map. Minor hesitation in identifying specified objects

Reason – Contains fields, forests and buildings, and the rivers are blue. **Right Hand**

Task two Map Interpretation

First object drawn – Road

Drawing Notes –The light blue building is a cake shop with cakes on right and breads on left. Red building is the Iceland store. Brown building at left is the library with a person in upper window selecting a book from shelf of coloured books. The road is black and brown because the tarmac changes colour in that area of town.

Classification using each model:

Appleyard (1970) - Almost totally isometric and so falls below the threshold

Ladd (1970) - Type 1 Pictorial Drawing category as although it features a label word it is impossible to identify the location or to use the image for way-finding.

Moore (1973) - Level I as it is isometric except for the roads but it does depict objects clustered in a spatial relationship and features a label word.

Hart (1981) - Another very simplistic and mainly isometric artefact which if taken at face value would underestimate the Spatial and Environmental knowledge possessed by the child who created it. The landmark elements depicted are mainly egocentric and the use of colour for the different windows of the library seems consistent with Lowenfeld and Lambert Brittain (1987) assertion that sometimes children simply use colour for its own sake. However, the child has drawn the Iceland (island) store in red and this is their corporate colour. She has also used different colours to symbolise different books in front of the person choosing a book so she is evidently aware of how colour can be used as a means of object differentiation. Elements are spatially ordered and a reasonably consistent scale is used.

Matthews (1984) - Grade 1 B Pictorial Verbal category due to label word although it is primarily isometric and the scale is fairly basic.

4.1.5 School S3

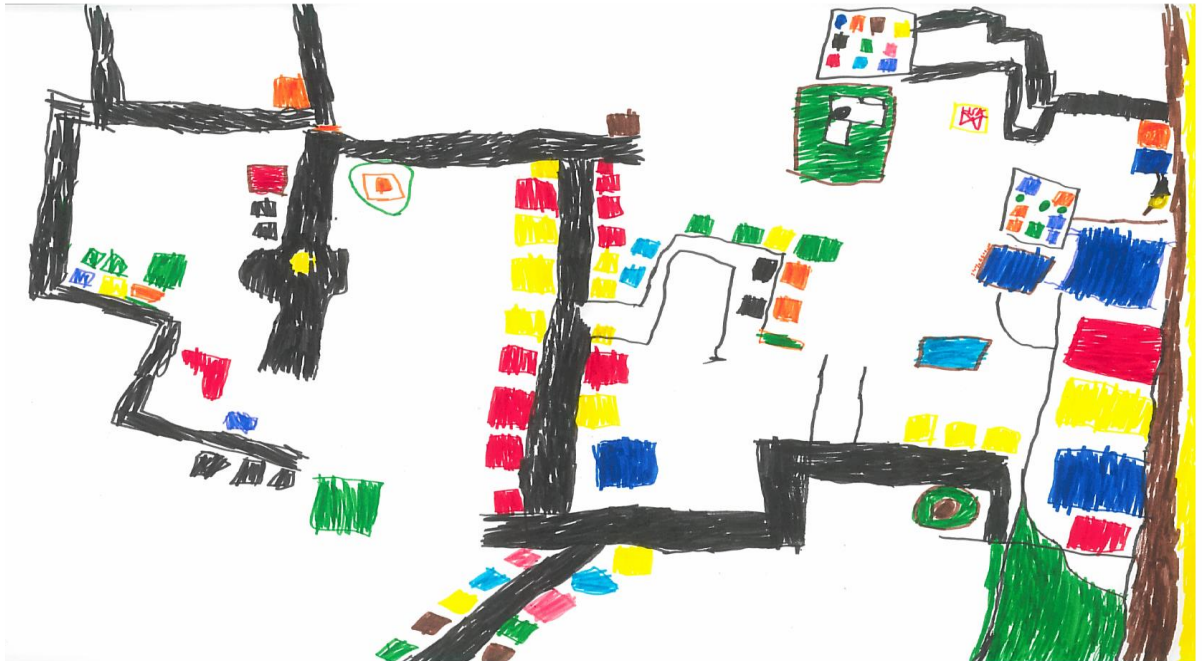
Small faith school in eastern part of large coastal town. Although the sea is within 800 metres in two directions it is not actually visible from the school. The school is located in a quiet leafy back-street, and the curriculum features a strong focus on children understanding local human and physical geography and history. At this site, it was possible to meet the class teacher and children during the visit to the Head Teacher and the children were very keen to take part in the research.

Student drawings are referred to by code S3 followed by B1 for the first boy and G1 for the first girl. A total of fifteen (15), students participated in the research at this site. This site is notable as it had a pair of non-identical twin boys.

This site showed some interesting inclusions and omissions in terms of the macro-spatial awareness amongst the children. Firstly, none of the fifteen children included the town pier in their maps despite it being one of the features an adult might note specifically if constructing a map of the town. Secondly, just three of the children included local castle as an object on their maps. However, one of the twins S3B5, verbally indicated his awareness of its existence and direction despite not actually depicting it. Thirdly several of the children explicitly distinguished between parts of the map which were their town and an immediately adjacent one despite there being no clearly visible boundary between the two places.

All the children appeared to share the conceptual error of placing the sea to the south of the town rather than to the east as it actually is. This is consistent with the findings of Levine, Marchon and Hanley (1984) and Evans (1980), and Downs and Siegel (1981) Stevens and Coupe (1978) that both adults and children appear to store spatial information which relates to the level between street maps and continents in ways which although broadly accurate are likely to contain significant local errors of alignment.

S3B1



Task One Map Interpretation – Identified image as a town and no difficulty locating specified objects.

Reason – It has buildings and a city would be bigger and it has a river which is blue.

Left Hand

Task Two Map Drawing

First object drawn – Beach

Drawing Notes – Although the drawing appears simplistic and untidy it displays an extremely detailed Spatial and Environmental knowledge of the layout of the town. Angle of view for this map is totally orthogonal and there are no label words used on it. The boy started at extreme bottom right edge using yellow and coloured up the edge and then did the same with the brown line next to it. This yellow vertical line is the beach with the undrawn sea to its' right. The dark blue block on the seafront is the ice-cream shop and the black and yellow object adjacent to it is the large ice-cream cone on the façade. The thin black line behind the sea front buildings is a footpath.

The brown line from the sea front to the library carpark is an alley between the ice-cream shop and the large blue building below it. To the left of that blue building is the library, which is the orange outline filled in dark blue and above it is the library car park in which purple and orange blocks as the cars and green dots as trees. The brown rectangle filled in light blue to the lower left of the library is a paddling pool.

At the top right of map there is a thick black line which forks into a parallel Y-shape. To its' left is a yellow square with a red X inside it which is a bank. The black square at the end of both arms of the road is the carpark of St George's Church and the brown rectangle below it is the wall around the church with the grass shown green and a plan view of the church in black.

The red block at bottom right edge of map is a shop which was burnt but repaired and is now a different kind of business. The green expanse at bottom right of map is the parkland surrounding the Tudor castle. The castle itself is the green circle with the brown centre and the thick black line behind it is the road toward the next town (towards the left of map). Above this road and behind the castle are three yellow blocks representing shops and one of these is a tea room but child could not say for certain which one it was.

In bottom centre of map the main road has a dark blue square above it and a yellow square below it which represents buildings of some sort. The child drew attention to these buildings and stated that the angled road and nine coloured squares that lie below and left of the main road should be considered to be part of the neighbouring town rather than his town.

The child identified the vertical thick black line to the left of the blue block as being Canada Road that he stated runs from seafront up to Gladstone Road where you turn left to get to the school. To the right of Canada Road are two smaller streets and the upper one contains the house of a friend from the class. This house is the yellow square above the corner of the road and the green square to its right is the large garden of his friend's house where the children often play. The other blocks in that area are houses. The child specified that Canada Road contains both old houses which are shown as yellow blocks and new houses which are shown as red blocks.

The brown block above the Gladstone Road is the business of a builder which the child named as the best of the local ones, (according to his father). Beneath Gladstone Road is a green circle containing an orange square with a solid orange centre and this represents the school. To the left of the school Gladstone Road turns toward bottom of map and has a large island in middle of road which is shown in yellow. To the left of that vertical part of Gladstone Road is a brown square coloured in red which is a sweet shop. The two black blocks below it are houses.

The child was quite clear (but mistaken), that if you are travelling to the left of the map and turned left after the school you are still in Gladstone Road but that if you turn right and go under the railway bridge you are in Hamilton Road. In fact, the road at the southern end of Gladstone Road is Hamilton Road in both directions but the sign at the corner is diagonal across the footpath rather than parallel to Gladstone Road and this may explain his confusion. He was equally clear that on the left immediately after the railway bridge was the Telegraph pub and that turning left there put you in Telegraph Road. The railway bridge itself is the thin orange line crossing Hamilton Road. The railway itself is not shown, but it runs parallel to, and in between, Telegraph and Gladstone Roads.

At the left hand edge of map the vertical thick black line is Salisbury Road and along its horizontal arm are an orange, yellow and purple block which represent houses with their individual green gardens behind them. When the road turns vertical again the red object to its right is the Esso garage, the purple block is the Parish Hall and the large green block is Markwood Park. The three black blocks are houses.

This map **S3B1** clearly illustrates the risks of taking a child's artefact map at face value without interacting with the child during the creation of the map. The lack of labels and the general untidiness of the artefact could easily obscure the fact that this child is capable of orally and visually reproducing an uncommon volume of highly specific and well-ordered Spatial and Environmental knowledge about his town.

Classification using each model:

Appleyard (1970) - Positional Spatial Linked as all the elements are sequentially linked by either vertical or horizontal spines which are clearly understood as such by the child even if not labelled in any way in the artefact map.

Ladd (1970) - Type 2 Schematic Drawings totally lacks labels, but it uses only orthogonal views of buildings and the level of information depicted is sufficient that solely as an artefact it 'could' be used for crude way-finding by an adult using intuition if the town were identified in other ways. As such it displays the spatial distribution and scale accuracy characteristics of Ladd (1970) Type 3 Images Resembling a Map.

Moore (1973) Taken simply as an artefact it falls below the threshold of Level I maps and yet the oral information conveyed by the child combined with the spatial distribution and scale accuracy easily places it in the Level III category.

Hart (1981) – The artefact has good levels of Spatially Proximity and Order with elements distributed in a manner consistent with actual location on ground. Routes are used to link clusters of elements and a fairly consistent scale is used

Matthews (1984) - Grade III A Plan although the lack of labels versus the amount of detail, spatial distribution and scale accuracy present the aforementioned challenges.

S3B3



Task One Map Interpretation – Identified image as map, some hesitation in identifying specified objects

Reason - Asked whether the large pyramid building was a Chinese temple as this is what roof reminded him of.

Right Hand

Task Two Map Drawing

First object drawn – School which is large building at right.

Drawing Notes – The barred rectangles are the school gates and the brown squares on the building represent bricks. The green square at bottom left is the school car park and the two rectangles with four attached circles represent cars. This child participates in a 'Walking Bus' before and after school and this may explain his inclusion of people between the road and the school gate but he offered no explanation beyond that the figures were people. After drawing the school and car park the child decided that he wanted to draw a sunset with some hills and clouds and these are the objects in top half of picture beginning with the green horizontal wavy lines.

Classification using each model:

Appleyard (1970) - Low end Topological Spatial Scattered map.

Ladd (1970) - Type 1 Pictorial drawing as it mixes orthogonal depictions of carpark and roads with isometric depictions of buildings and gates and it is impossible to orientate it to ground or to use it for way-finding.

Moore (1973) - Very low end Level 1 map exemplifying Undifferentiated Ego-centric conception of the environment.

Hart's (1981) The limited Spatial and Environmental knowledge displayed both orally and graphically by this child makes it difficult to classify but it does possess basic Spatial Order with clustered elements linked by known routes and a basic scale is discernible.

Matthews (1984) - Low end Grade 1 A Pictorial Depiction.

S3B4



Task One Map Interpretation – Although this child clearly understood the image as an orthogonal view of a portion of the Earth's surface he was unable to think of the word 'map' until later while drawing. The child was capable of differentiating land from water and easily identifying specified objects.

Left Hand & stood to draw

Reason - Image has buildings and river which is blue

Task Two Map Drawing

First object drawn – Own house.

Drawing Notes – This child is the younger of the non-identical twin boys and he displayed an exceptional ability to recall and depict highly detailed and organised Spatial and Environmental knowledge both orally and visually. While drawing he maintained an audible monologue describing objects and routes as if he were walking between them. This boy has recently started at Cubs and is fascinated with maps and this may explain why after roughly 90 seconds of drawing he stopped and asked the researcher if he might use a symbol key on his map. After being assured that it was his map to construct as he pleased, the boy constructed his key. Thereafter he consistently demonstrated a highly logical ability to agree arbitrary cartographic symbols with the researcher in order to allow him to construct a very detailed image without having to waste time in repetitious drawing.

A clear example of this, is the way his symbol for a shop has a round top rather than the pointed top of the houses because it symbolises a shopping bag. His use of enveloping arrows around objects allowed him to demonstrate that roads or paths passed behind the building which he had already drawn. He decided early on to symbolise rows of houses simply by drawing one or two near the centre of roads and then placing arrows on either side to indicate that the houses continued to the next intersecting road. The boy also displayed awareness of ability to use one symbol to create shades of meaning by varying the space between the dots which he used to symbolise foot traffic areas. In most of the map the dots are widely spaced and these represent normal roadside footpaths but along the seafront (top of map) and in the area of the lower right quadrant of map (above the word 'alley'), the dots are closer together and this symbolises footways that are inaccessible to vehicles.

The object in the centre of map marked F is the local fire station and this symbolism is supported by the icon of a fire. The dog-legging double line with bars between the lines is the railway line and the level crossing boom gates are to the right of the fire station. The child identified several specific buildings and marked them with single letters such as S for his own school, N for the Nursery where he used to go and GH for his grandmother's house. He identified several roads by name, as did his brother **S3B5**. The black area at top left of map is reported as a place where lumps of coal can be found in the ground. The large building on the Strand labelled 'Sch' appears to be the large walled complex of former naval buildings which is in process of being turned into prestige apartments.

When viewed from the street it does visually resemble many large schools and this may explain the reason for the boy identifying it in this manner.

Given his detailed knowledge of the area as a whole, the map constructed by this child shows some interesting errors and omissions. Firstly, he depicted the cluster of objects around his house as being adjacent to the seafront when in fact it lies about 600 metres inland. Secondly, he omitted both the pier and also the flower-shaped Tudor castle which several other children included in some detail.

As in the case of **S3B1**, this map would yield far less information if it were to be taken at face value as a finished artefact without the interaction with the child during its creation. This child clearly understands a great deal about the physical space in his local environment and thinks in quite original ways which display high levels of several of the multiple intelligences identified by Gardner (1983).

Classification using each model:

Appleyard (1970) – Solid example of Positional Spatial Linked maps.

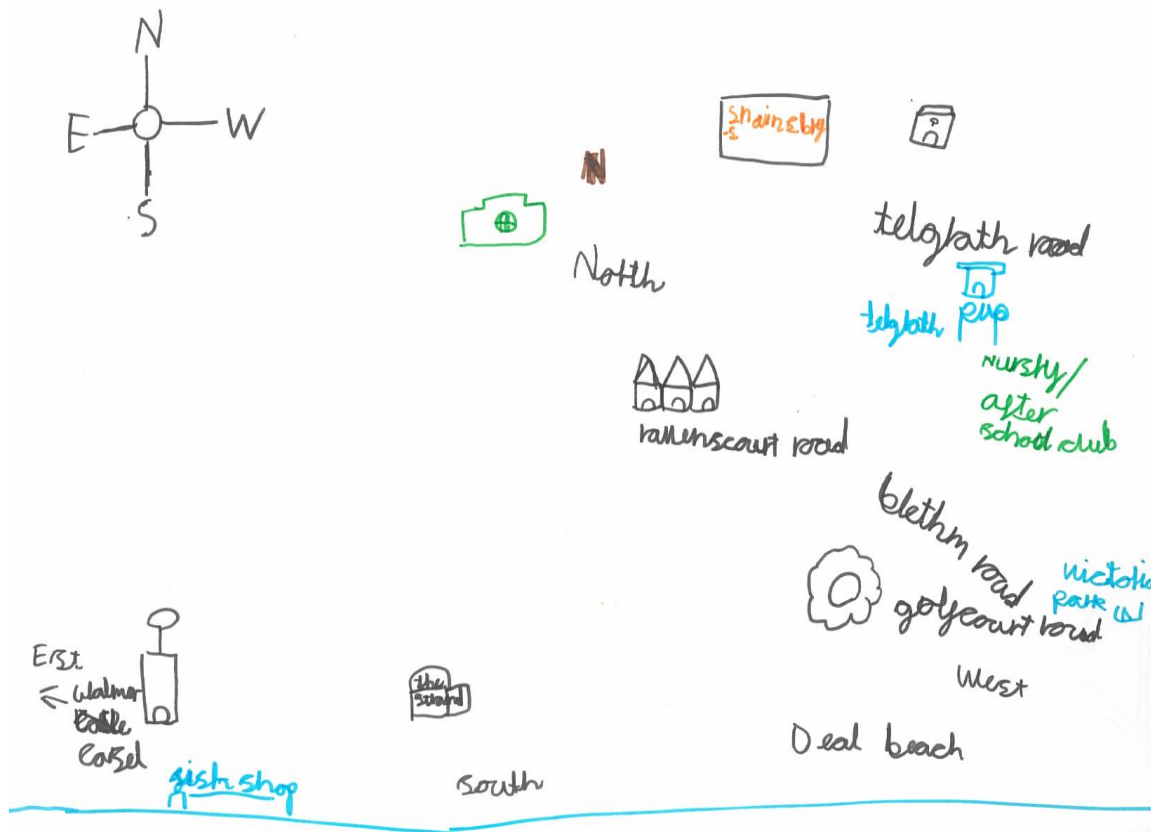
Ladd (1970) -Type 3 Image Resembling a Map as it uses an overall orthogonal view and possesses sufficient use of scale and distributional accuracy for it to be orientated to ground and used for way-finding although it remains impossible to identify the actual town without having been present during the creation of the artefact.

Moore (1973) - Level III map as it uses labels, differentiates street size and types and utilises a key to convey additional layers of Environmental Knowledge about land uses.

Hart (1981) – High level of Spatial Position and Order with routes linking elements which are spatially distributed in a fairly accurate manner using a consistent scale. This particular child is a clear example of his findings about the ability of children to develop extremely detailed Spatial and Environmental knowledge when afforded opportunities to explore the physical environment independently. The child is also a strong example of how much children can retain if taught about maps and mapping skills early in life.

Matthews (1984) - Grade III A Plan. What prevents it from immediately being a Grade II B Plan Verbal is the continuance of isometric views of buildings. However, in this instance I am of the view that the use of this perspective is a deliberate choice by the child to employ a cartographic symbol in order to efficiently convey land use types rather than because the child is unable to mentally adopt an orthogonal perspective. My evidence for that view is his differentiation of the symbol for houses (pointed roof) and shops (semi-circular roof) and his use of spacing of dots to illustrate different types of footpath.

S3B6



Task One Map Interpretation – Identified image as map and no difficulty locating specified objects.

Reason – The child asked whether the image was a city from the game Minecraft as it featured objects that he pointed out as a medieval fortress, wharves and buildings. The child stated that rivers can be differentiated from land because ‘water is blue obviously’.

Right Hand

Task Two Map Drawing

First object drawn – Tudor castle, which is the circular object in lower right of map between labels Blethm road and golfcourt road

Drawing Notes – Like the twins S3B4 and S3B5, this boy talked constantly during his drawing, both as personal monologue and as interaction with the researcher negotiating meaning of symbols. Before beginning, this boy actually asked whether the researcher wanted a plan or a picture and as an answer the instruction ‘Draw me a map of your town’ was repeated. The boy nodded and began to draw an orthogonal view.

This map is interesting in that although several roads were explicitly identified and labelled absolutely no attempt was made to draw a road of any kind.

Interestingly, this boy was the only child at any of the three schools who included a compass rose, but this must be set against the fact that firstly he has confused the position of East and West on it (and on the words written in the map). Also in order for the compass rose to be spatially accurate with regard to the ground depicted in the map it would need to be rotated 90 degrees clockwise.

The failure to recognise this does indicate the common error for the children of thinking the sea lies to the south of the town, but also the more general Western cartographic convention of assuming that North is at the top of the map.

Having drawn the circle within the flower-shape to symbolise the Tudor castle, the boy drew the green block in upper centre of map and stated it was the school. Next he drew the black rectangle which is labelled with the orange word "Sainsbury's" which suggests a strong association for him with the corporate colour of that retailer. Then he drew the small brown rectangle between the school and Sainsbury's and stated that it was the wooden gate of some allotments which he would draw later (he never returned to do so though). Then he drew the black square to the right of Sainsbury's and stated that it was a garden centre. Having drawn those four objects in a sequence he then rotated the paper and drew the sea as a light blue line along the bottom of the map and labelled it 'South'. From then on the map remained rotated 180 degrees from original start position

Near the bottom left corner he has placed a light blue label 'fish shop' by which he meant a fishing tackle seller rather than a fish and chip café but interestingly he did not draw a square object to depict the shop. The object actually nearest the bottom left corner is the town hall with a door at base and a clock on a spire above the building. The boy then drew an arrow to the left of the town hall and pointing left and wrote a label to indicate what lay in that direction

In the bottom of the map above and left of the word 'South' is an L-shaped group of blocks labelled 'The Strand' which seems to mean the large walled complex of former Naval Buildings which was also identified by S3B4.

In the bottom right corner of the map there is an interesting collection of labels to the right of the Tudor castle. These collectively suggest an awareness of the broader

area but some understandable errors of the sort discussed at the introduction to this school. The boy has identified a place 'Victoria Park' which does lie to the east (right) of the Tudor castle and it is located near 'Blethm (Blenheim) Road'. Beneath those two labels are the words 'golfcourt road' and 'west' which was one of the direction indicators that he wrote after drawing the compass rose. A consultation of a street map indicates that the Golf Course does indeed lie off to the right of the map and that the road to it 'Golf Road' starts in this area as 'West Road'.

At the right hand edge of the map is another cluster of labels and a light blue square with a door and a lintel. According to the label beneath it his object is the 'Telgrath (Telegraph) Pub' and it is located on 'telgrath (Telegraph) road'. Beneath that cluster are the labels 'Nursry' (nursery) and 'after school club'. In the middle of the map is a line of three houses and the label 'ravenscourt road'.

This map is quite difficult to classify using the selected theorists as it is unique in its absence of drawn roads. It does contain clusters of objects and labels which are of importance and familiarity to the child and they are distributed with a broad spatial accuracy, but the complete lack of detail or linking roads between the clusters places it below the lowest category of each theorist.

Classification using each model:

Appleyard (1970) – broadly similar to Topological Spatial Scattered, but it features both isometric views (houses, school garden centre, Telegraph Pub, Town hall) and orthogonal views (Tudor castle and The Strand). It also displays a broad awareness of spatial distribution of depicted elements.

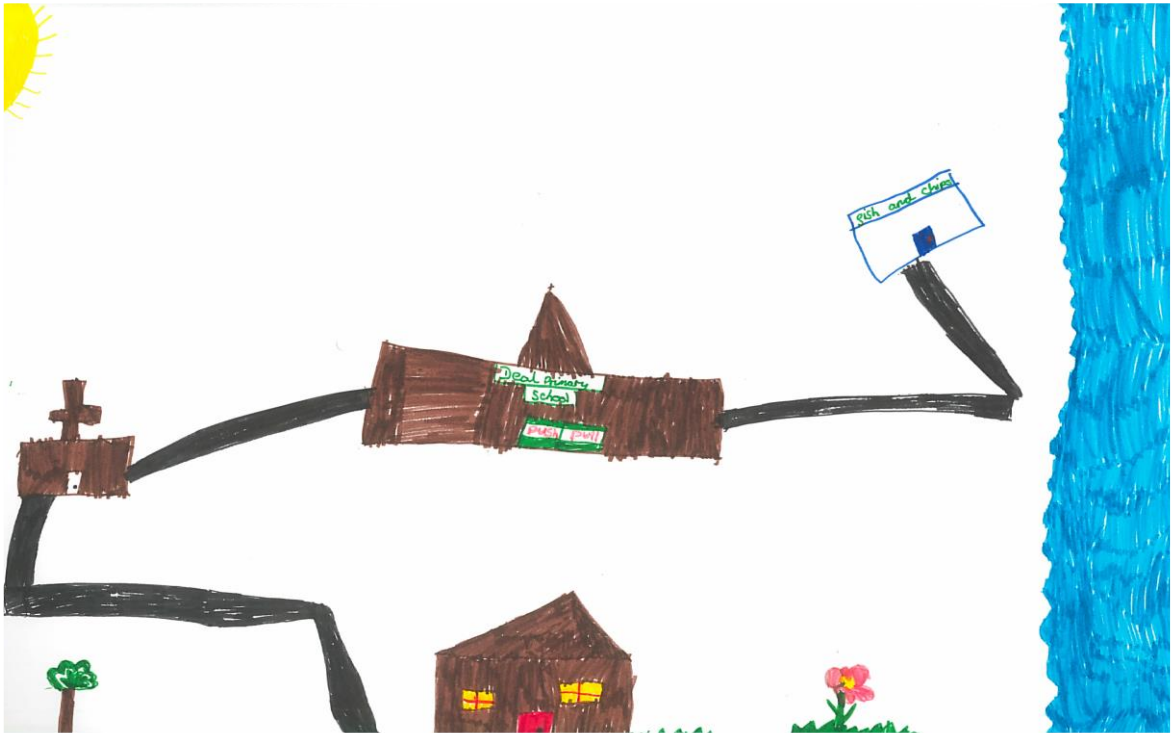
Ladd (1970) - Type 3 Image Resembling a Map but the use of spaces rather than symbols for roads is problematic. The artefact 'could' be orientated to ground and used for crude way-finding as it is possible to identify the actual location and the spatial distribution of objects is broadly accurate despite scale inconsistencies.

Moore (1973) - Level II for the above reasons.

Hart (1981) Again, reasonable levels of Spatial Order and Proximity with clusters of objects linked by routes and use of label words. If taken at face value as an artefact without interaction during its creation, this map would give a falsely diminished impression of the spatial awareness of the child who created it. The experience of conducting the research at this school in particular reinforces the importance of interacting with the child in order to gain an accurate understanding of their capabilities, (Donaldson, 1978; Hart, 1979; Hart, 1981; Reggio Children, 2000).

Matthews (1984) – Grade IIB Plan Pictorial Verbal as the view is overall orthogonal despite the isometric buildings. There is an obvious order to spatial distribution, understanding of routes linking clusters and use of label words within a complex and detailed image.

S3G1



Task One Map Interpretation – Identified image as a map and no difficulty locating specified objects.

Reason - Shows land and river. Rivers are usually long thin and blue

Right Hand

Task Two Map Drawing

First object drawn – Sea

Drawing Notes – This map is interesting as the information conveyed by it is as much sequential as it is survey knowledge possessed by the child. In the bottom centre of the map is the child's home with a flower to the right and a tree to the left. An unnamed road leads to the church attended by her family and another road connects that to the school. A further L-shaped and unidentified road to the right of the school connects to a fish and chip shop near the sea. The map is also unusual in that if we assume the common western cartographic convention of the top of the map being north then unlike most of the children, this girl has correctly placed the sea to the east of the town. All of the buildings are isometric in view and the sun has been included in the top left hand corner of the map for decoration.

Classification using each model:

Appleyard (1970) – Positional Spatial Linked as all the elements are in effect linked by a single route.

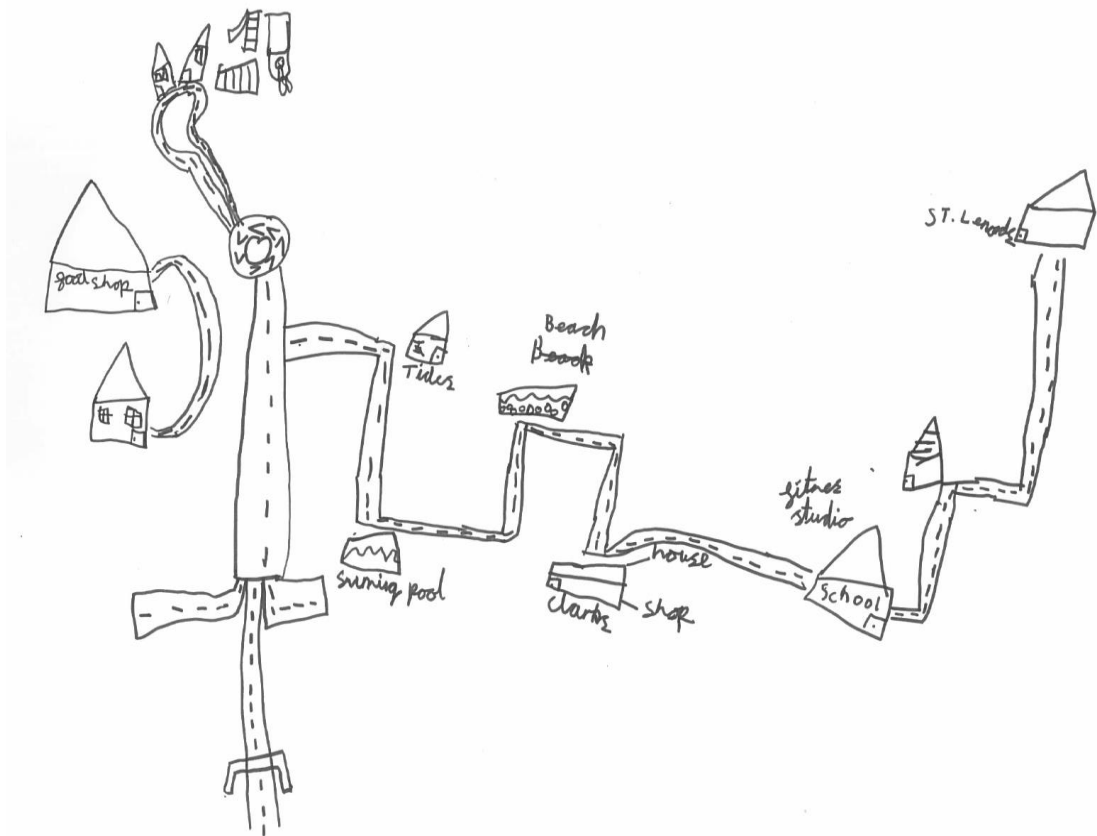
Ladd (1970) - Type 2 Schematic Drawings as although it has labels the view of buildings is isometric, it is only loosely spatially organised and it would be difficult to identify the town without the label on the school.

Moore (1973) – falls below Level 1 as it features ego-centric object selection and limited correlation between depicted objects and their actual spatial distribution on the ground.

Hart (1981) – There is a limited Spatial Order and Proximity shown. The depicted objects are evidently conceptualised as clusters by the child and linked by a single route with limited use of scale. However, taking the map purely as an artefact without interaction during its creation would be to underestimate the spatial awareness of the girl about her town. She has chosen the objects/places which are significant to her and has depicted them in a logical sequence. Unlike many of the more detailed maps of her peers she has located the sea correctly and she has depicted four different types of buildings with sufficient accuracy that their probable use can be estimated with reasonable accuracy. That is to say, the church and house look like typical isometric depictions of a church and house. Interestingly the depiction of the school with the words “Push” and “Pull” on the double doors seems consistent with the assertion of Spencer and Darvizeh (1983) about children attending to environmental details which fall before the conscious information horizon of most adults.

Matthews (1984) Grade 1B Pictorial Depiction as it is isometric and has order and label words but no scale.

S3G2



Task One Map Interpretation – Identified image as a map after a pause

Reason – None given **Right Hand**

Task Two Map Drawing

First object drawn – House at centre left edge of map connected to building labelled 'food shop' by a curving road.

Drawing Notes – Although the map appears spatially disorganised and inaccurate it still represents comparatively detailed networks of locations which have significance to the child. It is quite ego-centric in the selection of those objects but arguably so is any map as it involves the creator making such choices about what objects to include and exclude.

At the top left of the map is a cul-de-sac with two houses and a playground to its right. Below this is a roundabout and a major road running vertically past the food shop and the girl's house to a four-way intersection. Following straight down this main road it passes under an unlabelled bridge.

Running off to the right from this road is a long mostly horizontal road which makes as number of right angle turns and leads to the right hand side of the map where a long vertical road leads to a church labelled 'St Leonard's' in the top right of the map.

The child has placed landmark buildings at each of the corners of this road and this is consistent with research findings that people tend to draw direction changes as right angle turns even if objectively they are not at this angle. This is also consistent with the work of Golledge (1978) who found that people tend to mark direction changes with a landmark or 'anchor point'. The first landmark object is the indoor swimming pool and the second object is also a swimming pool. The third object is the beach which is presumably the main beach and is therefore located incorrectly by being in the centre of the map rather than at the right hand edge where it would actually lie if the top of the map were assumed to be north. The fourth object labelled 'Clarks' 'house' 'shop' is actually the business premises and dwelling of her grandparent, with them living in a flat above the franchised shoe shop.

Classification using each model:

Appleyard (1970) - Positional Spatial Linked as all the elements are linked by major spines and present the town as a linear object in both vertical and horizontal planes.

Ladd (1970) Type 2 Schematic Drawings as it features isometric views of buildings and label words but inaccurate spatial distribution and limited scale accuracy and is impossible to identify the town without having spoken with the child who drew the map.

Moore (1973) – mostly below classification of Level I Planometric view as it features only isometric views of buildings but it does display ego-centric object selection and limited correlation between depicted and actual spatial distribution of objects.

Hart (1981) – There is a quite clear Spatial Order present with objects logically positioned and routes used to link clusters. A basic scale is consistently used and the overall spatial distribution is objectively broadly accurate. Taking this map simply as an artefact would again underestimate the spatial knowledge possessed by this girl as all of the depicted locations had stories attached to them which caused them to serve as anchor points Golledge (1978) especially those at the direction changes along the horizontal spine road.

Matthews (1984) - Grade 1 Pictorial Verbal mainly by virtue of the extensive use of label words.

S3G4



Task One Map Interpretation – Identified image as map and no difficulty locating specified objects.

Reason - It shows places and has a river which is long thin and blue. **Right Hand**

Task Two Map Drawing

First object drawn – Vertical Road at left of map labelled ‘St Edmund’

Drawing Notes – A drawing displaying some greater levels of sophistication than some others and the oral interaction supported the impression that the child possessed a much more detailed spatial awareness. This was shown through use of label words to identify specific streets, the use of house numbers and the details of people and the brown horse in the large green paddock with a blue water trough and a yellow and orange hay box. The sun is depicted by a yellow half circle in top left corner.

After drawing the vertical double lined road at left the child drew three houses and labelled them 11, 12 and 13. On the thin vertical road labelled ‘St Francis Road’ the houses were drawn and then labelled 13, 14, 15 and after single black horizontal line was drawn across top of map and labelled ‘St Richard’ the four houses were drawn and labelled 1, 2, 3, 4. The child stated when asked that these numbers were not the actual house numbers but were just because houses have numbers and they are usually in order along the street. There are two trees above St Richard road and the left one with red dots is an apple tree with fruit on.

The people between the houses at left of St Edmund road are known to the child and the cluster of four people in the curve of St Edmund Road are the girl and her friends playing with a pink doll pram. At the top right of the map is a large green block which appears to be on a road above St Richard's Road. This object is labelled 'The Sun' and features a green circle with radiating rays which was coloured over yellow.

The child answered the question about what kind of building this was by stating that it was a shop that sold newspapers and snacks. Without visiting the site it is impossible to say with certainty whether this is actually the name of the building, or whether the child has taken the typically large tabloid newspaper awning to be the name of the premises. However, in that case we might expect that she would show the sign as red and white rather than green and yellow.

Classification using each model:

Appleyard (1970) - Positional Spatial Linked.

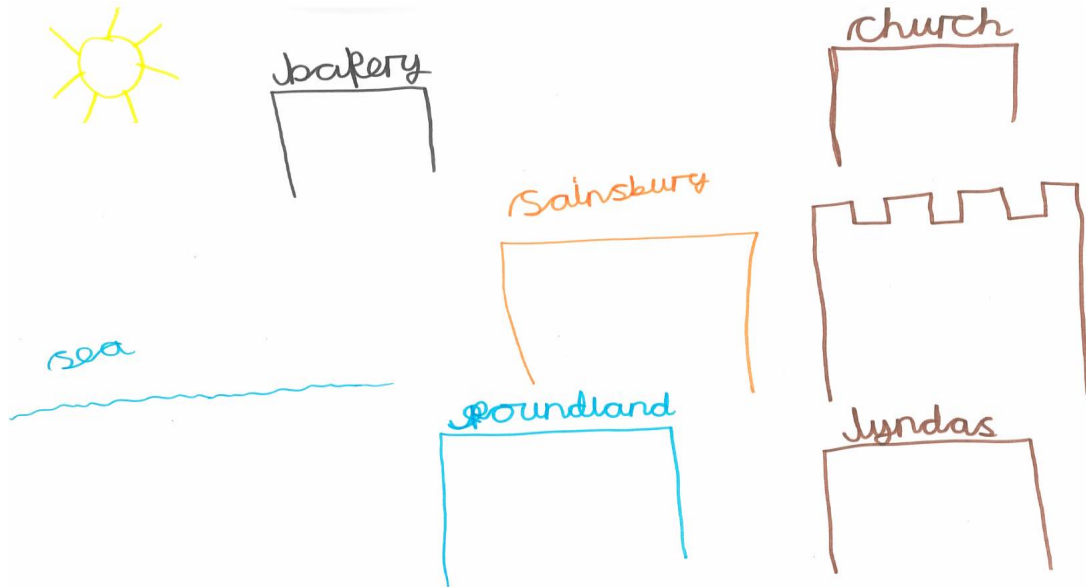
Ladd (1970) - Type 3 Images Resembling Maps. Depiction of buildings is isometric but it possesses sufficient specific detail through the labelled roads, to enable the map to be orientated to ground and used for crude way-finding.

Moore (1973) Level II and Level III categories despite isometric views of buildings as major road junctions are identified and roads are labelled and street sizes are differentiated. However a consultation of the satellite image (Google Earth angle 90 degrees vertical elevation 400 metres) show that this differentiation of size of roads is ego-centric rather than actual because St Richard's Road is the main thoroughfare with St Edmund Road and St Francis Close both being only small side streets. The map is closer to Level III in many ways as the spatial distribution and scale is better than Level II. The horse paddock depicted is actually very large, and behind the rows of houses it extends a considerable distance in both directions parallel to St Richards Road and it does have two troughs quite close to the end of St Edmund Road

Hart (1981) - There is an obvious Spatial Order to the image with elements positioned logically and with a basic scale. Clustering is evident and label words are used on routes which link the clusters.

Matthews (1984) – Grade IIB Pictorial Plan Verbal as overall view is orthogonal despite the isometric buildings. Label words are used, with roads differentiated by size and some level of detail is shown such as house numbers and the newsagent sign.

S3G5



Task One Map Interpretation – Image identified as map and no difficulty locating specified objects.

Reason – Because land is green and water is blue. **Right Hand**

Task Two Map Drawing

First object drawn – Sea

Drawing Notes – Although a fairly simplistic image which includes the yellow sun at top left a consultation of the satellite image (Google Earth angle 90 degrees vertical, elevation 400m) shows that this map actually covers an area of approximately 1200m x 400m. Within that area the arrangement of objects is reasonably accurate in terms of the relationship between the buildings. However, the sea is at the left side of the map rather than the top where it would actually lie in reality.

All of the buildings are simple isometric outlines and none of them features a base but all are clearly labelled and there is some association of colour depicting it and the corporate or actual colour of the object. That is to say that Sainsbury's is drawn and labelled in orange and Poundland in light blue. The bakery is drawn and labelled in black and the object in brown labelled "Lynda's" was identified by the child as a shop selling numerous items for roughly £1.00. The unlabelled crenelated brown object in middle of right hand edge of map is the Tudor castle.

Classification using each model:

Appleyard (1970) - Topological Spatial Scattered as it features a collection of objects relevant to the map creator but the incorrect location of the sea makes it difficult for an unfamiliar person to place them in a wider context.

Ladd's (1970) - Type 1 Pictorial Drawings as it features isometric views of buildings and an absence of roads.

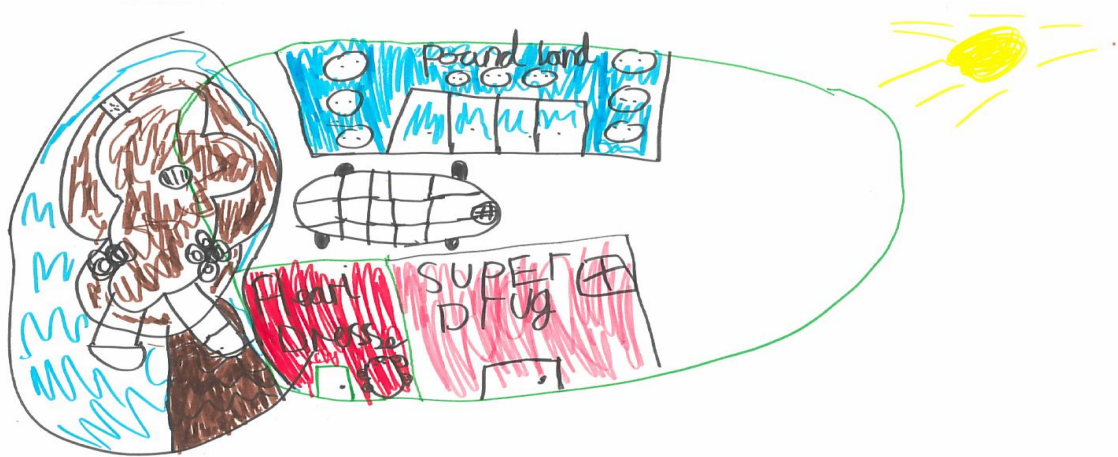
Moore (1973) - Level I category as it has ego-centric object selection with the exception of relations between the buildings themselves it features limited correlation between overall actual and depicted spatial relations.

Hart (1981) – Limited Spatial Order. Elements are simply clustered together and drawn isometrically at a similar very basic scale. Given that all the buildings depicted are shops it could be argued that clustering is present and the spaces are routes, but this is only at the most basic level.

Matthews (1984) - Grade 1B Pictorial Verbal despite the absence of roads.

Once again we must conclude with Hart (1981) and Reggio (2000) that attempting to interpret this map purely as an artefact without interaction with its creator would have led to a significant underestimation of the child's spatial knowledge.

S3G7



Task One Map Interpretation– Identified image as ‘map of the world’ and not able to identify all specified objects.

Reason - It has grass and rivers.

Right Hand

Task Two Map Drawing

First object drawn – Green circle which forms outer boundary of town

Drawing Notes – A rather unique drawing style in this artefact in terms of being a cluster of clustered elements in the same small area of the town. There is a use of squiggly shading rather than solid colouring in of objects. This child was the second last of the day and during their interaction with the researcher the class was engaged in group craft activities and her body language conveyed clearly that she wished to complete the drawing and return to class as soon as possible.

The blue block at top centre is labelled ‘Poundland’ store and as in some other children’s artefacts the colour used for it shows a strong association by the child with the corporate colour of that retailer. The circles with dots in them on the Poundland store are faces of people and the squiggles on the doors are sunlight reflections. At bottom centre right is a pink block labelled ‘Superdrug’ and this raises a cautionary note about assuming the above linking by the child of the colour with the retailer. The corporate colours for this chain of chemists are dark blue and white and the child stated that the store was dark blue but she had coloured it pink because she likes pink and the black writing would disappear if she coloured it dark blue.

At bottom centre right is a red block labelled 'Hair dresser' (Hair dresser) and an orthogonal view of a car is drawn on it. The researcher asked if this building was in fact red and the child said "Kind of. It's bricks". At left centre of the image is a brown and black flower-like object with light blue squiggles around it. This represents the Tudor castle with a moat around it. The girl stated that she drew the water in the moat because that's what moats have, even though this particular one is dry and grassy. The long objects at bottom of castle are cannons with the small circular objects representing piles of cannon balls. The black oval in centre of image is an orthogonal view of a car with many seats. This child has also included the sun at top right of her artefact map as a standard yellow circular object with rays emanating outward.

Classification using each model:

Appleyard (1970) - Topological Spatial Mosaic due to it depicting clusters or clusters as a whole object.

Ladd (1970) - Lower end Type 2 Schematic Drawing as despite some labelling of objects it would be difficult to identify the wider location or to use for wayfinding.

Moore (1973) - Low end Level 1 drawing for the same reasons as Ladd's ranking, with limited correlation between actual and depicted objects.

Hart (1981) – The overall image is isometric in nature and represents a single cluster of objects, drawn at a consistent though basic scale and with an internally cohesive Spatial Order and Proximity.

Matthews (1984) - Grade 1B Pictorial Verbal, due to use of label words despite the lack of accuracy in terms of scale and spatial distribution.

This artefact again shows the danger of attempting post-factum interpretation of children's maps in a prima facie manner because the child possessed some quite detailed environmental knowledge even about the limited spatial area that she chose to depict.

Chapter 5 Discussion

5.0 Introduction

In this chapter there will be discussion of the data from this research in relation to the existing literature. In section 5.1 it will state what I feel confident in asserting from my data. In Section 5.2 it will discuss the performance of the children in Task One – Interpretation of common cartographic symbols from map of fictional town. In Section 5.3 it will discuss the children's construction of a free-recall hand-drawn artefact map of known large-scale environment. In Section 5.4 it will discuss the response of the research to the proposed questions. Next Section 5.5 will examine anomalies in my data not elsewhere encountered. Section 5.6 will briefly discuss variables such as gender, toy play and young children's independent mobility which were not specifically investigated in my research but which literature suggests are useful directions for future research. Lastly Section 5.7 provides a conclusion to the chapter.

5.1 What can I say with certainty from my research?

It appears from this research that the assumptions made by Lynch (1960) are unreliable in terms of how children understand, recall, represent and use knowledge about their familiar large-scale physical environments. His proposed typology is visible in the artefacts in terms of landmarks, paths and nodes, but more research would be required before conclusions could safely be drawn regarding children constructing artefact maps of sufficiently large spaces to discern the depiction of edges and districts. In pursuit of this replication of my research in a major urban centre would be useful.

Similarly, the Piagetian understandings of how children understand, recall, represent and use knowledge about their large-scale environments which underpin much of the research prior to 2000 are increasingly challenged by contemporary constructions of children and their cognitive capacities as seen in, (Herman, Kolker and Shaw, 1982; Hillman, Adams and Whitelegg, 1990; Karsten, 2002; Karsten, 2005; Hope, 2008; Leitch, 2008; Lehman-Frisch et. al. 2012 and Gopnik, 2012). It appears that many children do possess quite detailed Spatial and Environmental knowledge about their local area. It also seems that the majority of them are able to convey this orally even if they cannot depict it graphically, (Blaut, McCleary and Blaut, 1970; Blades and Spencer, 1987c; Spencer, Blades and Morsley, 1989; Matthews, 1992; Blades, Blaut,

Darvizeh, Elgua, Sowden, Soni, Spencer, Stea, Surajpal and Uttal, 1998; Wallace and Almy, 1999; Risotto and Tonucci, 2002).

On balance then, it appears that more research is needed to improve our understanding of how children create their cognitive and artefact maps of large-scale physical environments. As part of that research, it seems that a new classification model which can capture the oral evidence of children's environmental knowledge may be needed.

5.2 Task 1 Interpretation of common cartographic symbols from map of fictional town

Only one child at any of the three schools had any difficulty in recognising the unlabelled image of the fictional town as a map. The majority of children (37/40) specifically said that they knew it was a map because it had a blue river and green grass. All children were able to locate the river immediately and confidently. However some of the more articulate children differentiated between a canal with straight banks and a river with meandering banks. Most of the children (38/40) easily identified the largest building and all children identified open fields with no difficulty. Some children (4/40) misidentified the surrounding defensive wall of the town as being the largest road but this was an understandable error of reasoning. These children assumed that a wide grey band around the outside of the town represented a ring road, with the smaller walls being feeder roads and the towers being roundabouts.

5.3 Task 2 Free-recall hand-drawn artefact map of known large-scale environment

Over half the children, (27/40), drew an object before drawing a road. In most cases the object drawn was either their own house or their school but (6/40) drew the seafront and (3/40), all of whom were girls, drew an enclosing circle or box as their first object. These findings appear consistent with the view that people commence maps with anchor points which may often be ego-centric landmarks, (Golledge, 1978; Karsten, 2005; Huynh, Hall, Doherty and Smith, 2008).

Most children (31/40), drew an orthogonal or mostly orthogonal view of the depicted space but just two children (S3B1 and S3G6) produced totally orthogonal images. The other children mostly drew an orthogonal view but buildings were frequently, or totally depicted isometrically. This seems to support the assertion of Lowenfeld and Lambert-Brittain (1987) about children under 10 years often still experiencing difficulty rotating their isometric experience of the world into an orthogonal depiction because how the buildings look from above is not likely to be of interest to the average child.

The majority (34/40), of artefact maps produced by the children 'could' be used by an adult for crude way-finding provided that the adult knew which town was being depicted.

Surprisingly few of the children (3 /40), drew the pier despite it being the single largest object in their town and a common recreational site. They did however draw adjacent land uses, (ice-cream and bait shops) which suggests that although they were aware of the pier, it was not significant to their understanding of that part of their town. It is suggested that parents not wanting to endure the long walk or be willing to allow children on the pier unsupervised may have contributed to the children's lack of familiarity with it. More research would be required to investigate that suggestion though.

Several children (3 / 40), left spaces for roads and even labelled the spaces with street names but did not use conventional cartographic symbols for roads. Several other children drew clusters of buildings with a ground-like line beneath them but did not join these clusters up.

5.4 Response of research to the proposed questions.

This research set out to address the four questions and a discussion in regard to each question will now be conducted.

5.4.1 Primary Question: *What Physical Objects and spatial relationships do children aged 7-8 years include in their map when drawing a free-recall map of a known large scale physical environment?*

The majority of children drew objects which were of immediate utility and presumably daily familiarity to them. Many artefacts included either the child's house or the school and several included both. Most included at least one major route and several included shops. Although a traditional Piagetian construction of children's spatial cognition would ascribe these choices to ego-centricity, it equally possible to argue that the children are simply anchoring their map with a familiar object in the same manner as adults, (Trowbridge, 1913; Golledge, 1978; Karsten, 2005; Huynh, Hall, Doherty and Smith, 2008). Often when shops were included they were labelled and depicted in something reminiscent of the corporate colour of the commercial entity e.g. Sainsbury's being drawn in orange, or Poundland being blue and yellow etc. A number of artefacts also included vehicles and animals but only a handful included any people. Interestingly when vehicles were included they were usually ones that had some visually memorable characteristic such as a tradesmen's signage or being a large tractor or earth moving machine which are often painted in primary colours such as red or yellow. These findings broadly support the view that people recall and depict the images that make the strongest visual impression, (Pocock, 1973; Pocock, 1975; Murray and Spencer, 1979; Taylor and Tversky, 1992). It is commonly known that this principle of visual retention of image underpins the famous 1931 London Tube map which is a schematic diagram rather than spatially accurate map.

5.4.2 Sub-Question 1: *To what extent can children interpret a map of a fictional location through understanding of cartographic conventional symbols?*

In Task One the children were shown an unlabelled colour A4 image of a fictitious town (See Appendix E) and asked what it was, and how they knew. The majority of children at all three schools, (36/40), immediately answered that it was a map and supplied the above reasons for their opinion. One child stated it was London, because he could see the Tower, and he indicated the largest building in the image. One child stated it was clearly a town as cities are bigger but offered no reason for his opinion. Another boy said it was a country but again advanced no reason for the belief. The remaining child (B5) stated it was a picture and had grass and water in.

All of those answers are consistent with the findings that even quite young children with limited exposure to orthogonal imagery will nonetheless readily recognise such images as depicting a portion of the Earth rotated as if looking down from above, as found by, (Blaut, McCleary and Blaut, 1970; Dale, 1971; Blaut and Stea, 1974; Blades and Spencer, 1987; Blaut, 1991; Matthews, 1992; Plester, Blades and Spencer, 2010) and Kim, Bernardz and Kim, 2012).

5.4.3 Sub-Question 2: *To what extent do these artefact maps of contemporary children conform to the spatial typology models from the literature, (Lynch, 1960; Ladd, 1970; Moore, 1973; Hart, 1981) and Matthews, 1984) ?*

Given the aforementioned issues of children generally not having sufficient exposure to city-sized physical environments it was always going to be problematic to assess the conformity of their artefact maps to any of the selected models. However, it was possible to examine the temporal construction order of their maps through the observation and interaction with the children during creation of the artefact maps. Through that observation and interaction it was possible to discern that children's Spatial and Environmental knowledge of their local large-scale physical environments frequently exceeds their graphical representational ability. Many of the artefact maps were difficult to classify using any of the selected models and this appears to support the need for a new model which more accurately captures children's abilities and knowledge.

5.4.4 Sub-Question 3: *To what extent do these maps exhibit the spatial typology proposed by (Lynch 1960)?*

As expected in my proposal, there is strong evidence that children tend to draw landmark objects before roads although roads are a definite consideration. There was a high number of roads as first object at School 1, (See Figure 20), but this is thought to be due to two situational factors. Firstly the school is located as the last building between town and farmland, tending to affect the children's thinking. Secondly, the main street of the village is a thoroughfare for commuters and also agricultural machinery so traffic noise and road safety are significant daily concerns to parents and teachers. This preference for roads as first object was not seen at the other two schools but more data would be needed to confirm my conclusion about children's preference for landmarks rather than paths

Conclusion

This research uses a quite small sample and further research is still needed to support my hypothesis that Lynch (1960) is incorrect in respect of how children construct cognitive maps of the large-scale physical environment. What is clear though, is that any post-factum attempt to interpret artefacts without having been present and interacting with the children during their construction will seriously underestimate the spatial and environmental knowledge possessed by the children.

5.5 Anomalies in data

5.5.1 Drawing boundaries as first object

The drawing of a boundary as a first object was uncommon in my research but it was an anticipated possibility because the work of Dupre and O'Neill-Gilbert (1985) found significant differences in how urban and rural children constructed artefact maps of their physical environment. Rural children consistently depicted clear boundaries and tended to emphasise dwellings while urban children tended to depict areas of varying size radiating outward from their own dwelling. The urban artefact maps tend to emphasise commercial premises and large infrastructure such as hospitals, railway stations etc.

In my research, three girls (S1G2, S1G7 and S3G7), each drew a boundary enclosing their entire depicted space as their first object. The discussion with them was insufficient to conclude whether this enclosing line was seen as a border of the town or an edge of their map. But in all cases it appeared a clear and conscious choice to represent only that portion of the physical environment which they conceived as lying within the boundary.

5.5.2 Drawing unclassifiable images

As Plowden (1967) pointed out, in any group of children the levels of any indices of development will be a continuum not a position and therefore there will always be variation in data regarding those children. In the UK we start children in formal schooling two years before the majority of the European Union and the impacts of this have been a constant debate for the past 50 years, (Alexander, 2009).

The work of Reggio Children (2000) reminds us that each child is unique and responds differently to their environment. It is not therefore altogether surprising that some of the children in this research, (Two girls and one boy) should produce artefact images which were unable to be classified as maps. The boy (S1B5) drew a very simple image of trees and an oval with lumps on the sides which he stated was his house and its windows. He was very shy and so it was not possible to ascertain his level of environmental knowledge. Both of the girls drew completely isometric scenes (pictures) and one of them (S2G2) also did not speak sufficiently to ascertain her level of environmental knowledge. The other (S1G3) spoke constantly and clearly possessed quite high levels of environmental knowledge and even artistic ability.

These three children serve to remind us that when we attempt to conduct research with children we are stepping into (and intruding upon), their daily lives for reasons that seldom truly benefit the child to the same degree as it does the researcher. We therefore need to ensure that respect for children's competence is part of our methodology, that we actively seek the 'messy' voices of children in our data collection and that we respect the privacy of the children's daily world in its role as a 'practice area' for life, (Arendt, 1954; Morrow and Richards, 1996; Thomas and O'Kane, 1998; Einarrsdottir, 2007; Elden, 2012).

5.6 What have we learned about children and maps?

Consistent with the work of the many authors underpinning this research, (Notably the several works of Blaut, Stea, Blades and Spencer), it was found that children under ten years of age:

- Do understand that maps represent a portion of the Earth's surface depicted from a perspective above the ground and are used by humans to convey information and for wayfinding
- Can recognise objects on maps through interpretation of common cartographic symbols and can articulate their reasons for those interpretations.
- Can construct an artefact map (with varying accuracy) of a familiar large-scale physical environment, and in some cases explicitly adopt cartographic conventions.
- Do possess quite detailed Environmental knowledge about their familiar large-scale physical environment which they can convey orally even if their graphical representational ability is still imperfect.

There is a great deal still to be researched about how children understand and map their familiar large-scale physical environments. However, the overall lesson is that children do possess much greater cognitive capabilities than the historical research in this field has credited them with.

5.6.1 Importance of toy play in developing spatial knowledge

It was argued by Blaut and Blaut (1987) that toy play (with blocks and toy cars) makes use of three crucial attributes of maps and allows children to simulate macro-environmental behaviour. Firstly, such play allows children to use signs (toy cars and floor mats with roads etc.) to represent features of actual places. Secondly, it allows the child to imagine the geographic reality to be reduced to a small scale. Lastly, because the child is looking down on the play-town etc. from an overhead perspective, he or she learns to mentally rotate the landscapes they encounter into an orthogonal view. Such play teaches the child in a concrete fashion, at an early age, how to use signs to represent real objects and to use the two transformation or positional rules of cartography, namely adoption of a consistent scale and single projection. Although my research did not investigate this variable it clearly represents an important future direction for investigation

5.6.2 Gender as a significant variable

Discussing behavioural and cognitive differences between genders is always a minefield and especially so when using broad generalisations about the possible origins and nature of those differences. But, it does appear that these differences are real and have direct bearing on the findings about the reduced play range of girls compared to boys of equivalent age, (Hart, 1981; Karsten, 2005; Lehman-Frisch et al., 2012).

Some useful overviews of existing research are provided by Coluccia and Louse (2004) and Huynh, Doherty and Sharpe (2010) who argue that although there are clear differences between how males and females perform spatial cognition tasks it is not possible to satisfactorily separate the biological aspects from the socio-cultural ones and more research is needed.

The research of Saucier, Green, Leason, McFadden, Bell and Elias (2002) concludes that the differences seem less a case of males being inherently better than females at spatial cognition tasks than it is of the strategies that males apply to those tasks being more efficient in large-scale physical environments. It seems that females employ primarily route-based strategies which rely on landmarks to recall spatial information (especially layouts).

This places a high cognitive load on the individual and leads to errors of orientation, (Kozlowski and Bryant, 1977; Bryant, 1982; Bryant, 1991). Males on the other hand appear to utilise Euclidean-based strategies to recall overall spatial layouts and the relationship between objects within them. This strategy places far lower cognitive load on working memory and hence leads to less errors of navigation or depiction, (Silverman and Eals, 1992; Saucier et al., 2002). This is not to suggest that the typical male-brain strategy is superior to that of the female-brain, merely that the former requires less cognitive load than the latter. However, Eals and Silverman (1994), and Geary (1995) in Huynh Doherty and Sharp (2010) and also Diamond (1998), argue that the evolutionary division of labour may have an important role in shaping storage and recall of spatial and environmental knowledge. They argue that the cognitive demands of hunting and warfare may have privileged those males with greater ability to use Euclidean-based strategies. On the other hand, successful females were rewarded in food gathering if they possessed skills related to recognising and recalling landmarks, particularly with regard to memory of the specific location of fixed objects.

The *Bent Twig Theory*, Sherman (1978) suggests that individuals possess innate predispositions in regard to particular abilities and therefore tend to engage more in the kinds of activities which suit those abilities and hence to develop and strengthen them through frequent practice. Males appear more interested than females in spatial exploratory activities and so they spend more time practicing the use of Euclidean-based spatial strategies in large scale environments, (Galea and Kimura, 1993; Lawton, 1994; Saucier et. al., 2002). It also appears that the male brain may possess an advantage in spatial activities due to the lower cerebral hemispheric lateralisation than female brains. In simple terms, having more connections within each half of the brain seems better for spatial activities than having numerous connections between the halves of the brain, (Annett, 1992).

It has also been suggested by some psychologists that some individuals, (more typically females than males), suffer a 'spatial anxiety' or a fear of becoming lost, and this impedes their observance of the environmental cues required to preserve accurate geographical orientation, (Lawton,1994; Lawton, 1996; Kozlowski and Bryant, 1977). This fear of becoming lost impedes the individuals' willingness to explore unfamiliar large-scale environments due to reduced self-confidence, (Coluccia and Louse, 2004).

This research suggests that Hart (1981) was correct in asserting that in terms of ability to recall and depict spatial and environmental knowledge, gender is not the primary impacting variable. It appears that access, either supervised or free-range, to a local environment, is more significant in allowing children to develop their recall and depiction skills. This is certainly suggested by the recent findings of (Karsten, 2005; Lehman-Frisch et al., 2012) with children in Holland and France and again, although my research did specifically explore this variable it does appear an area worthy of future study.

5.6.3 Children's independent mobility

Despite the perceived increase of parental restriction on children's independent play range it is worth noting that Bernard (1939), Landy (1965), Farley (1977), Ward (1977), Van Vliet (1983) and Pooley, Turbull and Adams (2003) all show similar patterns to those found by Rissotto and Tonucci (2002), Karsten (2005) and Lehman-Frisch et al. (2012). Working class children today appear to have greater access to unsupervised play than middle class ones, but as Ward (1977) and Matthews (1992) noted this does not necessarily equate to greater physical play range, (O'Brien, Jones, Sloan and Rustin, 2000; Shaw, Bicket, Elliott, Fagan-Watson, Mocca and Hillman, 2015). It was argued by Jacobs (1961) and Jacobs (2004) that many of the restrictions on children's play range have to do with the logistical realities of daily life in urban industrial societies with high levels of car ownership, increased high stakes testing in primary schools and decreased parental employment security.

My research did not directly address the issue but it appears to support the above authors in that regardless of social class, the more significant factor restricting play range is gender, (Page, Cooper, Griew and Jago, 2010; Loo and Lam, 2013; Pacilli, Giovannelli, Prezza and Augimeri, 2013; Shaw, Bicket, Elliott, Fagan-Watson, Mocca and Hillman, 2015). It seems that Hart (1981) was correct that girls everywhere and always are permitted a smaller range with more behavioural restrictions than boys of equivalent age, (Rissotto and Tonucci, 2002; Lehman-Frisch et al., 2012). This issue remains one very promising area for future research.

This is a significant issue for the early education of children, especially girls, as the ability to explore a particular large-scale physical environment seems central to development of effective strategies for comprehending and depicting any such environment, (Webley, 1981; Spencer, Blades and Morsley, 1989; Matthews, 1992; Joshi, MacLean and Carter, 1999; Huynh, Hall, Doherty and Smith, 2008; Villanueva, Giles-Corti, Bulsara, Timperio, McCormack, Beesley, Trapp and Middleton, 2013).

5.6.4 Children not being sufficiently engaged with data collection task

Several children participating in my research exhibited limited engagement with the research tasks and in all cases their verbal and non-verbal language indicated boredom and distraction by more interesting nearby activities. This is consistent with literature as it was found by Hart (1981), Gauvain and Rogoff (1986), and Spencer, Blades and Morsley (1989), that in order to get useful and reliable data from children it is necessary to tie the data collection task to a sufficiently concrete task to engage their genuine attention. By that I mean, that the task should not be an artificial space or activity but rather a legitimate use of the real physical environment as done by Spencer and Darvizeh (1981a, 1981b) and Ottosson (1987). Otherwise there is a risk of the child simply treating the data collection as an unassessed activity without tangible benefit to themselves. In designing such activities closer attention should be paid to the insights gained from Reggio Children (2000) than to Piagetian understandings of child competence.

5.6.5 Drawing landmarks before paths

The work by Golledge (1978) proposed a more nuanced understanding of how subjects constructed an artefact map by suggesting that they 'anchored' their map with points of detail and then drew additional information with reference to those points. This is broadly consistent with Siegel and White (1975) who contradict Lynch (1960) by suggesting that for children at least, landmarks appear more significant than pathways. Despite some studies by Stevens and Coupe (1978) and Hirtle and Jonides (1985) it was not until the work of Taylor and Tversky (1992) that serious attention was paid to the order in which subjects drew the chosen elements of their artefact maps. That latter study clearly suggested that elements are selected and depicted according to a perceived hierarchy of importance to the producer of the artefact map.

Significantly, the hierarchies identified in these studies appear to be based upon landmarks rather than paths and this is consistent with the findings of Saucier et al (2002) and Huynh, Hall, Doherty and Smith (2008).

The research of Taylor and Tversky (1992), required separate groups of undergraduates to use either oral description or artefact maps to reproduce previously seen maps. They found strong positive correlation with their subjects between the first mentioned or depicted element being a landmark rather than a path. They also found positive correlation between largest landmark on original map and first object mentioned or depicted by subjects. Both findings echo those of Ladd (1970), Moore (1973) and also strongly anticipated my hypothesised research outcomes with the children. In this respect, the omission of the pier by most children was a surprise as it is easily the most striking feature of the town from an adult point of view.

The work of Taylor and Tversky (1992) strongly suggests that any artefact maps produced by children will be affected by such things as time available for construction of artefact, limitations of media (number and colour of pens etc.) and also by the common conventions of written communication such as working from left to right and top to bottom for English speakers. This would be supported by Donaldson (1978) who argued that formal schooling serves to form a cognitive range of 'acceptable' answers that children feel that they can provide to adults in a classroom situation. A view shared by Gardner (2011) in his discussion of how formal schooling can constrict rather than enable learning. It was found by Taylor and Tversky (1992) that the artefact maps may also show evidence of subjects reducing mental and physical effort through drawing similar elements in proximity to each other even if this is not objectively so. There was some evidence of this phenomena in the artefact maps produced by my study but it did not appear as a significant occurrence.

Chapter 6 Proposal for new model for classification of children's free-recall sketch maps

6.0 Rationale for proposal of new model for classification of children's free-recall sketch maps

During the course of this research it became clear that the majority of research studies on children and mapping conducted prior to 2000 have suffered from a trio of shortcomings. Firstly, they have often been quite small scale spaces e.g. a room or a model of a room or a section of the playground with tasks that are not sufficiently real for the children to take the completion of them seriously. Secondly, they have often been conducted with teenagers or adults and have made explicit demands for recall and depiction of certain kinds of information, e.g. major landmarks and the routes linking them. Thirdly, they have often been post-factum attempts by adults to interpret children's artefact maps with no attempt to gather the voice of the child during their creation.

The clearest findings from this original research are that:

- Any post-factum adult attempt to interpret children's artefact maps is likely to seriously underestimate children's spatial and environmental knowledge.
- A new classification model is needed to improve our understanding of children's cognition of spatial and environmental knowledge.

Proposing a new model for classifying children's maps is a complex task and while striving to be comprehensive it can never be exhaustive.

6.1 Proposed model

The proposed model seeks to create a means of capturing not only what the children depict when asked to construct a free-recall sketch map, but also the things which they talk about whilst doing it. It is noted that Appleyard (1970) was not entirely suitable for this task as the children often did not depict sufficiently large portions of the physical environment and that using the other four models could easily lead to underestimating the children's cognitive mapping abilities in regard to their Environmental knowledge. This is because in constructing any artefact map spatial knowledge is more 'mappable' (easier to graphically depict) than environmental knowledge, (Pocock, 1975).

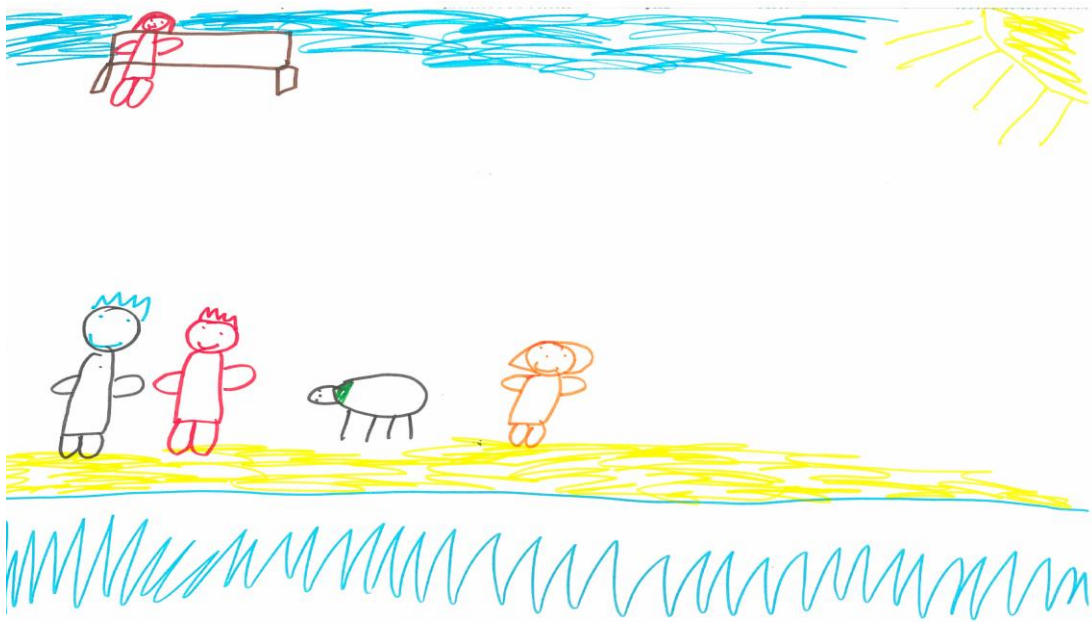
The following model is an amalgam of the four models used in this research but the salient difference is that it explicitly requires recording of the child's interactions with the researcher during construction of their free-recall sketch map. Prior to using the model, the reader is commended to read the work of Huynh, Hall, Doherty and Smith (2008) and Huynh, Doherty and Sharpe (2010) as their use of software has enabled interesting details to be recorded about the sequence in which subjects constructed their maps. It is also noted that the ability to retain a mental image whilst drawing it, and talking about what is being drawn, and why, is an exercise that places high cognitive loads on the subjects and even some adults struggle with it, (Murray and Spencer, 1979). In any research with children, shyness may also reduce their interactions and so silence should not be taken as prima facie evidence of limited understanding Anning and Ring (2004), Thomson (2008), Harcourt, Perry and Waller (2011) and Walker and Solvason (2014).

An exemplar of each level of the model is provided below using some of the children's artefact maps created in this research.

Level 1 Pictorial Drawings

| What is drawn | What is said | Sequence of construction |
|---|---|---|
| Completely isometric scene. Unable to identify area. Inconsistent scale and inclusion of extraneous objects like sun, clouds etc. No differentiation of road sizes | Limited or no accompanying narrative, or the narrative may be frequently unrelated to task. | May be drawn without a discernible logical sequence, e.g. objects appear to be drawn when the thought of them occurs. |

S2G2



Level 2 Schematic Drawings A

| What is drawn | What is said | Sequence of construction |
|--|---|--|
| <p>Overall orthogonal orientation but most buildings are depicted isometrically. A spatial order is evident with elements or clusters linked by a route. Mainly ego-centric landmarks and objects which are placed according to relationship as well as objective accuracy. There is an attempt to use a consistent scale and roads are differentiated according to size. Possible to orientate map to ground if depicted area is known. Numerous gaps in fabric of image.</p> | <p>Narrative suggests better spatial and environmental knowledge than being depicted graphically. May include extraneous information unrelated to task.</p> | <p>A logical sequence can be discerned such as following a route or completing a cluster of objects before moving on to others. There may be sequential temporal jumps between the depiction of elements</p> |

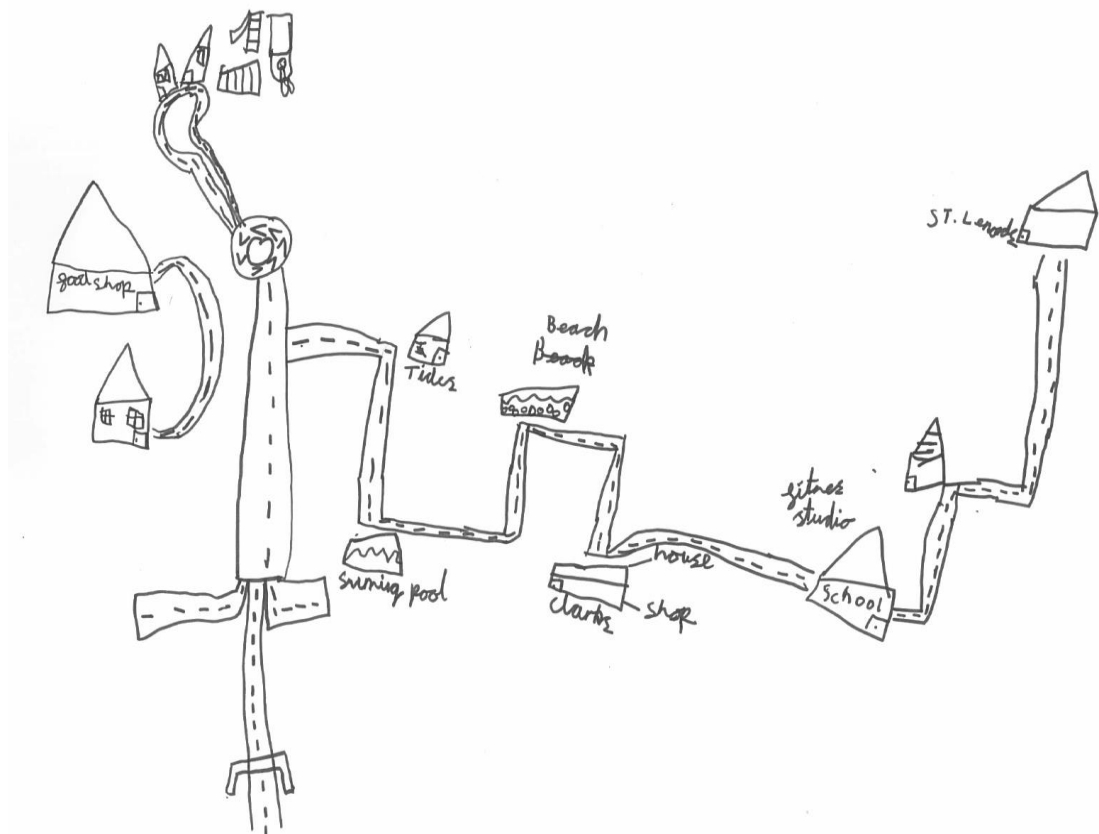
S2B4



Level 3 Schematic Drawings B

| What is drawn | What is said | Sequence of construction |
|---|---|--|
| <p>Overall Orthogonal orientation of both image and majority of buildings. Consistent scale is used. Roads are differentiated in terms of size. Clusters are coherent internally and between them. Non-egocentric landmarks are used and label words are present. Objects are placed in an objectively accurate manner in terms of spatial order and proximity. Possible to orientate map to ground and use for crude way-finding within immediate area.</p> <p>Some attempt to use conventional symbols and colours.</p> | <p>Narrative shows clear understanding of landmarks, paths and nodes. Good level of Environmental knowledge and subject can explain most depicted objects. Narrative may still include extraneous information</p> | <p>Artefact may be constructed in a logical sequence throughout, but sequential temporal jumping between elements may still occur.</p> |

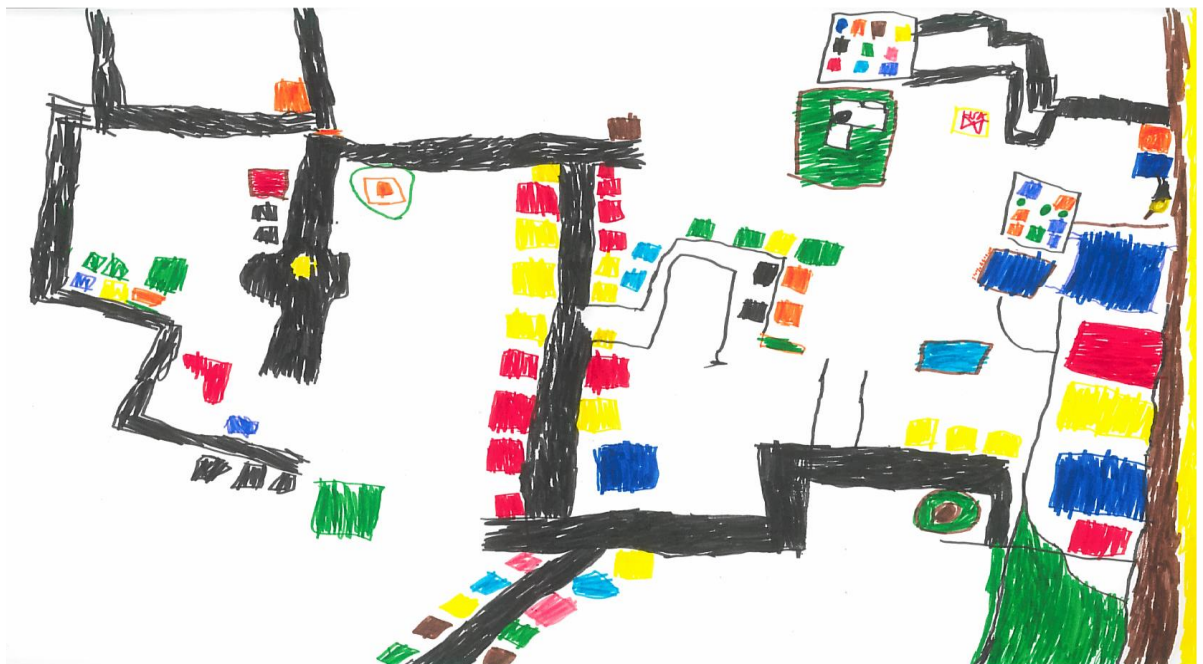
S3G2



Level 4 Pictorial Verbal Map

| What is drawn | What is said | Sequence of construction |
|--|--|--|
| <p>Totally orthogonal orientation but occasional isometric object. Consistent scale used and objects are placed with good level of objective accuracy in spatial order and proximity both within and between clusters. Label words are common and roads are differentiated by size. Artefact is easy to orientate to ground, and could be used for way-finding with only minor intuition required. Main nodes are evident and non-egocentric landmarks are used. A compass rose or other directional indicator may be present and a legend using mainly conventional cartographic symbols may be present. Conventional symbols and colours may be used inconsistently. There may still be gaps in fabric of image.</p> | <p>Narrative shows good level of spatial and environmental knowledge. Subject can readily explain any object depicted and narrative includes little extraneous information. Subject can answer prompted questions about maps and conventions of mapping.</p> | <p>Artefact is constructed in orderly sequence and manner but there may still be sequential temporal jumping between the depictions of elements.</p> |

S3B1



Level 5 Reliable map-like image

| What is drawn | What is said | Sequence of construction |
|---|---|--|
| <p>Totally orthogonal orientation but occasional isometric object. Consistent scale used and objects are placed with good level of objective accuracy in spatial order and proximity both within and between clusters. Label words are common and roads are differentiated by size. Limited or no gaps in fabric of image. The major routes and landmarks are labelled. Compass rose or similar directional indicator and legend are present, using only conventional symbols and colours. Artefact is easy to orientate to ground and can be reliably used for way-finding within depicted area, and wider area is identifiable.</p> | <p>Narrative shows high level of Spatial and Environmental knowledge. Subject can readily explain all depicted objects. Narrative includes only relevant information and shows unprompted awareness of uses of maps and conventions of mapping.</p> | <p>Constructed in a visibly coherent and logical sequence, e.g. road network laid out or major landmarks drawn before other elements. Each section is completed before moving onto next section.</p> |

S3B4



6.2 Original contribution to the field

The use of this proposed model may provide some epistemic insights, Hendricks and Symons, (2015) into how children understand and graphically map their physical environment. This model is a significant part of my original contribution to knowledge in this field as it provides a more holistic tool for assessing the survey and environmental knowledge possessed by children about their local physical environments. By collecting verbal data as well as graphic representations the model is able to be used with younger children and by explicitly examining the sequence of construction it enables researchers to investigate the hierarchies of importance in artefact maps regardless of age. By examining what is drawn, in which order and what is said about it during construction of the artefact map, the model enables researchers to investigate in finer detail what children (or adults) know rather than just what they can draw about their environment.

Chapter 7 Conclusion

7.0 Introduction

As an initial observation on all the artefacts and their classification according to the selected theorists, I am reminded of George Orwell's (1937) observation that the terms Working, Middle and Upper class are misleading over-simplifications of complex and diverse realities. By that I mean, that despite their intended use as objective measures, the classifications used are still ultimately somewhat subjective and approximate interpretations, (Kuhn, 1962; Onwuegbuzie, 2002). They are quite broad categories and it is possible to say that each one has a lower, middle and upper end in terms of children's graphical representational ability. My application of these categories to the children's artefacts is also a subjective exercise in pursuit of an objective classification of information which returns me to my ontological position as a Pragmatic researcher.

It was argued by Dewey (1915) that the child must employ certain spatial and graphic conventions in order to be considered to have drawn an artefact that an adult will recognise as a 'map'. Even if these conventions are not formally cartographic they must be at least sufficiently common as to be intelligible to an adult looking at the artefact. This is somewhat problematic, as Lilley (2000) reminds us that a person creating an artefact map is necessarily required to transfer the three dimensional physical landscape onto a two dimensional surface through a process of cognitive choices about what to include and how to represent it.

This task is exacerbated when we consider that the cognitive landscape 'map' is a geographically grounded mental frame through which objects and events in a specific area are assigned coherent meanings based on individual experience of them, (Bruun, 1996). Consequently to be intelligible, a map must use shared symbols to depict spatial relationships and functions which exist as shared meanings between the creator of the map and the person reading it.

This research began with Lynch (1960) who said that a universal spatial typology exists for recording, storing, recalling and depicting spatial knowledge (and probably also environmental knowledge). His work acknowledged the importance of examining the temporal construction order, (though he did not use this term), in order to understand the importance that the individual attached to objects within such a typology. This was the main direction of my research as my hypothesis was that children would prioritise landmarks rather than paths.

7.1 Summary

In all cases in my research, during the first task the children identified that the paper object set before them was an orthogonal view of a portion of the Earth's surface and the majority actually named it by using the word *map*. The majority of children stated their reason for doing so was that the paper showed land as green and rivers as blue, with some children adding that there was a town and roads. It was difficult to locate a suitably scaled unlabelled map at a reasonable level of object definition and so a map from a fantasy game was used. It was accepted by the researcher that the selected image was a medieval rather than modern looking town and included a surrounding wall and a large ziggurat-type structure but this was not expected to present major challenges in the proposed use. In actuality, a number of the children did identify the surrounding city wall as being a ring road. But the oral interaction between researcher and children showed this to be a quite reasonable error of interpretation which might equally confuse any casual adult. The children's mistake was directly derived from their interpretation of a wide grey band surrounding the city as depicting a major ring road and the towers as intersections. This is itself an interesting direction for future research on children and urban environments as it mirrors the concerns of Jacobs (1961) and Dimendberg (1995) about the impact of private motor vehicles on shaping urban fabric and society as well.

The findings of this research were consistent with those of Blades and Spencer (1987b) who found that children aged 4-6 years can fairly easily identify common objects like houses, roads and rivers from an unlabelled cartographic map of a fictional urban area through ability to recognise their conventional symbols.

With respect to the second task, the majority of children (27/40) did indeed draw objects before routes as suggested by the work of Siegel and White (1975) and in many cases the objects were somewhat ego-centric in nature, such as their house, their school or the sea front.

However, this is entirely consistent with the work by Golledge (1978) which proposed that people construct their artefact maps by 'anchoring' it with points of detail and thereafter drawing additional information with reference to those points.

The artefact maps produced by the children were consistent with the work of Dupre and O'Neill-Gilbert (1985) who found significant differences in how urban and rural children constructed artefact maps of their physical environment.

That research found that rural children consistently depicted clear boundaries and emphasised dwellings while urban children tended to depict areas of varying size radiating outward from their own dwelling. The urban artefact maps, both in Dupre and O'Neill-Gilbert (1985) and this original research, tend to emphasise commercial premises and large infrastructure such as hospitals, railway stations etc. These differences are also reflected in the findings of Moore (1973), Hart (1981) and Matthews (1984) as well as that of Karsten (2005), Mitchell, Kearns and Collins (2007), Thommen et al. (2010) and Lehman-Frisch et. al. (2012) and are thought to derive from breadth of independent play range.

There were no significant gender differences in the artefact maps across the three schools except that the average level of detail indicating Environmental knowledge was slightly higher for girls. There were however, notable exceptions though at two schools where individual boys displayed equal or greater levels of such knowledge. From this research, it appears that play range, either independent or accompanied, is indeed a highly significant variable in the development of children's spatial and environmental knowledge.

In general the Environmental Knowledge possessed by the children at all three schools in this study far exceeded the information which would have been extracted by simply taking their artefact maps at face value. This was particularly the case for one boy whose artefact map appeared extremely cluttered and messy. Through the interaction though, it became clear that the level of detail which he possessed about his town in terms of both spatial and environmental knowledge would compare favourably with that of an average adult.

It was argued by Blaut and Blaut (1987) from the work of Mountford and Walsh (1943), Davenport (1960), Spink and Moodie, (1972) and Marshak (1979), that map making behaviour does appear to be a universal human cognitive activity and that it is closely related to use of natural everyday language. They contend that although the maps of young children are not as graphically perfect as an Ordnance Survey map they are nonetheless coherent and purposive utterances, Schiller (1929), by the child about the physical environment. Indeed Blaut and Blaut (1987), argue from Lynch (1960) work that the maps produced by the average adult are not necessarily better than those produced by the average child.

This view is supported by the work of Huynh et al. (2008) with adults sketch mapping. It appears that humans of all cultures, and quite young ages, are all able to reduce the physical environment to a two dimensional artefact in order to convey basic sequential (route), and survey (area layout) knowledge. They do this by using symbols which are common within their culture, and then they support that artefact through the oral delivery of environmental knowledge, (Spencer and Darvizeh, 1983; Spaggiari, 2000; Karsten, 2005; Lehman-Frisch et al., 2012)

7.2 Limitations

This was small scale study involving just 40 children at three primary schools in East Kent in the United Kingdom. The data was collected in just two visits at each site and the data collection was somewhat affected by the distractions to children which are inherent in the final teaching weeks before summer term break. The children were all aged between seven (7) and nine (9) years and were mostly White British in ethnicity. No attempt was made to identify social class amongst the children and only a basic attempt was made to secure equal numbers of children of each gender. Realistically, the sample group could be described as being comprised of the children who assented, from the group whose parents and school had consented. This does not automatically however make it invalid, merely a Convenience Sample, (Newb, 2010).

In this respect, it was noted that the increased UK emphasis on child safety and the impact on pedagogy of increased formal academic testing can make it difficult to obtain access to children in the ways that previous researchers did. The fact that as a male researcher I was not permitted to be alone with children meant that my data collection had to be done in a hallway at each school. This meant that the areas were noisy and had many potential distractions for the children due to people (including groups of other children) walking noisily past in a confined space.

7.3 Directions for future research

7.3.1 Replication of study outside the United Kingdom

It appears useful to replicate this study in contexts where the physical environment and the early childhood (0-8 years) experiences of the children are significantly different. This may be possible in Norway where the education and care regimes are much more child-centric and free ranging. It may also be possible in the mid-western USA where the flat landscape and grid-pattern streets may affect child understandings of the physical environment. Obviously it would be desirable to explore these mapping abilities of non-western children but such research opportunities are more difficult than they were in the 1950-1990 period due to changes in global security and university funding regimes.

7.3.2 Exploration of children's cartographic knowledge through diorama models

It has long been an interest to investigate the ability of children to interpret cartographic information from a 3D model compared to from a normal 2D map as the tactile experience may facilitate their understanding. It is proposed to use plaster and cardboard models of continents on stiff cardboard about 100cm x 60cm. These models will be used in recorded one-to-one interactions to investigate the survey and environmental knowledge that the children have about each continent.

7.3.3 Replication of Task 2 with adults to investigate their ability to construct a free recall sketch map of a known large scale area

It has been suggested by several authors that researchers typically over-estimate the mapping abilities of the average adult just as we tend to underestimate those of the average child. It therefore appears a fruitful line of inquiry to undertake the free-recall sketch mapping task with some groups of adults to generate some baseline data for future research.

7.4 Closing comments

This research sought to learn what children considered worthy of drawing or speaking about when asked to draw a map of their town. That is to say, which places, spaces and things were used by them to define what constitutes their town.

The children in this research, like any person making such a map, made subjective choices and represented their chosen objects imperfectly, but this is natural and to be expected because;

The development of spatial skill involves the ability to use space effectively both to solve problems and to conduct meaningful activity, to be able to communicate this knowledge to others and to learn to use the tools and practices of the culture to do these things. (Gauvain, 1993 p. 114)

Being able to explore the physical environment and to find or create spaces in which to be an individual is vital in the development of a healthy identity for children, adolescents and adults, (Hart, 1979; Moore, 1986; Torell, 1990; Korpela, 1992; O'Brien, James, Sloan and Rustin, 2000; Pooley, Turnbull and Adams, 2003; Page, Cooper, Griew and Jago, 2010; and Zwerts, Allaert, Janssens, Wets and Witlox,, 2010). It seems that being able to identify specific places that link the individual to groups and events is highly significant in defining personal identity across the lifespan, (Cooper Marcus, 1992).

It is not only to individuals that this matters though, because constructive participation in civil society rests upon the individuals understanding of how places and organisations work, (Spencer and Blades, 1993).

This is why more research is needed on how children understand their large-scale physical environments and more effort is needed to develop their geographical understandings and skills during their.

All maps are subjective representations of the complexities of the world and they are by nature a snapshot of a moment in time. They are still useful though, because if a child can determine where they are, then it will be easier to learn where they have come from and where they and their world are going.

Bibliography

Acredolo, L.P., Pick, H.L., and Olsen, M.G. (1975) Environmental differentiation and familiarity as determinants of children's memory for spatial location. *Developmental Psychology*, 11 pp.495-501.

Acredolo, L. (1976) Frames of Reference used by children or orientation in unfamiliar spaces, in Moore, G. and Golledge, R (Eds.) (1976) *Environmental Knowing*. Stroudsburg Pa.: Dowden, Hutchinson and Ross.

Acredolo, L.P. and Boulter, L.T. (1984) Effects of hierarchical organisation on children's judgements of distance and direction, *Journal of Experimental Child Psychology*, 37 pp.409-425

Alanen, L (1992) *Modern Childhood ? Exploring the Child Question in Sociology*. Publication Series A, Research Report, Institute for Educational Research. Tutkimuksia, Finland.

Alexander, R.J. (2009) *Children, their World, their Education* Final Report and Recommendations of the Cambridge Primary Review, London: Routledge

Andrews, H.F. (1973) Home Range and Urban Knowledge of School-age Children, *Environment and Behavior*, 5, (1) pp. 73-86

Annett, M (1992) Spatial Ability in sub-groups of left and right handers. *British Journal of Psychology*, 83, (4) pp.493-515

Anning, A. and Ring, K. (2004) *Making Sense of Children's Drawings*. Berkshire: Open University/ McGraw-Hill.

Appleyard, D., Lynch, K. and Myer, J.R. (1964) *The View From the Road*. Cambridge Massachusetts: MIT Press.

Appleyard, D. (1969) Why buildings are known: a predictive tool for architects and planners. *Environment and Behaviour*, 1, pp.131-156.

Appleyard, D (1970) Styles and methods of structuring a city, *Environment and Behaviour*, 2, pp.100-117

Arendt, H (1954) The Crisis in Education, in Arendt, H (1958) *Between Past and Future: Eight exercises in political thought*. London: Penguin Classics. (pp. 170-193)

Atkins, C.L. (1981) Introducing basic map and globe concepts to young children. *Journal of Geography*, 80, pp.228-233.

Bacon, F (1620) *Novum Organum*. <https://www.gutenberg.org/files/45988/45988-h/45988-h.htm> accessed 1450hrs 13 Aug 2018

Beck, R.J. and Wood D. (1976) Cognitive transformation of information from urban geographic field to mental maps. *Environment and Behaviour*, 8, pp.199-208.

Berland, J.C. (1977) *Cultural amplifiers and psychological differentiation among Khanabadosh in Pakistan*. Unpub. Doctoral Dissertation: University of Hawaii

Bernhard, J (1939) The neighbourhood behaviour of school kids in relation to age and socio-economic status, *American Sociological Review*, 4, pp.652-662.

Blades, M and Spencer, C (1987a) Map use by young children. *Geography*, 71, pp. 47-52.

Blades, M and Spencer, C (1987b) Young children's strategies when using maps with landmarks. *Journal of Environmental Psychology*, 7, pp. 201-208.

Blades, M and Spencer, C (1987c) Young Children's Recognition of Environmental features from aerial photographs and maps, *Environmental Education and Information* 6 pp.189-198

Blades, M. and C. Spencer, C. (1990) The development of 3- to 6-year-olds' map-using ability: The relative importance of landmarks and map alignment. *Journal of Genetic Psychology* 151 pp. 181-94.

Blades, M., Blaut, J., Darvizeh, Z., Elgua, S., Sowden, S., Soni, D., Spencer, C., Stea, D., Surajpal, R and Uttal, D. (1998) A Cross-cultural study of Young Children's Mapping Abilities, *Transactions of the Institute of British Geographers*, 23 (2) pp.269-277

Blaut, J.M, McCleary, G.F and Blaut, A.S. (1970) Environmental Mapping in Young Children, *Environment and Behavior*. 2 (3)

Blaut, J.M and Blaut J (1987) Notes Toward a Theory of Mapping Behavior, *Children's Environments Quarterly*, 4, (4), pp. 27-34

Blaut, J.M. (1991) Natural Mapping, *Transactions of the Institute of British Geographers* 16 (1) pp. 55-74

Blaut, J.M. and Stea, D. (1997a) The Mapping Abilities of Young Children: Children Can. *Annals of the Association of American Geographers*, 87, (1), pp. 152-158.

Blaut, J.M. and Stea, D.(1997b) Piagetian Pessimism and the Mapping Abilities of Young Children: A Rejoinder to Liben and Downs. *Annals of the Association of American Geographers*, 87 (1), pp.168-177.

Blaut, J.M., Stea, D., Spencer, C and Blades, M. (2003) Mapping as a Cultural and Cognitive Universal, *Annals of the Association of American Geographers*, 93 1) 165-185

Bluestein, N. and Acredolo, L. (1979) Developmental Changes in Map Reading Skills *Child Development* Vol. 50 pp. 691- 697

Boardman, D. (1989) The Development of Graphicacy: Children's Understanding of Maps, *Geography*. 74 (4) pp. 321-331

Boas, F (1911) *The Mind of Primitive Man*. London. Macmillan and Co.
<https://ia801403.us.archive.org/4/items/mindofprimitivem031738mbp/mindofprimitivem031738mbp.pdf> : Accessed 23 April 2016

Bonawitz, E.B., Van Schindjel, T.J.P., Friel, D and Schulz, L (2010) Children balance Theories and Evidence in Exploration, Explanation and Learning, *Cognitive Psychology* Vol 64 (4) pp 215-234

Bowerman, M. (1989). Learning a semantic system: what role do cognitive predispositions play? In M.L. Rice & R.L. Schiefelbusch (Eds.), *The teachability of language* (pp. 133-169). Baltimore: Paul H. Brookes.

Bronfenbrenner, U (1977) *The ecology of human development*. Boston Massachusetts. Harvard University Press

Brotton, J. (2012) *A History of the World in Twelve Maps*. London. Penguin.

Bruner, J (1986) *Actual Minds; Possible Worlds*. Cambridge, Massachusetts. Harvard University Press

Bruun, H. (1996) *Environment and meaning: Toward a theory of cognitive mapping*. Paper presented at International Nordic Conference in Human Ecology, Stromstad, Sweden.

Bryant, K.J. (1982) Personality correlates of sense of direction and geographical orientation. *Journal of Personality and Social Psychology* 43(6) pp.1318-1324

Bryant, K.J. (1991) Geographical/Spatial orientation ability within real world and simulated large-scale environments. *Multivariate Behavioral Research* 26(1) pp. 109-136

Buchsbaum, D., Gopnik, A., Griffiths, T.L. and Shafto, P. (2010) Children's Imitation of Causal Action Sequences is Influenced by Statistical and Pedagogic Evidence, *Cognition* Vol. 20 (3) pp. 331-340

Burton, N. and Brundrett, M. (2005) *Leading the Curriculum in the Primary School*. London: Paul Chapman.

Bustamante, T. (2011) Comment on Petroski: On MacCormick's Post-Positivism. *German Law Journal*, 12 (2), pp.693-728

Catling, S.J. (1979) Maps and Cognitive Maps: The Young Child's Perception. *Geography*, 64 (4) pp. 288-296

Choi, S., & Bowerman, M. (1991). Learning to express motion events in English and Korean: the influence of language-specific lexicalization patterns. *Cognition*, 41, 83-121.

Clough, P. and Nutbrown, C. (2002) *A Student's Guide to Methodology*. London: Sage.

Cole, M and Griffin, P. (1980) Cultural Amplifiers Reconsidered, in Olson, D.R. (Ed) (1980) *The Social Foundations of Language and Thought: Essays in honour of Jerome S. Bruner*. London. W.W. Norton

Cooper-Kahn, J and Dietzel, L.C. (2008) *Late, Lost and Unprepared: A Parents' guide to helping children with Executive Function*. Bethesda Maryland USA, Woodbine House

Cooper Marcus, C.C. (1992) *Environmental Memories*, in Altman, I and Low, S.M. (Eds.) (1992) *Place Attachment: Human Behavior, Advances in Theory and Research*. New York, Plenum

Coluccia, E., and Louse, G (2004) Gender differences in spatial orientation: A Review. *Journal of Environmental Psychology* 24 pp.329-340

Cosgrove, D (2007) Mapping the World, in Akerman, J.R. and Karrow, R.W. (Eds.) (2007) *Maps: Finding our Place in the World*. Chicago, University of Chicago Press pp. 65-115

Craik, K.H. (1969) The Comprehension of the everyday physical environment, *Journal of the American Institute of Planners*, 34 pp. 29-37

Crotty, M. (1998) *The Foundations of Social Research*. St. Leonards NSW, Australia: Sage.

Cullen, G (1961) *The Concise Townscape*. London Routledge/Architectural Press

Patrick Meehan 2018

Dale, P.F. (1971) Children's Reaction to maps and aerial Photographs, Area (3) pp.170-177

Danforth, N (2014) *How the north ended up on top of the map.*

<http://america.aljazeera.com/opinions/2014/2/maps-cartographycolonialismnortheurocentricglobe.html> accessed 09 May 2017

Darvizeh, Z. and Spencer, C.P. (1984) How do young children learn novel routes? The importance of landmarks in the child's retracing of routes through the large-scale environment. *Environmental Education and Information* 3 pp. 97-105

Davenport, W. (1960). Marshall Islands navigational charts. *Imago Mundi* pp 15 -19

Daviola, M and Ferri G (Eds) (2000) *Reggio Tutta: A Guide to the City by the Children.* Reggio Emilia, Italy. Reggio Children SRL.

DeGrasse-Tyson, N (2016) Twitter 4.03pm 5th February 2016

Denzin, N. and Lincoln, Y. (Eds) (2003) *The Landscape of Qualitative Research: Theories and Issues.* California, USA. Sage

Derrida, J (1997) *On Grammatology.* Baltimore, Maryland. Johns Hopkins University Press

Dewey J (1910) *How we think.* Boston D.C. Heath and Co. (Current Edition – 1998 Houhoughton-Mifflin)

Dewey J (1915) *The School and Society, The Child and the Curriculum*. Chicago. University of Chicago Press.

Dewey, J. (1938), *Logic: The Theory of Inquiry*, Henry Holt and Company, New York, NY. Reprinted, pp. 1–527 in Boydston, J.A., Poulos, K. and Nagel, E. (Eds.), (1986) *John Dewey, The Later Works, 1925–1953*, Volume 12: 1938, Carbondale and Edwardsville, Illinois. Southern Illinois University Press,

Diamond, J (1998) *Guns, Germs and Steel: A Short History of Everybody for the last 13,000 years*. New York. Vintage.

Dimendberg, E. (1995). The Will to Motorization: Cinema, Highways, and Modernity: For Wolf Donner, in Memoriam. *October*, 73, 91-137. doi:10.2307/779010

Donaldson M. (1978) *Children's Minds*. London. Fontana

Downs, R.M. and Stea, D.(1977) *Maps in Mind*. New York Harper and Row

Downs, R.M and Siegel, A.W (1981) On mapping researchers mapping children mapping space, in Liben, L., Patterson, A.H and Newcombe, N (Eds) *Spatial Representation and Behaviour across the life span*. New York. Academic Press.

Dupre, A.and O'Neill-Gilbert, M. (1985) Town and City children's macro-space cognitive representation: A comparative study. *Children's Environments Quarterly* 2 pp. 27-33

Eals, M and Silverman, I. (1994) The Hunter-Gatherer Theory of spatial sex differences: Proximate factors mediating the female advantage in recall of object arrays. *Ethology and Sociobiology* 15 (2) pp.95-105

Eckert, M and (Trans) Joerg, T (1908) On the Nature of Maps and Map Logic, *Bulletin of the American Geographical Society*, 40 (6) pp. 344-351

Edwards, C., Gandini, L and Forman, G (Eds) (2012) *The Hundred Languages of Children; The Reggio Emilia Experience in Transformation*. Santa Barbara, California. Praeger

Efland, A. (2004) Emerging Visions of Art Education, in Eisner, E. and Day, M. (2004) *Handbook of Research and Policy in Art Education*. New Jersey USA: National Art Education Association (NAEA). pp. 601-700.

Einarsdottir, J (2007) Research with Children: methodological and ethical challenges, *European Research Journal* 15 (2) pp.197-211

Elden, S. (2012) Inviting the messy: Drawing methods and 'children's voices', *Childhood* 20 (1) pp. 66-81

Evens, T. M. S. and Handelman, D. (Eds.) (2006) *The Manchester School: Practice and Ethnographic Praxis in Anthropology*. Oxford. Berghahn Books,

Farley, J (1977) *Effects of residential settings, parental life styles and demographic characteristics on children's activity patterns*. Doctoral Dissertation. University of Michigan.

Fenna, D (2006) *Cartographic Science: A compendium of map projections with derivations*. Boca Raton Florida, USA. CRC Press

Patrick Meehan 2018

Findlay, L (2002) "Outing" the Researcher: The Provenance, Process, and Practice of Reflexivity, *Qualitative Health Research* 12 pp. 531-545

Foucault, M (1970) *The Order of Things: An Archaeology of the Human Sciences*. London. Pantheon.

Froebel, F. (1826) *The Education of Man*. Current edition – Trans and annotated by Hailmann, W.N. Mineola New York USA. Dover Publications.

Fromm, E (1941) *Escape From Freedom*. New York. Henry Holt.

Galea, L.A.M. and Kimura, D (1993) Sex differences in route learning. *Personality and Individual Differences* 14 (1) pp.53-65

Gardner, H (1983) *Frames of Mind: The Theory of Multiple Intelligences*. New York. Basic Books

Gardner, H (2011) *The Unschooled Mind: How Children Think and How Schools Should Teach*. New York. Basic Books

Gaster, S. (1991) Urban children's access to the neighbourhood: changes over three generations, *Environment and Behavior*, 23(1), (pp.70–85)

Gauvain, M and Rogoff, B. (1986) 'Influence of the goal on children's exploration and memory of large-scale space.' *Developmental Psychology* 22 No. 1 pp 72-77

Gauvain, M (1992) 'Sociocultural Influences on the Development of Spatial Thinking.'
Children's Environments 9 No. 1 pp 27-36

Gauvain, M (1993) The development of spatial thinking in everyday activity,
Developmental Review 13 pp. 92-121

Geary, D.C. (1995) Reflections of evolution and culture in children's cognition:
Implications for mathematical development and instruction. *American Psychologist*
50 pp.24-37

Geeslin, W.E., and Shar, A.O. (1979) An alternative model describing children's
spatial preferences. *Journal of Research in Mathematics Education* 10 pp.57-68

Gerber R.V. (1981) Competence and Performance in Cartographic Language, *The
Cartographic Journal* 18 (2) pp. 104-111

Gibbs, R.W., Costa Lima, P. and Francozo, E. (2004) Metaphor is grounded in
embodied experience. *Journal of Pragmatics* 36 pp.1189-1210

Gibson, J. J. (1979) *The ecological approach to perception*. Hillsdale, NJ. Lawrence
Erlbaum.

Gillespie, C.A. (2010) How Culture Constructs Our Sense of Neighborhood: Mental
Maps and Children's Perceptions of Place, *Journal of Geography*, 109 (1) pp. 18-29

Glaser, B and Strauss, A.L (1967) *The Discovery of Grounded Theory*. Chicago,
Aldine

Glaeser, A (2005) An Ontology for the Ethnographic Analysis of Social Processes: Extending the Extended-case method. *Social Analysis: The International Journal of Social and Cultural Practice*, 49(3), pp.16-45

Schiller, F.C.S. (1929) *Logic for Use; an introduction to the voluntarist theory of knowledge*. London, G. Bell & Sons, Ltd.

Sechrest, L., & Sidani, S. (1995). Quantitative and qualitative methods: Is there an alternative? *Evaluation and Program Planning*. 18 pp.77–87.

Shaw, B., Bicket, M., Elliott, B., Fagan-Watson, B., Mocca, E and Hillman, M (2015) *Children's Independent Mobility: An International Comparison and Recommendations for Action*. London. Policy Studies Institute.

Sherman, J. (1978) *Sex-related Cognitive Differences*. Springfield Illinois. Charles C Thomas

Sidaway, J.D. (1992) In Other Worlds; On the Politics of Research by 'First World' Geographers in the 'Third World', *Area* 24 (4) pp 403-408. London. Royal Geographical Society (with the Institute of British Geographers)

Sieber, S. D. (1973) The integration of fieldwork and survey methods, *American Journal of Sociology*. 73, pp.1335–1359.

Siegal, A.W. and White, S. (1975) The development of spatial representations of large-scale environments, in Reese, H.W. (Ed) ((1975) *Advances in Child Development and Behavior*. 10. New York, Academic Press

Siegal, A.W. (1982) Toward a social ecology of cognitive mapping, in Cohen, R. (Ed.) (1982) *Children's conceptions of spatial relationships*. pp. 83-94 San Francisco, California Jossey-Bass

Silverman, I and Eals, M (1992) Sex Differences in Spatial Abilities: Evolutionary Theory and Data, in Barkow, H., Cosmides, I., and Tooby, J (Eds) (1992) *The Adapted Mind*. New York

Smith, M. & Bowers-Brown, T. (2010) Different Kinds of Qualitative Data Collection Methods, in Dahlberg, L. & McCaig, C. (Eds) (2010) *Practical Research and Evaluation: A Start-to-finish Guide for Practitioners*. London: Sage. Pp.111-125.

Spaggiari, S. (2000) Children and Cities, in *Reggio Tutta*, Reggio Emilia, Reggio Children

Spencer, C.P, Harrison, N and Darvizeh, Z. (1980) The development of iconic mapping in young children. *International Journal of Early Childhood* 12 pp. 57-64

Spencer, C.P. and Darvizeh, Z. (1981a) The case for developing a cognitive environmental psychology that does not underestimate the abilities of young children, in *Journal of Environmental Psychology* 1 pp.21-31

Spencer, C.P. and Darvizeh, Z. (1981b) Young Children's descriptions of their local environment: a comparison of information elicited by recall, recognition and performance techniques of investigation, in *Environmental Education and Information* 1 pp.275-284

Spencer, C.P. and Darvizeh, Z. (1983) Young children's place descriptions, maps and route-finding: A comparison of nursery school children in Iran and Britain. *International Journal of Early Childhood* 16 pp. 26-31

Spencer, C, Blades, M. and Morsley, K (1989) *The Child in the Physical Environment*. New York. John Wiley and Sons

Spencer, C and Blades, M (1993) Children's understanding of places: The world at hand. *Geography* 78(4) pp.367-373

Spencer C.P. and Weetman, M. (1981) The microgenesis of cognitive maps: a longitudinal study of new residents of an urban area *Transactions of the Institute of British Geographers* 6 pp. 375-384

Spink, J., and Moodie, D. (1972). Eskimo Maps from the Canadian Eastern Arctic. *Cartographica*, Monograph 5.

Spyrou, S (2011) The Limits of children's voice: From authenticity to critical reflexive representation, *Childhood* 18(2) pp.151-165

Stea, D., and Blaut, J. 1973. Notes toward a developmental theory of spatial learning. In Downs, R. (Ed.) (1973) *Image and environment: Cognitive mapping and spatial behaviour*. pp. 51–62. Chicago. Aldine.

Stevens, A and Coupe, P. (1978) Distortions in Judged Spatial Relations, *Cognitive Psychology* 10 pp. 422-437

Stubbs, S. (1999) *Engaging with Difference : Soul-searching for a methodology in disability and development research*. in Stone, E. (Ed.) (1999) *Disability and Development : Learning from Action and Research on Disability in the Majority World*. Leeds. The Disability Press.

Taylor, H and Tversky, B (1992) Descriptions and depictions of environments. *Memory and Cognition* 20 (5) pp 483-496

Thomas, G. & James, D. (2006) 'Reinventing grounded theory: some questions about theory, ground and discovery', *British Educational Research Journal*, 32 (6), pp.767-795.

Thomas, N and O'Kane, C (1998) The Ethics of Participatory Research with Children, *Children and Society* 12 pp336-348

Thommen,E., Avelar,S., Zbinden Sapin, V. , Perrenoud, S.and Malatesta, D. (2010) Mapping the journey from home to school: a study on children's representation of space, *International Research in Geographical and Environmental Education*, 19 (3) pp.191-205

Thomson, P (Ed) (2008) *Doing Visual Research with Children and Young People*. Abingdon, Oxfordshire, Routledge

Thralls, Z.A. (1958) *The Teaching of Geography*. New York Appleton-Century-Crofts

Tindal, M. (1971) *Home-range of black elementary school children*. Place Perception Reports, No. 5, Clarke University

Tolman, E.C. (1948) Cognitive maps in rats and men, *Psychological Review* 55 pp. 189-208

Torell, G (1990) Children's conception of large scale space. *Goteborg Psychology Reports* 20

Trieb, M (1980) Mapping Experience. *Design Quarterly*, 115. pp. 1-32

Patrick Meehan 2018

Trowbridge, C.C. (1913) On fundamental methods of orientation and imaginary maps. *Science, New Series* 38 (990) pp.888-897

Tversky, B (1981) Cognitive maps, cognitive collages and spatial mental models
Journal of Experimental Psychology Human Learning and Memory 7 pp.15-32

United Nations Convention on the Rights of the Child (1989)

https://downloads.unicef.org.uk/wp-content/uploads/2010/05/UNCRC_united_nations_convention_on_the_rights_of_the_child.pdf Accessed 1100hrs GMT 13th Aug 2018

Valentine, G. and McKendrick, J. (1997) Children's outdoor play: exploring parental concerns about children's safety and the changing nature of childhood, *Geoforum*, 28 (2), (pp.219–235)

Vanselow, G. W. (1974) On the Nature of Spatial Images, *Proceedings of the Association of American Geographers* 6 pp. 11-14

Van Vliet, W (1983) Exploring the fourth environment: an examination of the home range of city and suburban teenagers, in *Environment and Behavior* 15 pp. 567-588

Villanueva, K., Giles-Corti, B., Bulsara, M., Timperio, A McCormack, G., Beesley, B., Trapp, G and Middleton, G. (2013) Where do children travel to and what local opportunities are available?: The relationship between neighbourhood destinations and independent mobility. *Environment and Behaviour* 45 pp.679-706

Wallace, J.R. and Almy, T.L. (1999) Do Children's Maps differ for Younger and Older Friends? *The Journal of Genetic Psychology* 160(1) pp.89-98

Patrick Meehan 2018

Walker, R and Solvason, C (2014) *Success with your Early Years Research Project*. London, Sage

Ward, C. (1978) *The Child in the City*. London. Bedford Square Press

Webley, P (1981) Sex differences in home range and cognitive maps in eight year old children. *Journal of Environmental Psychology* 1 pp. 293-302

Weindling, P. (2001) The Origins of Informed Consent: The International Scientific Commission on Medical War Crimes and the Nuremberg Code. *Bulletin of the History of Medicine* 75 (1) pp. 37–71

Weigand, P. (1999) Children's Understanding of Maps, *International Research in Geographical and Environmental Education*, 8 (1) PP. 66-68

Weinstein, C. (1979) The physical environment of the school: a review of the research. *Journal of Elementary Psychology* 2 pp.23-36

Weizenbaum, J. (1976) *Computer Power and Human Reason; From Judgement to Calculation*. New York. W.H. Freeman and Company.

Werner, H. (1957) 'The concept of development from a comparative and organismic point of view' in Harris, D.B. (Ed) (1957) *The Concept of Development* Minneapolis University of Minnesota

Whewell, W (1847) *The Philosophy of the Inductive Sciences, Founded Upon Their History*, 2nd edition, in two volumes, London: John W. Parker.

Wood, D (1992) How Maps Work, *Cartographica* Vol 29 (3) pp 66-74

Wood, D (2010) *Rethinking the power of maps*. New York, The Guildford Press

Patrick Meehan 2018

Woodward, D., and Lewis, G.M (1998) The history of cartography. Vol. 2, book 3, *Cartography in the traditional African, American, Arctic, Australian, and Pacific societies*. Chicago. University of Chicago Press.

Zwerts, E., Allaert, G., Janssens, D., Wets, G and Witlox, F (2010) How Children view their travel behaviour: A case study from Flanders (Belgium). *Journal of Transport Geography* 18 pp.702-710

Appendices

A – Ethics Proposal

B – Ethics Approval

C – Letter to Schools

D – Letter to Parents

E – Map of fictitious town, used for Task 1 child interpretation

F – Artefact maps by children

Appendix A Ethics Proposal



Canterbury Christ Church University Guidelines for the EdD Research proposal

| | |
|--|-------|
| Name: Patrick Meehan | Words |
| Heading <i>"Draw me a map of your town" : Exploring children's mapping skills</i> | |
| [1] Topic <i>An investigation of the construction of a free-recall hand-drawn map of a known physical environment by young children to examine the selection and depiction of objects, and their spatial orientation, distribution and scaling with respect to Lynch (1960) spatial typology.</i> | 37 |
| [2] Location Research will be carried out in a primary school in Kent, UK after a school has been chosen from several schools in the East Kent and Medway Towns area with similar student and familial demographics. The Head Teachers of several such schools will be contacted and a school chosen based on positive response to enquiry and proximity for Canterbury-based researcher. | 40 |
| [3] Research questions <ol style="list-style-type: none"> 1. What physical objects and spatial relationships do children aged 7-8 years include in their map when drawing a free-recall map of a known physical environment? 2. To what extent do these maps exhibit the spatial typology proposed by Lynch (1960)? 3. How accurate are these maps when compared to a satellite image of the same area? 4. 'How useful are spatial typology models from the literature (for example Lynch, 1960; Moore, (1973), Hart, (1981) and Matthews, (1984) for interpreting and understanding children's map drawings?' <p>The research seeks to examine what children choose to depict, and how they depict it when given an open ended instruction about an environment that they may be assumed to be reasonably familiar with, namely the area where they live. This will be tested via the pilot study and modified if child responses seem to require clarification of the instruction.</p> <p>The theoretical model offered by Lynch (1960) assumes that children will construct maps which display a universal and identifiable spatial typology derived from how space is understood by human beings. However, this proposed understanding of space by children appears to be contradicted by Siegel and White (1975) and Spencer and Darvizeh (1983) and this research seeks to examine that disjuncture through discussion with the children during the construction of their maps. The work of Moore (1973), Hart (1981) and Matthews (1984) provides three different methods of categorising and analysing the objects drawn by the children in response to a similar open ended instruction. The newest of those methods is 31 years old and it is suspected that some differences in child mapping may be discernible in contemporary drawings.</p> | 50 |

| | |
|--|-----|
| <p>[4] Importance</p> <p>Explain (a) why the research is important, (b) how it relates to existing discussions, and (c) what makes it sufficiently broad, deep and original for MPhil/PhD/EdD work</p> <p><u>This research is justified on the following grounds:</u></p> <p>This research investigates the continued application of the landmark study by Lynch (1960) which assumed that people's spatial typology begins with networks of routes upon which landmarks are then identified. In terms of child cognition this seems contradicted by Siegel and White (1975) who suggested that for children the opposite may be true. They argue that children identify visible landmarks along a route and thereafter recall the route through those landmarks. The study is to be with contemporary 8 year old children through an activity similar to Moore (1973), Hart (1981) and Matthews's (1984) use of free-recall sketch maps depicting a known environment. This is significant because as was argued by Siegel (1982) most studies on child cognitive mapping have been in comparatively small scale space (e.g. laboratory or inside a school building) and used tasks divorced from concrete daily experiences of children. This is significant because the work of Neisser (1976) and Spencer and Darziveh (1983) clearly showed that children can usually both walk a route and successfully describe it to a stranger even if they are unable to draw a recognisable map of it.</p> <p>The work of Piaget and Inhelder (1967) presented children between 4-8 years as capable of understanding and depicting a known route in a familiar large scale environment by using models. That research seems consistent with Harley and Woodward (1987) assertion that the desire to order and depict information about their physical environment is a universal human trait. It seems supported by the work of Blaut, Stea, Spencer and Blades (2003) who found that the selective ordering, storage and recall of such information does occur even in young children. However the work of Matthews (1992) questions the existence of mental versions of the artefacts we call 'maps' and the work of Evans (1980), and Downs and Siegel (1981) suggests that even adult mental 'maps' of large scale space are much more like approximate metaphors than objective depictions of physical space.</p> <p>The work of Moore (1973), Hart (1981) and Matthews's (1984) all provide systems for classification of objects drawn by the children in response to the instructional task. All three theorists make assumptions about the children's understanding of space based on the style of map constructed and while they all show awareness of differences between children's cognitive understanding and representational abilities these are worthy of further exploration via the proposed discussions with each child.</p> <p>It was demonstrated by Gauvain and Rogoff (1986) and supported by Spencer and Blades (1993) that activity goal is a key determinant in children's ability to recall and depict both layout and route information within large scale space. Those findings then lend support to the conclusions of Neisser (1976) and Spencer and Darziveh (1983).</p> <p>This original research therefore seeks to :</p> <ol style="list-style-type: none"> 1. Compare the accuracy of the children's free-recall hand-drawn maps of a known large scale environment with a satellite image of the same area in order to see whether or Lynch's (1960) spatial typology is actually discernible. 2. Classify the children's free-recall hand-drawn maps of a known large scale environment using the three main systems of classification for child maps, namely Moore, (1973), Hart, (1981) and Matthews, (1984). 3. Examine the mental processes by which the children construct the artefact 'maps' from their internal cognitive 'maps' with respect to points 1 & 2 <p>Given the passage of time and numerous changes to the human world since these spatial typologies were initially investigated, it is suspected that changes in child cognition may be discernible in their artefact 'maps'. As such the research will be cognizant of debates in several disciplines regarding child cognition, and representational abilities, object selection, spatial distribution, orientation and scale.</p> | 200 |
|--|-----|

| | |
|--|-----|
| <p>[5] Literature</p> <p>Several pieces of research on children’s free hand mapping of known routes were done between 1973- 1987 exploring the Piagetian aged-based linear development of child cognition about space and way-finding. Their general finding was that Piagetian views were an incomplete understanding of these phenomena. This proposed research seeks to examine contemporary children’s representation of their local physical environment in terms of Lynch’s (1960) spatial typology via the medium of free-recall hand-drawn maps of a known physical environment. These maps will be compared to the Moore (1973), Hart (1981) and Matthews (1984) typologies of children’s maps.</p> <p>As such it is necessary to draw upon literature about the ways that humans make, interpret and use maps both as cognitive process and as physical artefacts. This will involve literature on how maps are understood by children and adults as methods of storing and communicating information and of ordering the experienced world. Piaget and Inhelder (1967), Robinson and Petchenik (1976) and Gerber (1981).</p> <p>These discussions will examine categorisations of space and the diverse skills required of a child (or adult) in order to construct a two dimensional representation of three dimensional space in a comprehensible form. Ward (1978), Beck and Wood (1976), Downs (1985), Matthews (1992), Gauvain (1992)</p> <p>This will require a more general discussion about the nature of the world as rationale and knowable, which is to say predictable rather than arbitrary as a set of experienced phenomena. Nichols and Yaffe (2014), Sissons Joshi et al. (1999), Blaut et al (2003) Blades and Spencer (1990). It will also be necessary to draw on literature about children’s performance of drawing tasks in general, especially within a school setting and to consider the effects of age, gender, class and ethnicity upon their performance, Kulhavy and Stock (1996), Mitchell (2006), Lehman-Frisch et al (2012), Elden (2012).</p> | 400 |
| <p>[6] Methodology</p> <p>The research approach adopted is an examination of the understanding, depiction and articulation of aspects of the physical environment by children aged 6-8 years considering Vygotsky (1978), Piaget and Inhelder (1967), Donaldson (1978), Moore (1973), Hart (1984) and Matthews (1992). It will ideally consist of a pilot study with four (4) children, followed by single instance visit to a primary school in the East Kent and Medway Towns area of Kent, United Kingdom. Should this process fail to generate sufficient participants it will be necessary to approach additional schools.</p> <p>The research will involve approximately a dozen children, in a ten (10) minute exercise with each child individually constructing a free-recall hand sketch hand map in response to the instruction “Draw me a map of your town.” whilst talking with the researcher about it. Ideally this will be undertaken in a separate room so as not to interfere with classroom teaching but it will need to be negotiated with teacher, head teacher and parents so as to address child safety concerns and to minimise loss of teaching time.</p> <p>The use of video-recording will permit interaction between the child and the researcher to clarify meaning of objects depicted and other aspects of the child’s cognition during the task. It will also allow for subsequent additional analysis to avoid missing data due to researcher being too involved in the situation.</p> <p>The data collection site will be chosen using <i>Convenience Sampling</i>, (Newby, 2010) based upon which of the invited schools respond to the invitation to participate in the research and the individual children will similarly be chosen based upon which parents and children consent to the invitation. In the event that this process fails to obtain the required responses it may be necessary to approach additional schools. This is a form of non-probability sampling and as such is not universally generalisable to children of this age in respect of the specified task.</p> | 600 |

| | |
|--|------------|
| <p>It is however sufficient to test whether the spatial typology proposed by Lynch (1960) is in fact discernible within the child maps. Similarly it should permit the observation of whether any or all of the three major systems Moore (1973), Hart (1981) and Matthews (1984), for the classification of children's map making are present in contemporary child maps. The study itself is being conducted in this way as it is similar to the sampling methods used by Moore (1973) Hart (1981) and Matthews (1984) in the construction of their classification systems.</p> <p>This research investigates issues around the suggestion by Lynch (1960) that a universal spatial typology exists and can be discerned in free-recall sketch maps, Spencer and Darvizeh (1983), Matthews (1992). The research accepts a priori that all maps are approximate metaphors for, rather than objective depictions of, the physical world and this is why discussion with the children during construction of the maps is desired. Schouela et al (1980) and Downs and Siegel (1981), Gibbs Jnr et al (2003)</p> <p>The instruction <i>“Draw me a map of your town”</i>, enables us to examine four aspects which I believe are likely to illustrate the spatial cognition of children. These aspects are :</p> <ul style="list-style-type: none"> • To what extent can the 3D world can be represented in a 2D way to communicate information by children of this age? • To what extent do children of this age understand maps as a rational pictorial form of communication? • What objects from the physical world are chosen to be encoded and decoded as rational information by children of this age? • To what extent does encoding and decoding this information require the child to employ a symbolic language either oral or physical, which they share with other users of the map if it is to be intelligible? <p>Whilst the maps themselves will answer the questions regarding Lynch (1960) and Moore (1973), Hart (1981) and Matthews (1984), it will only be possible to address the above aspects through discussions with the children. This is significant as both Siegel and White (1975) and Spencer and Darvizeh (1983) found that children appear to construct their mental maps by initially using (often ephemeral or experiential), landmarks to construct routes rather than in the manner theorised by Lynch (1960)</p> <p>Site selection is intended to be completed by February 2016. Collection of data to be completed by April 2016 with the analysis of data and construction of dissertation for submission to be completed by December 2016.</p> | |
| <p>[7] Arrangements and access</p> <p>It is intended to contact approximately six (6) primary schools in the East Kent and or Medway Towns area to invite the Head Teacher to discuss my proposed research aims and methods. I will select one of the Head Teachers who responds positively and will write to parents at that school seeking consent for their children to participate in the research. One of these schools will be used for the pilot study and a different school for the research itself.</p> <p>When a sample group of approximately twelve (12) children is obtained I will visit the school and brief the Head Teacher and Class Teacher on the proposed method of data collection.</p> <p>With approval from Head Teacher and Class Teacher I will arrange a day to attend and collect my data. I will utilise a digital video-camera from School of Childhood and Education Studies to record the daily activities.</p> <p>Consent from parents will be required in order to video record the children completing the task</p> <p>On the day of data collection explicit assent to participation in the research will be sought from each proposed child participant consistent with Article 10 (1) European Convention on Human Rights 1950 and Article 12 United Nations Convention on the Rights of the Child 1989.</p> | <p>200</p> |

| | |
|--|-----|
| <p>[8] Timed objectives</p> <p>Subject to approval by Ethics Committee it is intended to approach a number of Kent schools between November 2015 and January 2016 and to select one by February 2016 to use for data collection. With the school tentatively selected it will be necessary to write to the parents of the chosen class group and to attempt to gain a suitable sample group. Ideally the sample group will be approximately twelve (12) students with half of each gender. This however is beyond the control of the researcher and adjustments may be required.</p> <p>In the event that sufficient parents at the selected school do not consent then it may be necessary to contact a reserve school and repeat the request to parents in order to obtain the desired sample group size. In that event it will obviously complicate the data analysis and this will take additional time, probably in the order of two months.</p> <p>It is intended to complete data collection by 30 April 2016 but depending upon the above considerations this may take until June 2016</p> <p>Subject to previous comments, it is intended to complete analysis of data and construction of dissertation by 31 December 2016.</p> | 300 |
| <p>[9] Ethics, Police and Occupational Health Clearance</p> <p>Will your research involve human participants as your research subjects? Yes</p> <p>Disclosure – In any interaction with children the possibility of having them disclose some form of abuse can never be totally eliminated. However, by constructing the interaction in particular ways the likelihood of this occurring can be minimised. Therefore the onus is upon the researcher to familiarise themselves with the child protection policies of the UK and also of the particular setting or school in which they are conducting research disclosure. In this manner if disclosure did occur or cause for concern was identified then the researcher would be competent to contain that information and refer it to the nominated child protection officer for the setting or to police. Given my professional experience of interaction with children as a Community Policing Officer, School Based Policing Officer and Child Sexual Offences investigator I am confident of my ability to source appropriate policy documents and locate appropriate persons in any setting where I propose to interact with children. This experience also will guide my data collection activities which in any case will most likely be overseen by a teacher or carer during each session.</p> <p>Anonymity – Given that the views of specific individuals are not a goal of this research it is required by BERA Guidelines that all research subjects be rendered anonymous in the final version of the work. It would also be good professional practice to anonymise the research subjects as early as possible in the research through a coding system (e.g. Boy A, Girl C etc.) and to thereafter refer to the subjects only by such code.</p> <p>Data storage – although this proposed research is not seeking data which is in any way sensitive or personal it is still an important principle that all research documents be stored securely and access to the raw information kept to a verifiable number of persons who have right and reason to possess it. Data is being sought, gather, interpreted, and subsequently used for purposes which have been consented to by the subjects of that research. Any subsequent use of the data which falls outside these purposes should ideally be the subject of further specific consent applications. The data is being gathered for the explicit purpose of testing the researcher theses and as such it may form the basis of future use by the researcher or by third parties. This potential for future use is why the access to any raw data or lists of subjects should be restricted to the researcher, their supervisor and the examiners of the finished dissertation. All raw data for this research will be stored electronically on a password protected computer and any physical documentation will be stored in a locked filing cabinet</p> <p>Consent – Consent of parents or guardians is required for the child to participate in the research activity as they bear parental responsibility for the welfare of the child under the Children Act 1989. Such consent is sought by communicating the aims and methods of the research in everyday language and the ultimate use of the data must also be made clear. Parent or guardian must clearly understand their right to withhold or restrict consent and the consent must be explicitly recorded in research documents.</p> <p>The onus lies with the researcher to ensure that the parent or guardian understands what they are consenting to, how the data will be used and that they have the right to withdraw consent at any time.</p> | 40 |

| | |
|--|------|
| <p>Assent – Gaining the assent of each child or other research subject for engaging in interactions on each occasion prior to commencing any data collection or other interaction is also important. This is consistent with BERA guidelines and the provisions of the United Nations Convention on the Rights of the Child 1989 which require children to be made aware of decisions and actions which affect their lives and their right to engage in consultation about those proposed actions and decisions. This explanation should be given at first meeting and provide to the child in age-appropriate language, the same information that their parent was given. On each later occasion the child should be given the opportunity to participate in, or withdraw from the research activities. Assent is important in ensuring that the research is conducted with, rather than simply upon those whose lives it is about.</p> <ul style="list-style-type: none"> • Have you received Criminal Records Bureau and Vetting & Barring Scheme clearance? YES <p>If 'yes' to any category a-g, or 'no' to category h & i, what steps are being taken to address these issues?</p> | |
| | 1840 |

Appendix B – Ethics Approval



22nd November, 2015

Ref 15/EDU/006

Dear Patrick

Project title: *"Draw me a map of your town": Exploring children's mapping skills.*

Members of the Faculty of Education Research Ethics committee have reviewed your application and have agreed to grant approval, with the following recommendations for amendments to your supporting documentation.

- In the information letter to parents you are recommended to clarify whether the teacher or another adult employed by the school will be present in the classroom during the research activities with children.
- You are recommended to clarify whether children involved in the research will be removed from, or excluded from other lessons in order to participate in the research.
- You are recommended to simplify some aspects of the consent form for pupils, in terms of the appropriateness of the language for the age group concerned.

I am writing to confirm formally that you can commence your research. Please notify me (or my replacement as Chair of the committee), of any significant change in the question, design or conduct of the study over its course.

This approval is conditional on you informing me once your research has been completed.

With best wishes for a successful project,

Yours sincerely,

A handwritten signature in black ink, appearing to read "Viv Wilson", with a long horizontal line extending to the right.

Dr Viv Wilson

Acting Chair, Faculty of Education Research Ethics Committee.

Faculty of Education
Canterbury Christ Church University
North Holmes Road, Canterbury, Kent, CT1 1QU
Landline: +44 (0)1227 782935 Fax +44 (0)1227 451739
www.canterbury.ac.uk

Registered Company No: 4793659
A Company limited by guarantee
Registered Charity No: 1098136

Professor Rama Thirunamachandran
Vice-Chancellor and Principal, Canterbury Christ Church University

Appendix C Letter to Schools



Mr/Ms
Head Teacher

XYZ School

XYZ Town, Kent

Request to undertake doctoral research at your school

Dear Sir / Madam

I am a Senior Lecturer in the Early Childhood Studies degree programme at Canterbury Christ Church University and I am currently undertaking doctoral studies which require me to conduct research with live participants.

My research area is the ability of children 0-8 years to understand and depict their local physical environment and I would like to investigate this by conducting a one day data collection at your school.

Research Topic : *An investigation of the construction of a free-recall hand-drawn map of a known physical environment by young children to examine the selection and depiction of objects, and their spatial orientation, distribution and scaling with respect to Lynch (1960) spatial typology.*

Research Questions :

5. What physical objects and spatial relationships do children aged 7-8 years include in their map when drawing a free-recall map of a known physical environment ?
6. To what extent do these maps exhibit the spatial typology proposed by Lynch (1960) ?
7. How accurate are these maps when compared to a satellite image of the same area ?
8. 'How useful are spatial typology models from the literature (for example Lynch, 1960; Moore (1973), Hart (1981) and Matthews (1984) for interpreting and understanding children's map drawings?'

Research Method : I wish to ask a group of approximately twelve (12) children aged eight (8) years to draw me a map of their town. While they draw I will sit with them and talk about what they are drawing. Due to the attention span of children this age I anticipate that the time with each child will not exceed ten (10) minutes. This interaction between myself and the child will be video-recorded to avoid the distraction of making notes and to allow for later analysis

If you and the relevant class teacher are agreeable, to this research occurring then I wish to send a letter to the parents of children in that class explaining the aims of the research. That letter will also seek their consent for their child to participate and it will outline the uses to be made of the data collected.

In addition to gaining parental consent for the child to participate, it is my intention also to seek explicit assent from each child on the day, in age-appropriate language, regarding their willingness to participate. At that time I will also explain to the child what I will do with their drawing and that they may have it back the next week if they wish after I have scanned it for later use.

All drawings will be anonymised, no children will be referred to except by alpha-numeric code (e.g. Boy A1, Girl C3 etc.)

The final uses of the data are the completion of my doctoral dissertation which be submitted to a panel for examination and all original drawings and the video-recordings will be destroyed five (5) years after acceptance of my dissertation. If the children request their original drawing then I will retain a scanned copy and return the original to the child.

It is my intention to self-publish a small Blurb book containing photographs of the children's drawings and an age-appropriate explanation of the research which I will provide to the school.

If you are able to assist me with this research then I would be most grateful if you could phone me to arrange to visit the school and meet yourself and the class teacher. If you are unable to assist me then an email to that effect will be sufficient.

Kind Regards

Patrick Meehan

Senior Lecturer, School of Childhood and Education Studies

Faculty of Education

Canterbury Christ Church University

Email : patrick.meehan@canterbury.ac.uk

Phone : 0754 0765 130

Appendix D – Letter to Parents



PARENTAL CONSENT FORM

Title of Project: "Draw me a map of your town" : Exploring children's mapping skills

Name of Researcher: Patrick Meehan

Contact details:

Address: Early Childhood Studies, Faculty of Education
Canterbury Christ Church University,
North Holmes Road Canterbury CT1 1QU

Tel: 01227767700

Email: patrick.meehan@canterbury.ac.uk

Please tick each statement if you agree and cross out whichever part of 5 you disagree with

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.
2. I understand that the participation of my child is voluntary and that both I and my child, are free to withdraw at any time, without giving any reason.
3. I understand that no personal information about myself or my child is sought as part of this research and that all data collected by the researcher will be kept strictly confidential.
4. I understand that my child will be audio and video-recorded during this activity but that the recordings will be seen only by the researcher and persons responsible for assessing their research and that the recordings will be destroyed five (5) years after completion of the research.
5. I do / do not consent to my child taking part in the above research study

| | | |
|---|-------|-----------|
| _____ | _____ | _____ |
| Name of Parent | Date | Signature |
| _____ | _____ | _____ |
| Name of Person taking consent (if different from researcher) | Date | Signature |
| _____ | _____ | _____ |
| Researcher | Date | Signature |

Copies: 1 for participant, 1 for researcher

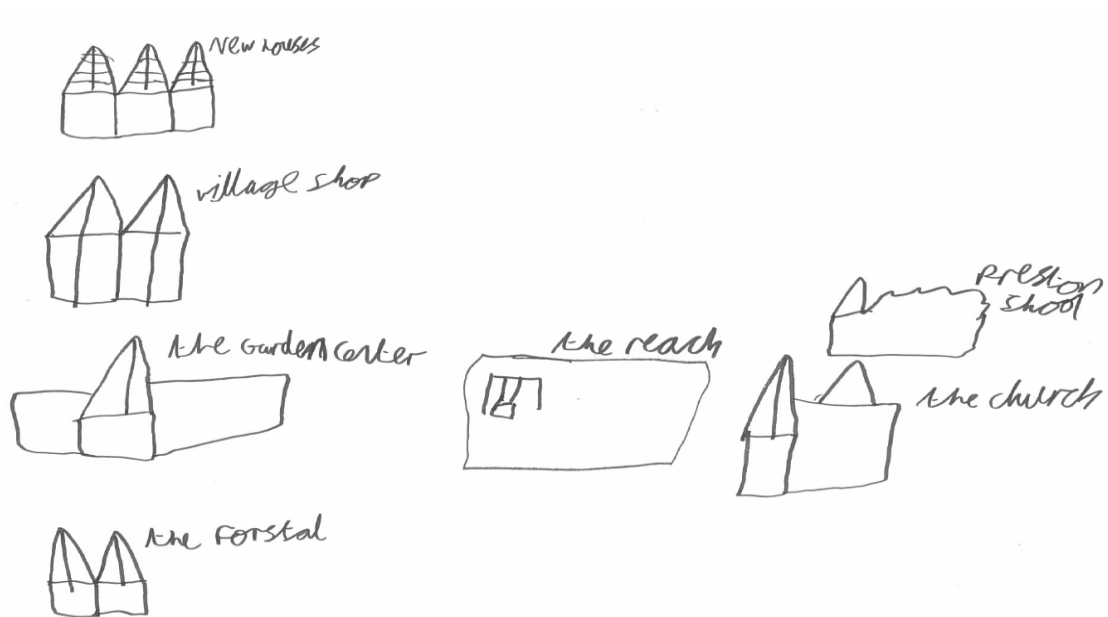
Appendix E – Map of fictitious town, used for Task 1 child interpretation



<https://jamescook8.files.wordpress.com/2013/03/map-otenjo.jpg>

Appendix F – Artefact maps by Children

S1B1



Interpretation Task – Image identified as map

Right hand

Reason – It has roads and a river

First object drawn – House

Drawing Notes – Although the map is fairly basic, it displays the vertical and horizontal axes of the village and contains label words for several buildings including the name of the school.

Classification using each model

Appleyard (1969) - Positional Spatial Linked type.

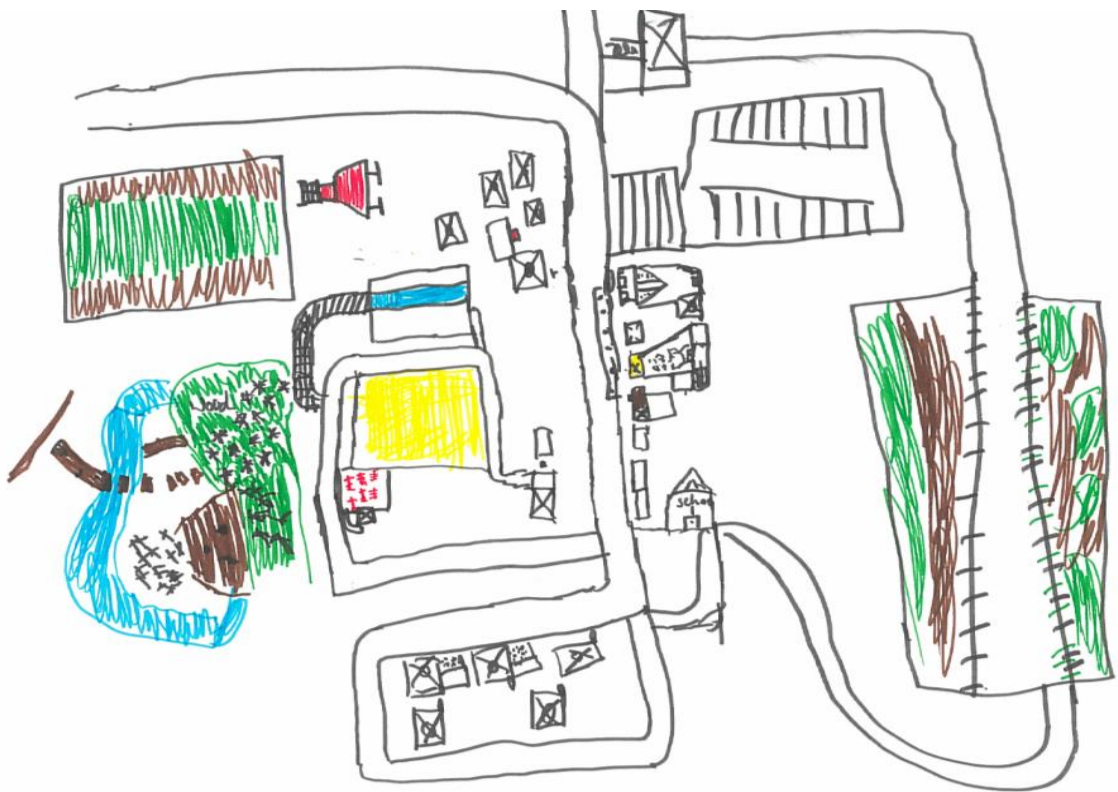
Ladd (1970) - Type 2 drawing with an overall orthogonal view but isometric views of all buildings.

Moore (1973) - Level II map as it is mainly orthogonal in orientation, generally accurate in scale and spatial distribution and uses label words.

Hart (1981) - the child was able to convey more spatial and environmental knowledge about the village orally than they chose to depict in their artefact map. This child was one of several children who depicted roads by leaving space for them rather than by drawing a line or a block to represent the road.

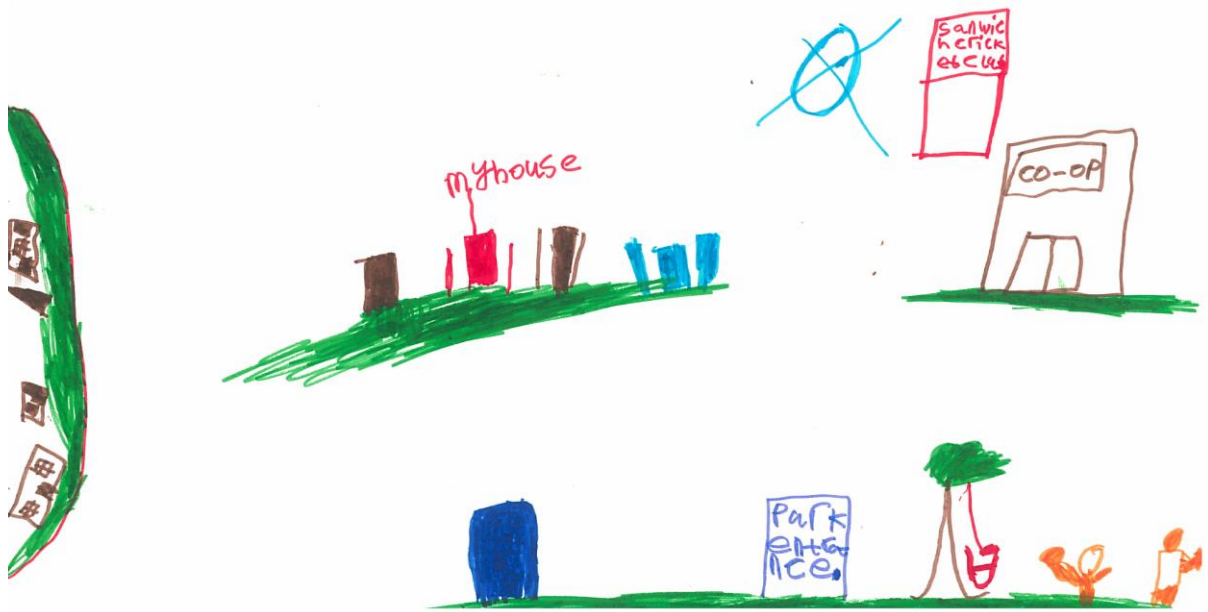
Matthews (1984) - Grade 1 Pictorial Verbal map as it is overall orthogonal in orientation, reasonably accurate in scale and spatial distribution of objects and utilises label words. In terms of

S1B2



Analysis provided within thesis

S1B3



Interpretation Task – Image identified as a map

Right Hand

Reason – Has a river

First object drawn – Road

Drawing Notes – Prima facie a quite simple drawing with all objects shown isometrically within clusters of egocentric land uses. There is some use of label words but no scale or accurate spatial distribution. Impossible to orientate map to ground or to identify location.

Classification using each model

Appleyard (1969) - Topological Spatial Scattered,

Ladd (1970) - Between Type 1 and Type 2 as there is an overall orthogonal orientation but all the objects are depicted isometrically and without spatial accuracy.

Moore (1973) - Level 1 drawing as it is entirely egocentric in terms of selected objects with limited or no accuracy of scale and spatial distribution.

Hart (1981) Illustrates point about being present during artefact creation if we are to avoid underestimating the child's Spatial and Environmental knowledge.

Matthews (1984) - Grade 1B Pictorial Verbal as although it suffers the above limitations, it also contains labels words.

S1B4



Interpretation Task – Image identified as map

Right Hand

Reason – Shrug of shoulders

First object drawn – Road

Drawing Notes – Fairly basic drawing using mostly isometric views and interestingly the only colour used was red despite other colours being offered. Unable to identify location or utilise for way-finding without the conversation with the child. It depicts a quite small portion of a village and it is impossible to locate it in a wider landscape context.

Classification using each model

Appleyard (1969) - Positional Spatial Linked mapping.

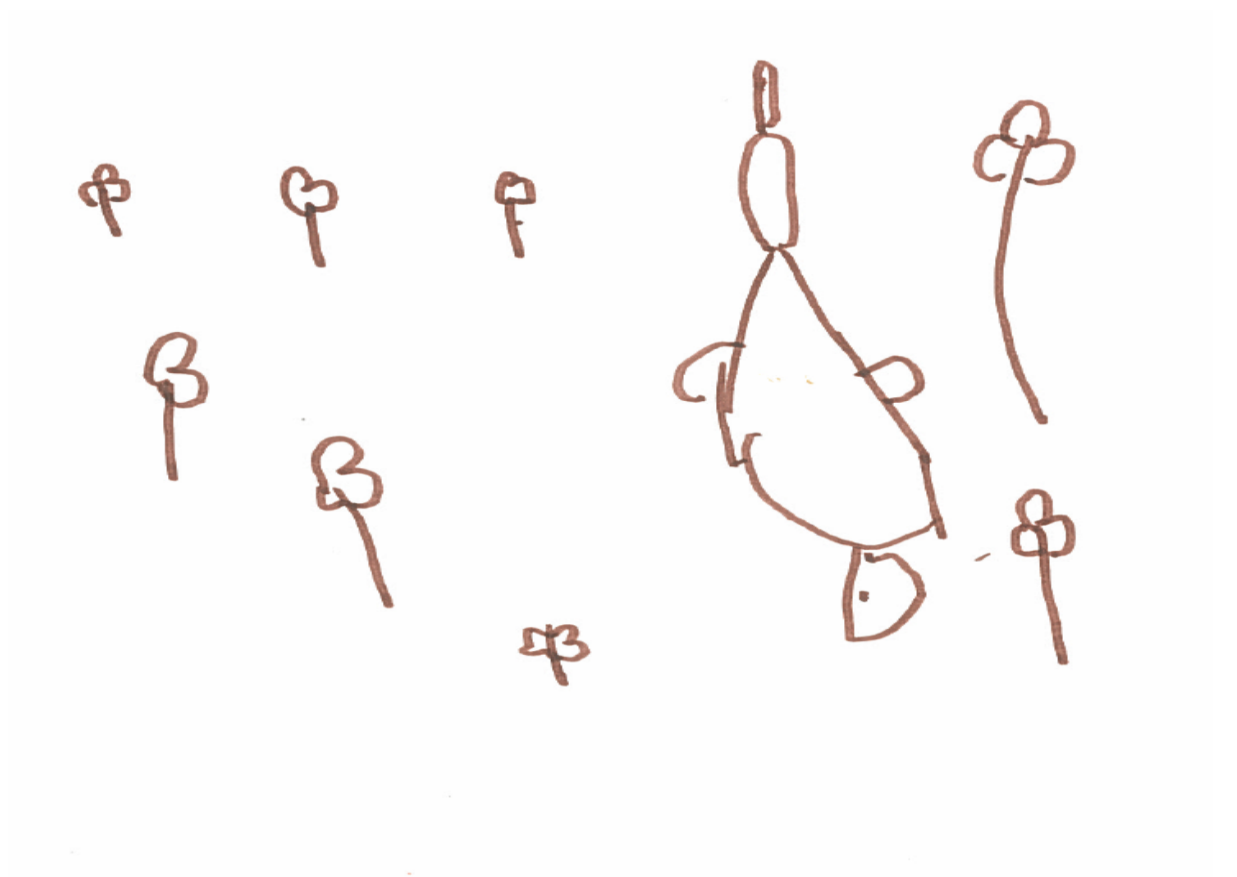
Ladd (1970) - Type 1 Pictorial Drawing as there are no label words and it is impossible to orientate it to ground.

Moore (1973) - Level 1 but only just, as it is mostly isometric in object depiction, features no label words and scale is inconsistent. For the same reasons

Hart (1981) - The child does possess greater Environmental Knowledge than the artefact suggests but they were limited in their conveyance of that knowledge orally as well as graphically, possibly due to shyness.

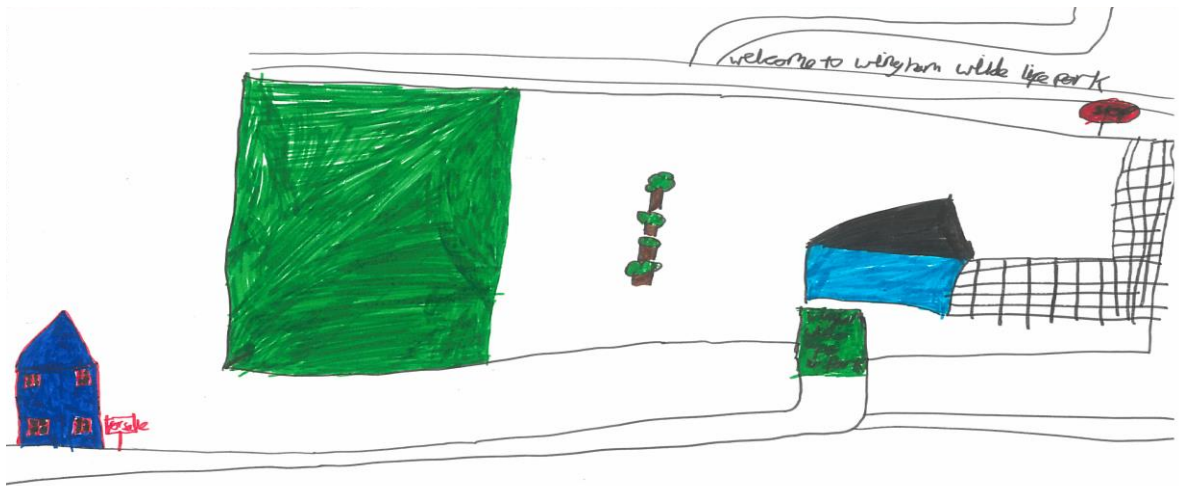
Matthews (1984) - Grade 1 A Pictorial Depiction.

S1B5



Analysis provided within thesis

S1B6



Interpretation Task – Image identified as a map

Right Hand

Reason – It has a river and buildings

First object drawn – Road

Drawing Notes – Fairly simple artefact depicting the Wingham Wildlife park rather than the village as such. The child possesses detailed Spatial and Environmental knowledge of the wildlife park but less about the village. The large green rectangle is a grass paddock next to the car park, which is divided in half by the central vertical line of trees. The smaller green rectangle at lower right is the wildlife park entrance sign. There is a red stop sign at upper right and the hashed area between it and the blue house is an isometric representation a timber fence. At lower left is a blue house with a red 'For Sale' sign.

Classification using each model

Appleyard (1969) - Positional Spatial Linked map.

Ladd (1970) - Type 2 Schematic drawing as it is possible to identify the broad location, to align it ground and to use it for way-finding. It features label words and several kinds of signage. Overall, it is orthogonal in view but all the buildings are shown isometrically.

Moore (1973) it would sit between Level 1 and Level 2, with the reason for moving up the scale being the use of label words.

Hart (1981) Again taking this artefact map at face value would be to underestimate the spatial and environmental knowledge of the child as they knew who lived in the house that was for sale, how long it had been on the market and a great deal about the wildlife park

Matthews (1984) this is a Grade 1 B Pictorial Verbal as there is a reasonable accuracy of scale and spatial distribution of objects.

S1B7



Interpretation Task – Image identified as a map

Right Hand

Reason – It has different places like land and water and you could use it to find your way. The river is blue like water and trees are green and sticky-outy and bushy.

First object drawn – Road

Drawing Notes – Child appeared bored with task and eager to return to classroom activity as it was 2nd last day of school before summer. Child also appeared to be drawing with non-dominant hand, perhaps to see how well he could draw in that manner. The largest rectangle house in centre right of map is the village store. The rectangle at top left of the vertical central road is a local used car dealership and the cluster of trees at centre bottom is below a foot track from main road to river. This artefact is fairly basic and was hurriedly done by a child whose verbal and body language suggested he felt that he was fulfilling an obligation rather than enjoying a creative experience.

Classification using each model

Appleyard (1969) - Positional Spatial Linked.

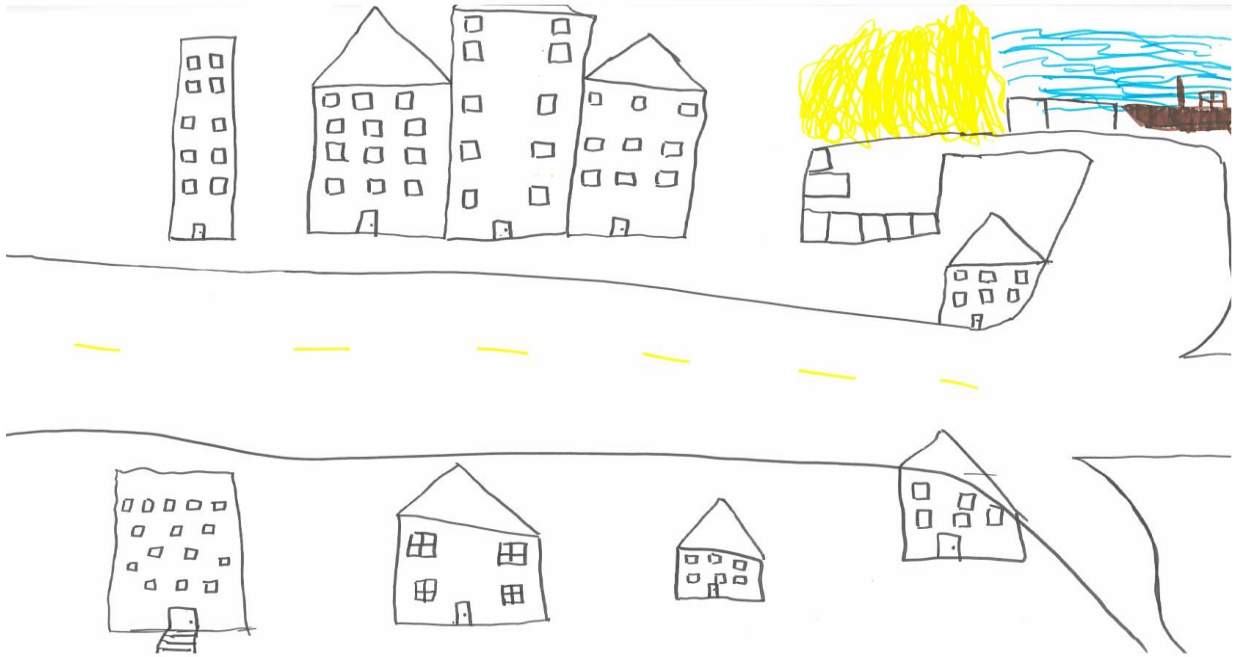
Ladd (1970) - Type 2 Schematic drawing as it is orthogonal in orientation but all buildings are shown isometrically. There is some use of scale and spatial distribution is fairly accurate, but without having been present during artefact creation it would be impossible to locate the area or to use the map for way-finding.

Moore (1973) - Level II Planometric view with a spatially accurate road layout and reasonable use of scale but no label words or ability to orientate map to ground.

Hart (1981) – Unable to classify but child did possess greater Environmental knowledge than conveyed in image.

Matthews (1984) - Grade II A Pictorial for the above reasons and the lack of label words. Clearly there was reasonable Spatial Knowledge but limited effort was made to convey any Environmental Knowledge.

S1B8



Analysis provided within thesis

S1G1



Interpretation Task – Identified image as map

Right Hand

Reason – It has grass and a river

First object drawn – House

Drawing Notes – A fairly basic drawing which is impossible to orientate to ground or to use for way-finding without being present during the creation of the artefact. This girl was visibly shy but nonetheless possessed reasonable Spatial and Environmental knowledge of her village.

Classification using each model

Appleyard (1969) - Positional Spatial Linked map.

Ladd (1970) - Type 2 Schematic Drawing despite the lack of label words as it is mainly orthogonal in view. The brown irregular objects are isometric views of buildings and the red objects are an isometric view of a playground with swings at left and a slippery slide at right.

Moore (1973) - Level 1 Planometric drawing.

Hart (1981) - There was evidence that the child possessed more Environmental knowledge than she was able to convey graphically, or was willing to convey orally. Interestingly, this girl drew the roads (black) as separate objects despite orally being clear that they all linked up, and she has left spaces rather than drawn roads between the houses. This seems to support Lowenfeld and Lambert Brittain's (1987) suggestion that children recall the landscape that they are to depict from an isometric perspective and so the buildings and the spaces between them for roads are more cognitively notable than the roads per se.

Matthews (1984) - Grade 1 A Pictorial Depiction.

S1G2



Interpretation Task – Image identified as map

Right Hand

Reason – It has a river and trees

First object drawn – Brown rectangular outline of the village

Drawing Notes – This child was one of two girls who drew an imagined boundary of the village prior to drawing any actual buildings or other objects within it. This seems to suggest that they cognitively recall the village as a discrete space with spatial and environmental characteristics which are different from the surrounding agricultural land. The girl drew her own house in yellow with their car in brown to the left of it. The brown square to the right of her house is the neighbour's house and the green circle with brown hash lines is a circular timber deck where they have had BBQ's with the child's family. The other purely green squares are buildings with windows and doors while the green squares with red objects (flowers) are gardens and so are the red objects at top left of image.

Classification using each model

Appleyard (1969) - Positional Spatial Linked.

Ladd (1970) - Type 2 Schematic Drawing due to the isometric views of building and the lack of labels. It is impossible to orientate this artefact to ground or to use it for way-finding.

Moore (1973) - Low end Level 1 map due to lack of label words and the fact that the houses are isometric in view.

Hart (1981) – impossible to classify but local environmental knowledge exceeds information depicted in image

Matthews (1984) Grade 1 A Pictorial Depiction.

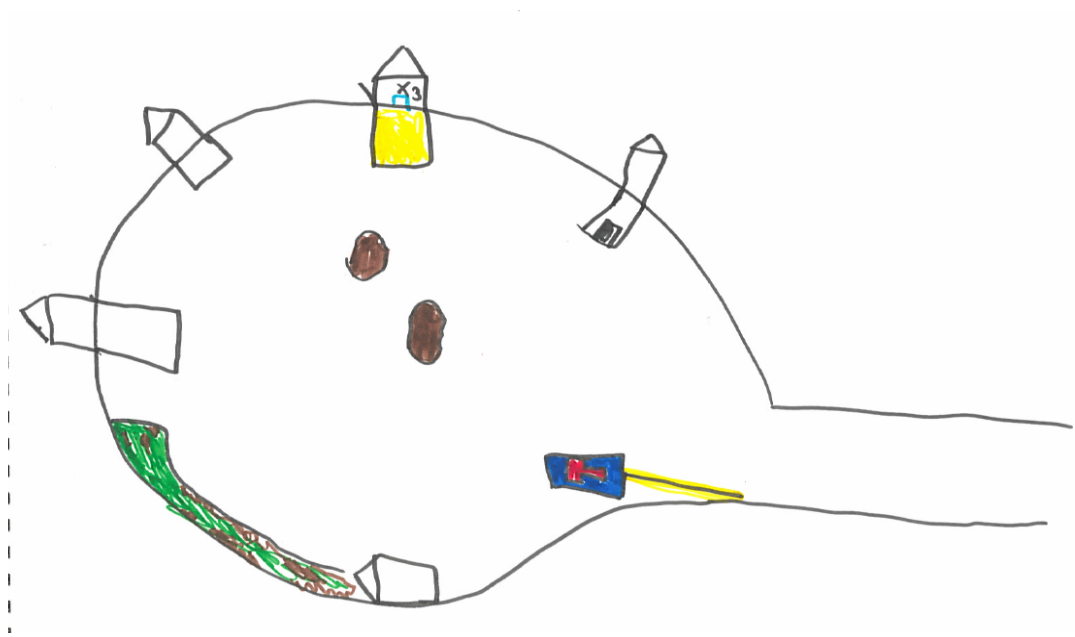
This artefact also leaves space for, rather than depicts roads as objects which seems to support Lowenfeld and Lambert Brittain's (1987) view on children's recall and depiction of Spatial Knowledge. This child displayed limited Spatial Knowledge graphically but a reasonable amount of Environmental Knowledge was displayed orally.

S1G3



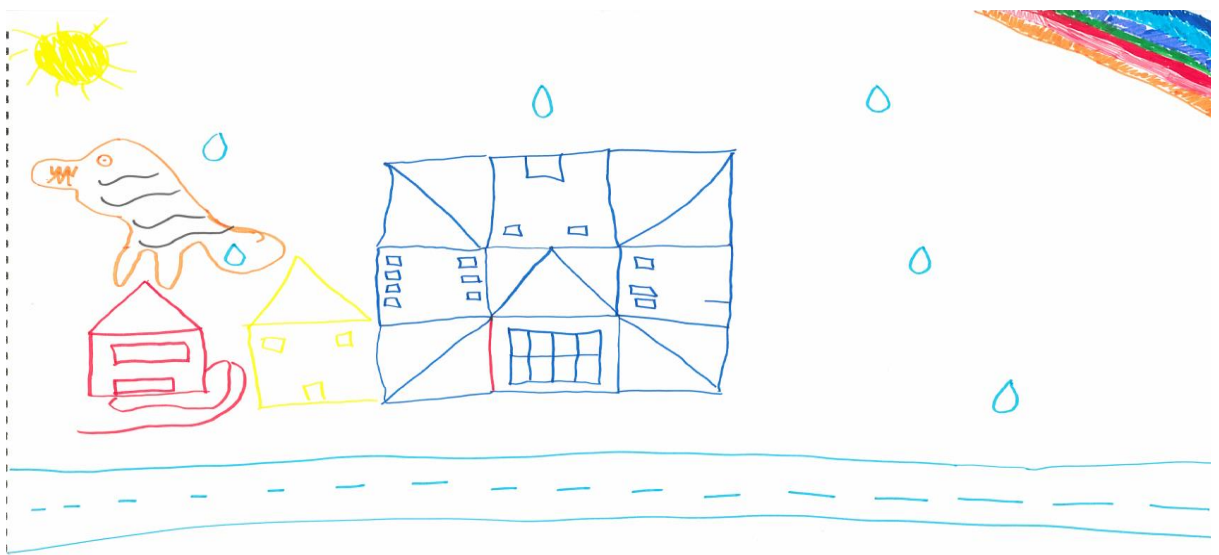
Analysis provided within thesis

S1G4



Analysis provided within thesis

S1G5



Interpretation Task – Image identified as map

Right Hand

Reason – There is grass and bridges over the river

First object drawn – House

Drawing Notes – This child is the sister of S1B6 and depicts Spatial Knowledge of a similarly small portion of the space near Wingham but similarly detailed Environmental knowledge of that space. The sun at top left, the rainbow at top right and the light blue raindrops could all be considered purely decorative elements as they were added as a distinct afterthought once the Spatial Knowledge had been conveyed both graphically and orally. The large orange dinosaur is actually a statue located nearby.

Classification using each model

Appleyard (1969) - Topological Spatial Scattered.

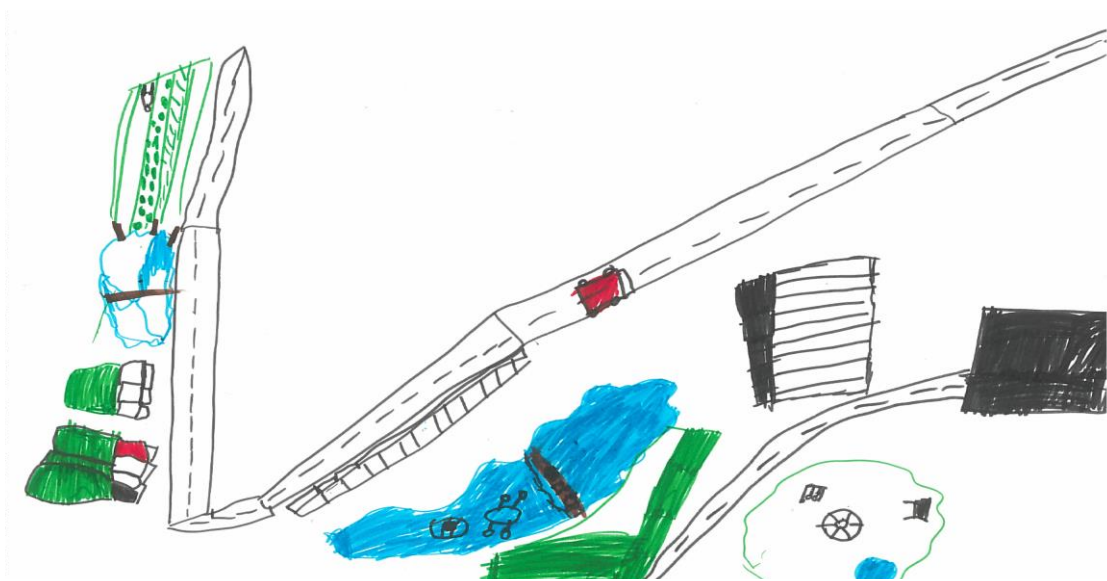
Ladd (1970) - Type 1 Pictorial. It is isometric in view and impossible to orientate to ground or to use for way-finding. The interpretation of this artefact was considerably assisted by the researcher knowing the physical location beforehand from having already dealt with S1B6. Interestingly the large blue house is an attempt by the child to draw the house as if it were a geometric net diagram to produce a three dimensional object. This was progressing well with the central square representing the roof and the cross formed by the squares on either side and above and below it and the child talking animatedly, but when it came to depicting the roof the child became confused and decided to add a roof block to each corner. For

Moore (1973) - Lower end Level 1 map. Lower end.

Hart (1981) Unable to classify but I would argue that the level of Environmental Knowledge possessed by this particular child would be seriously underestimated if the artefact were to be viewed as a stand-alone presentation of the child's Spatial Knowledge.

Matthews (1984) - Grade 1 A Pictorial Depiction

S1G6



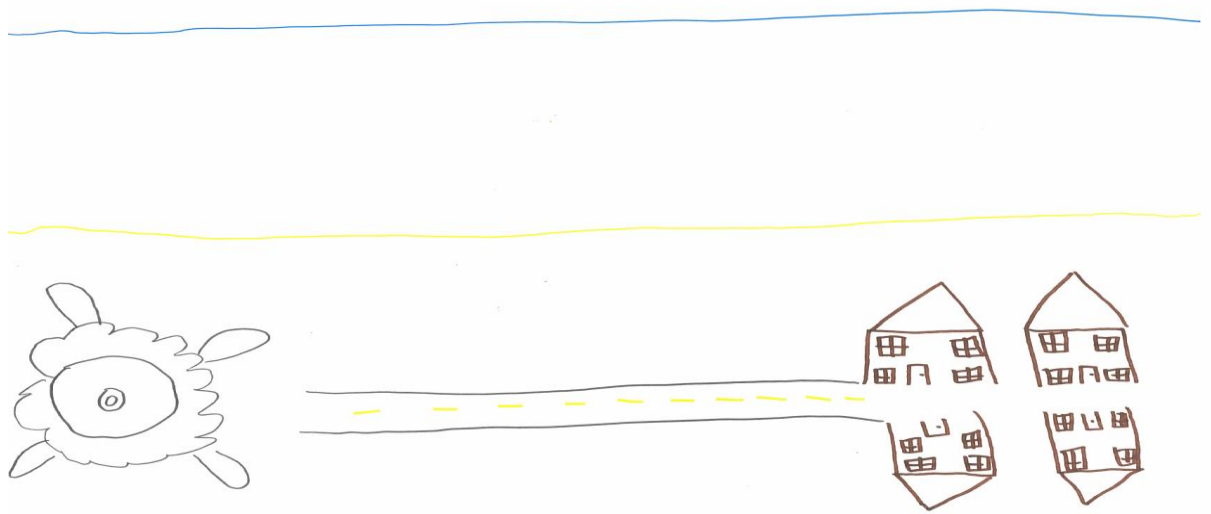
Analysis provided within thesis

S1G7



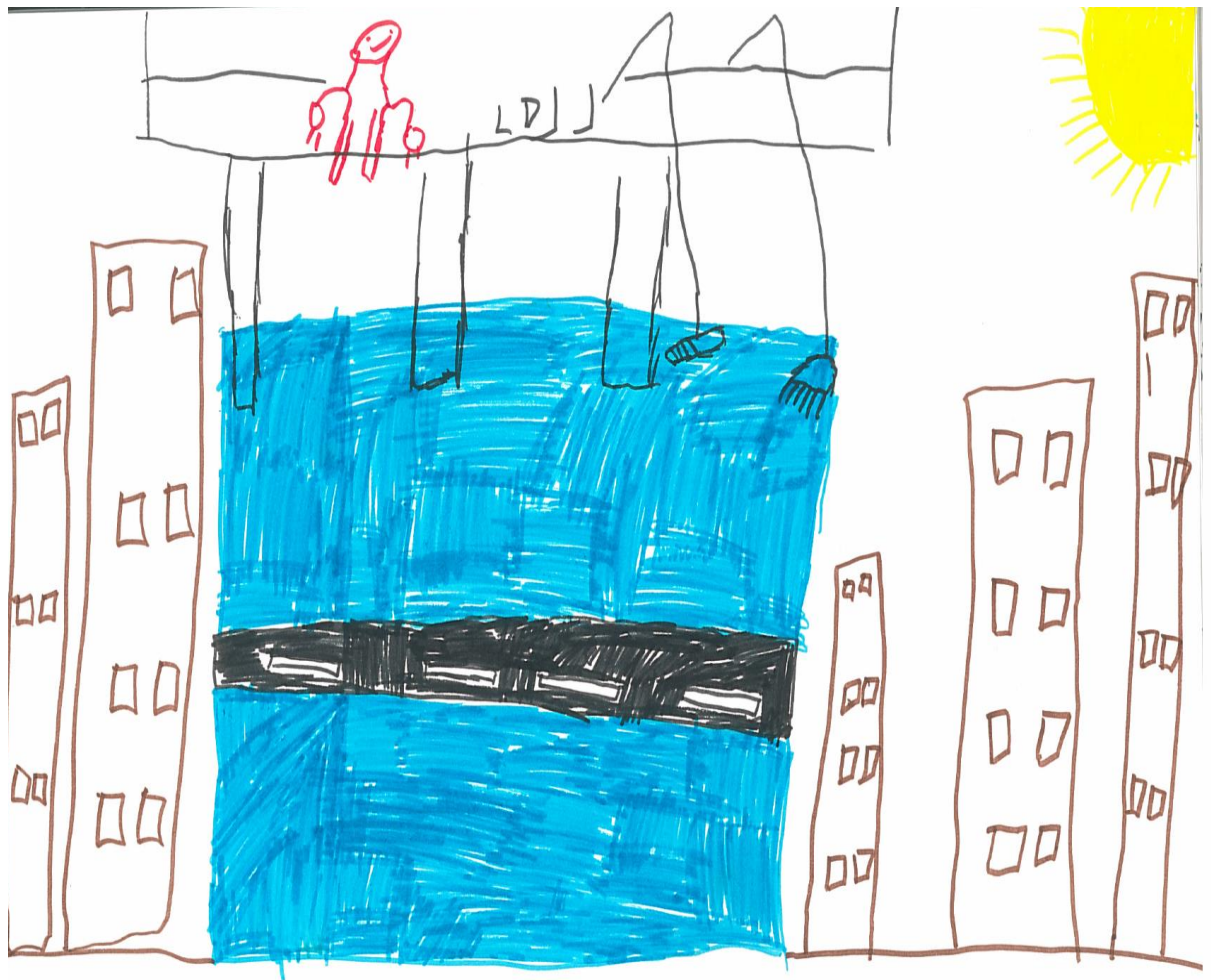
Analysis provided within thesis

S2B1



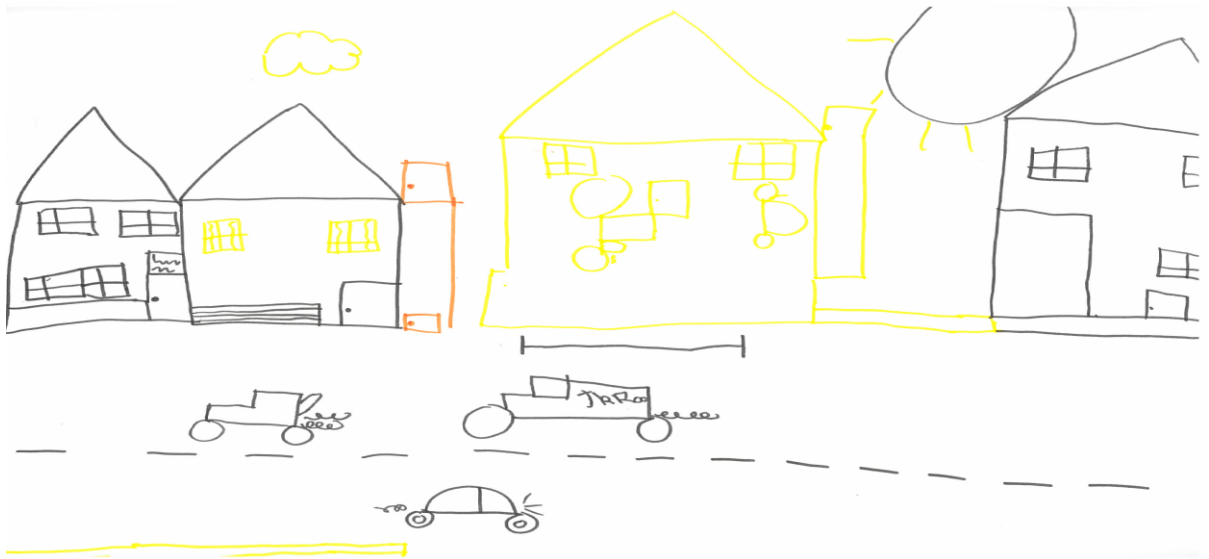
Analysis provided within thesis

S2B2



Analysis provided within thesis

S2B3



Interpretation Task – Image identified as London

Right Hand

Reason – City with a river and trees around it

First object drawn – House (2nd in from left, Child's house with brown side lane with gate at each end)

Drawing Notes – The child drew their house and then the brown side yard which has a gate at either end then the other two black houses and then the yellow house. This house was noted by the child as it has a forecourt for car parking rather than a front garden. They also noted that the people who live there own a tractor (Large cluster of circles and squares on front of house) and there is a white (dimension style) line on the road in front of the house to indicate that people cannot park across the driveway. The double yellow lines at bottom left of image are road markings on other side of his street. The child has drawn three vehicles using the road and has drawing exhaust plumes from each one. The left hand vehicle is a sports car with a spoiler at rear. The lowest vehicle is a small car with its lights on and the right hand vehicle is a van with signage of a local tradesman on the side.

Classification using each model

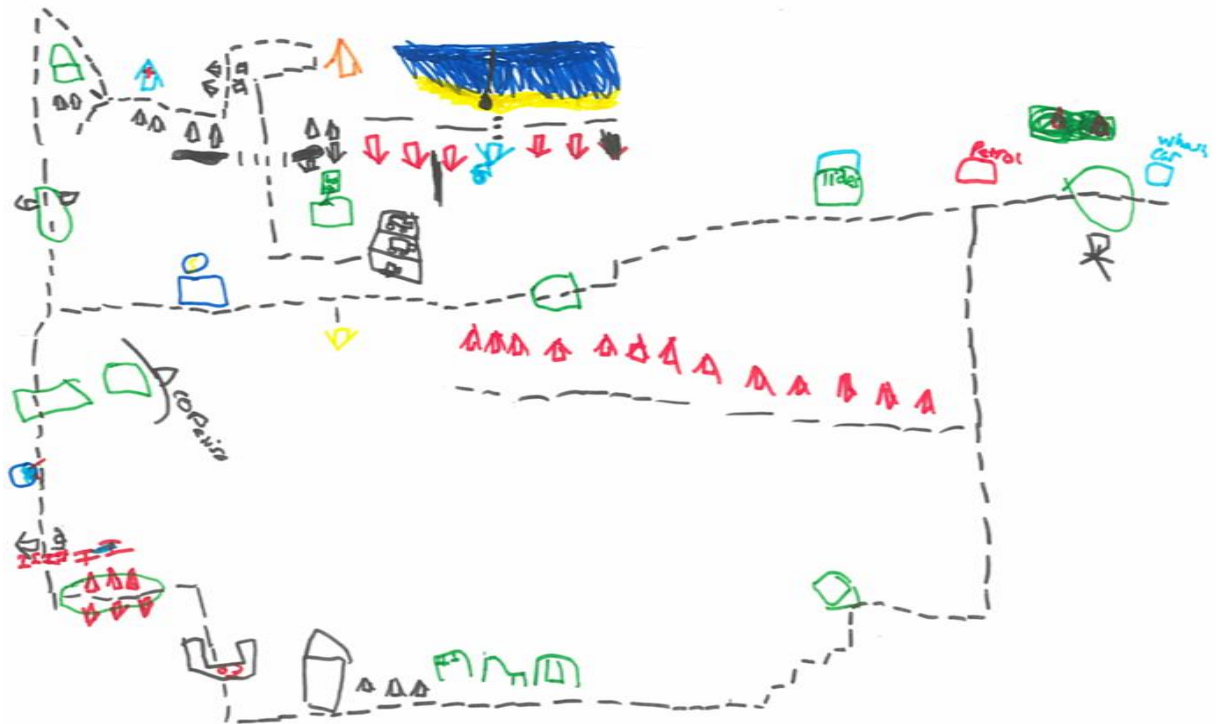
Ladd (1970) Type 1 Pictorial Drawings

Moore (1973) -Below the classification threshold as it is almost totally isometric.

Hart (1981) Unable to classify but we again see how the artefact plus the interaction during its creation yields a much more detailed amount and range of spatial and environmental knowledge than the superficial artefact alone suggests.

Matthews (1984) Grade 1 Pictorial Depiction. The objects depicted by the child are roughly of a similar scale but it is impossible for another person to use it to identify the area or for way-finding unless they had been party to the creation of the artefact

S2B4



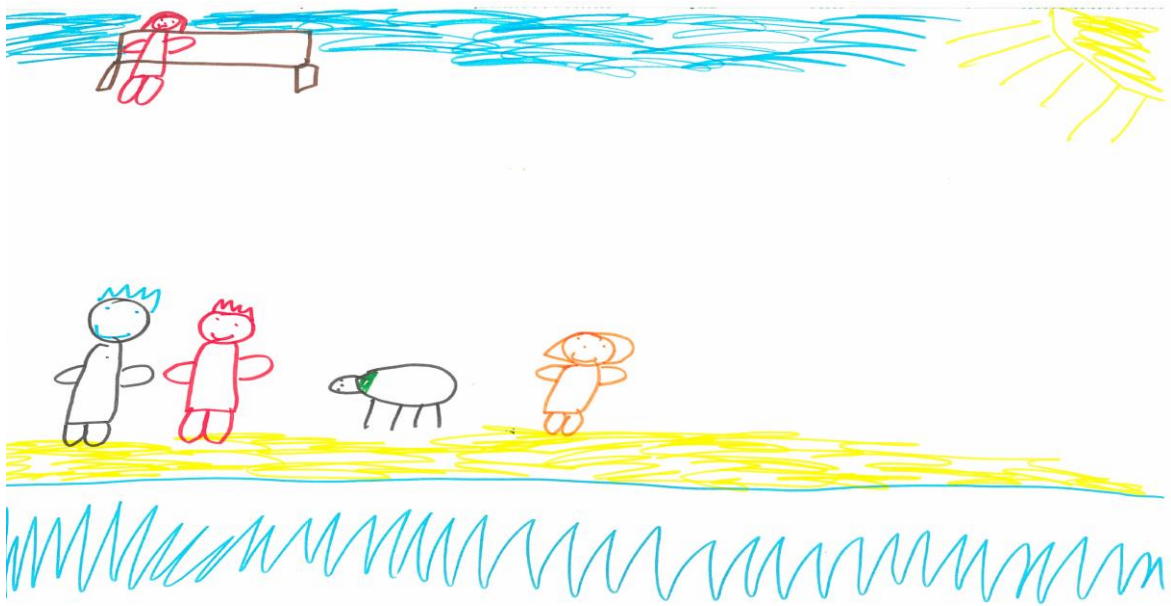
Analysis provided within thesis

S2G1



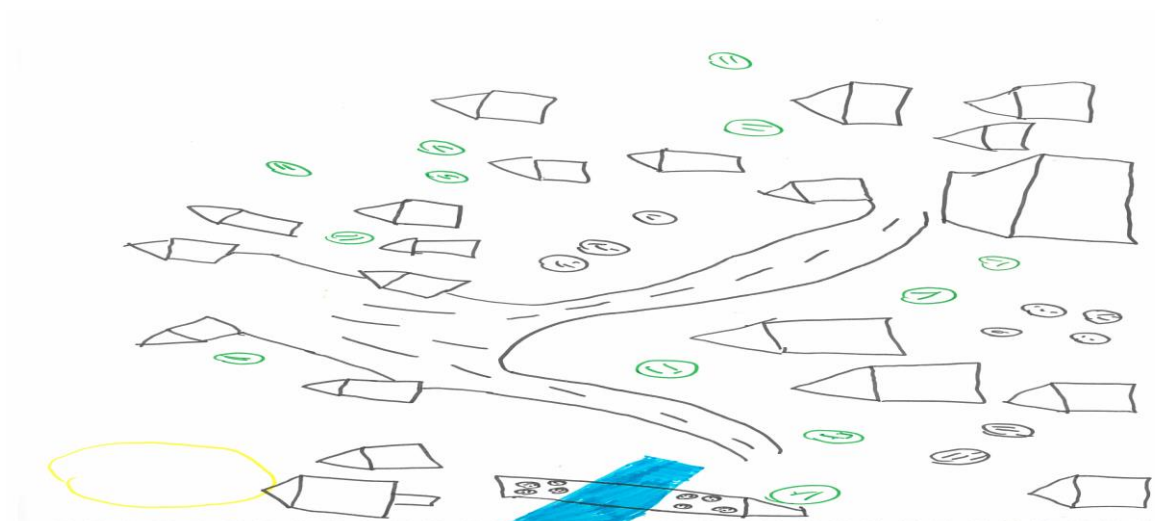
Analysis provided within thesis

S2G2



Analysis provided within thesis

S2G3



Interpretation Task – Image identified as map.

Right Hand

Reason – It has buildings and fields.

First object drawn – House

Drawing Notes – The black rectangle with circles in it and blue bar across in bottom centre of picture is the pier. The green and black circular objects are plan views of trees. Yellow circle is the sun.

Classification using each model

Appleyard (1969) - Positional Spatial Linked.

Ladd (1970) - Type 2 Schematic Drawing.

Moore (1973) - Low end Level 1 as it has orthogonal trees and roads but isometric buildings. It is impossible to orientate to ground unless present for its creation and it cannot be used for way-finding.

Hart (1981) Unable to classify but illustrates the view that girls' ability to conceive of, and represent the environment is strongly impacted by their gender and socio-economic circumstances due to the limits these things place on their independent play range. The child is aware that the town has a pier but has not been able to orientate the town or the pier to the sea.

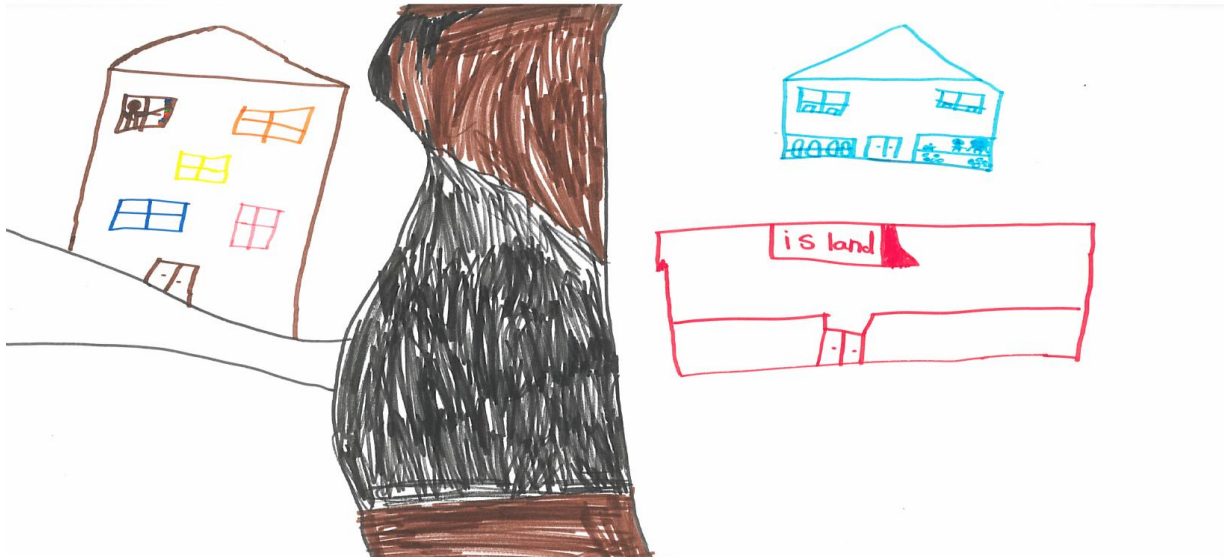
Matthews (1984) - Grade 1 A Pictorial Depiction for the same reasons. The Spatial and Environmental knowledge displayed by this child both graphically and orally were fairly limited.

S2G4



Analysis provided within thesis

S2G5



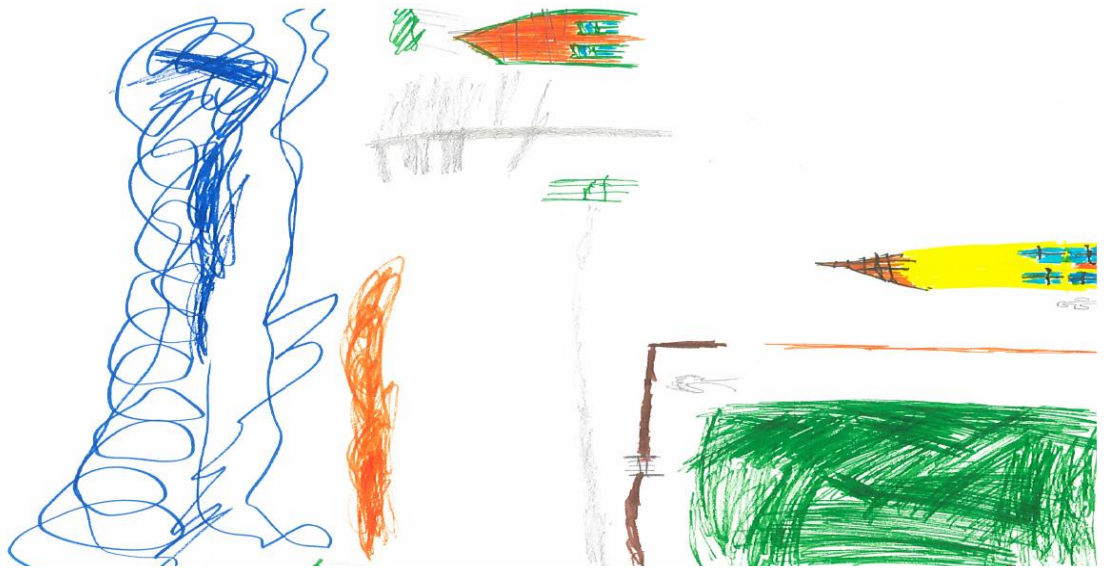
Analysis provided within thesis

S3B1



Analysis provided within thesis

S3B2



Interpretation Task – Identified image as a country **Left hand**

Reason – It has buildings and bridges and a river which is usually blue.

First object drawn – The large green block at bottom right. This is a garden shared between several houses

Drawing Notes – This child drew the house and school by first drawing the door, then the central crosses of windows and colouring in the windows. The buildings were then coloured in. In the case of the house no attempt was made to draw an outline. With the school the green outline was drawn last. The blue squiggles at left are the sea and the thick orange line is the beach. Although the green block of the garden was drawn first it was not outlined until the end. The child began the fence by drawing the gate and then putting the lock on it. He then drew the sea and beach before returning to draw the fence. The vertical pencil line to left of garden / fence is the road to the school and the green barred object at the upper end of it is the school gate. The pencil lines below the school represent car parking bays within the school grounds. The last objects drawn were drawn in pencil and they are the tree at top left of garden and the child himself below the house. It is noted, that although this image shows the sea to the left of the town, the child had rotated the page and drew it with the sea at the top of the picture

Classification using each model

Appleyard's (1969) - Topological Spatial Scattered as the linkage between the elements must be inferred due to the lack of clear connecting roads.

Ladd (1970) - Both the lack of labels and the limited scale and spatial distribution accuracy place it below the threshold of Type 2 Schematic Drawings.

Moore (1973) - Below the threshold for Level I as it displays isometric views of buildings and has no labels.

Hart (1981) – Unable to classify but interaction showed much greater environmental knowledge than suggested by image

Matthews (1984) - Grade 1 A Pictorial Depiction as it uses isometric views of buildings and limited accuracy of scale and spatial distribution.

However, despite the apparent simplicity of this map the child made an ego-centric selection of objects which are of direct relevance to him and depicted them in a logical sequence. His depiction of two pedestrian gates and the school carpark suggests an awareness of different modes of transportation. His mode of drawing the houses and the gate suggests an unusual level of awareness of detail and micro-spatial elements. This assessment is supported by his need to rule lines on the school building to indicate rows of bricks. A consultation of the satellite image (Google Earth, angle 90 degrees vertical, elevation 400m) indicates that he has placed the car park on the opposite of the school to where it actually lies. However, such a placement of the carpark 'could' afford the depicted isometric view of the school building from ground level which supports Lowenfeld and Lambert Brittain (1987) view on how children recall the environment in primarily isometric terms.

This child was one of several whose artefact map failed to fit within the existing theorist classifications and suggests a need to a new classification model which allows more nuanced interpretations through inclusion of environmental as well as spatial knowledge.

S3B3



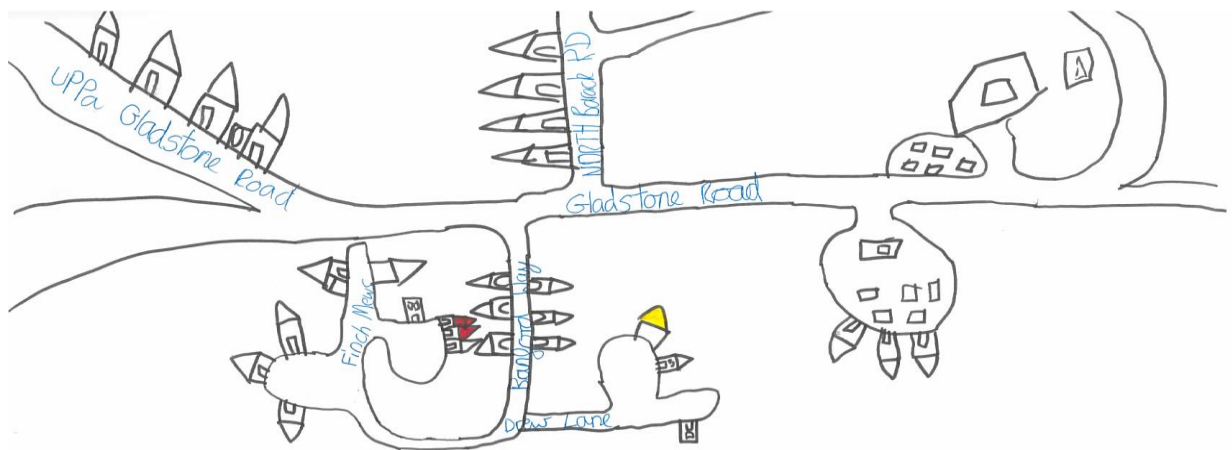
Analysis provided within thesis

S3B4



Analysis provided within thesis

S3B5



Interpretation Task – Identified image as a map **Left Hand, stood to draw**

Reason – Shows land as green and water as blue

First object drawn – The road labelled Finch Mews

Drawing Notes – Brother of S3B4. This child also maintained an oral monologue during drawing and engaged the researcher in negotiating meaning of symbols he used, but he does not share his brother's fascination with maps. This may explain why his map is spatially accurate in terms of object distribution and direction but not in terms of scale. The boy identified his own house and also the house where his sister lives with his separated father by colouring the roof yellow. He labelled the roads where these houses are located and also the major road linking them. He identified the cul-de-sac at right of map and below Gladstone Road as containing mostly new houses. Unlike his brother he displayed awareness of the existence of the Tudor castle by stating that it is reached by following the road labelled 'Uppa Gladstone Road'. He stated that the lower limb of this fork takes you into the main part of the town. The boy stated but did not specifically depict the fact that there are many flats around his neighbourhood but this may indicate that the flats are subdivided houses rather than purpose-built apartment complexes.

Classification using each model.

Appleyard (1969) - Positional Spatial Patterned

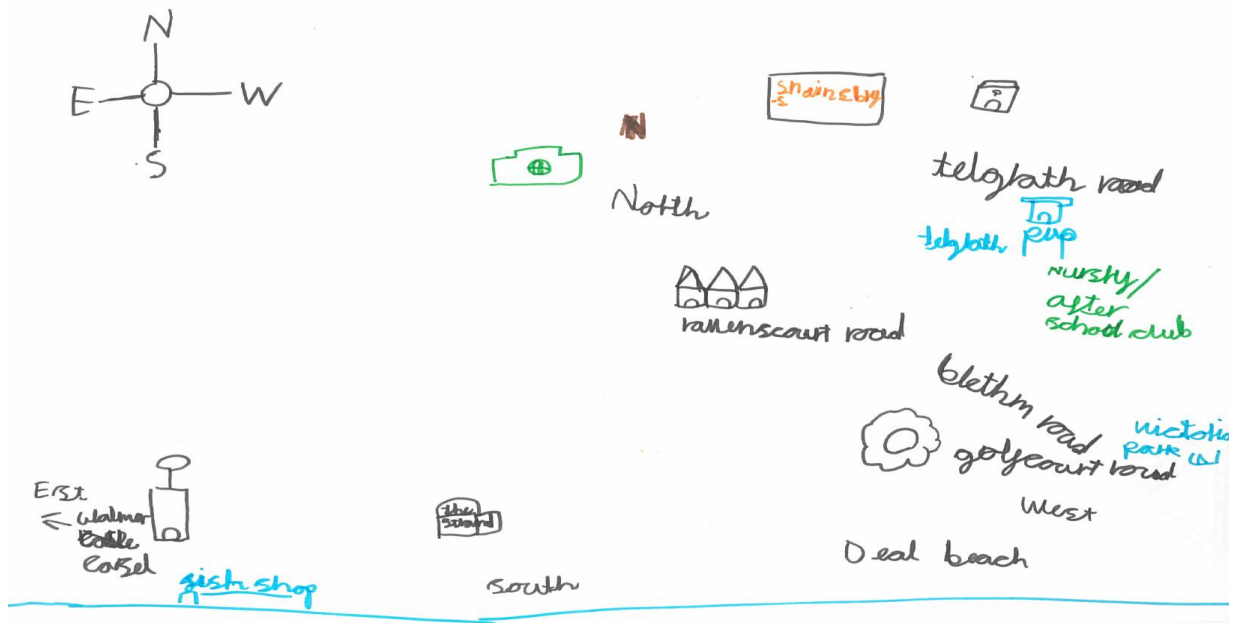
Ladd (1970) - Between Type 2 and 3 due to depiction and labelling of roads.

Moore (1973) – Between Level II and III because it utilises both orthogonal views of buildings as in the pentagonal school at upper right and also isometric views of the majority of houses. Further, it contains clusters of detailed information relevant to the child which are arranged in an accurate distribution but the areas between the clusters has no detail.

Hart (1981) – Again the ability of children to develop detailed Spatial and Environmental knowledge through free range play appears to be demonstrated.

Matthews (1984) - Grade 1 B Pictorial Verbal.

S3B6



Analysis provided within thesis

S3B7



Interpretation Task – Identified image as a map (City)

Right Hand

Reason – It has a river going through it which has bridges over it. Rivers are usually long thin and blue. The river in this image had ripple lines at its edge and these were also noted by the child as indicating water.

First object drawn – Brown concentric pentagons at right of map. Child stated this was the school.

Drawing Notes – As with several of the children at this school the unusual hollow pentagon footprint of the school was a noted impression for this child. The V-shaped objects at the left side of the map are the roof of houses but this child was comparatively shy and he did not elaborate on whether this was an isometric or orthogonal view. The absence of the commonly drawn square beneath the triangles suggests the latter but this is pure conjecture on the researcher's part. The brown double line with bars between them at the left edge of the map is the railway line. The green objects at bottom left corner of map are trees and their location is a point that will be returned to shortly.

This boy stated that the large black vertical lines at left of map represent Gladstone Road and the L-shaped objects to the left of it at lamp posts with the lines beneath them representing light beams. The black concentric rectangles are the school Expressive Arts block and the green dashes and circles above it represent respectively grass and trees on the school grounds. The vertical line of green circles at right edge of map are also trees located on the school grounds. In top centre of map is a black rectangle containing a circle surrounded by smaller rectangles and this represents the school pond surrounded by seating logs.

The vertical cluster to its right of a black U circle and arch represent the school basketball court. Interestingly, the child made no attempt to draw edges for the court.

In terms of spatial extent this map barely covers a 200 metres circle and features two errors of object placement. Firstly, the basketball court actually is located below and to the left of the school. Secondly, a consultation of a satellite image of the area shows that where the railway line actually passes the school there is a line of trees but no houses between them. This suggests that the child has compressed space by moving the trees and houses down from above the map so as to locate them in proximity to the school. It was noted that on the Google Earth image which was consulted (elevation 90 degrees height 400metres), that the first row of houses backing onto the railway line displayed quite prominent V-lines on their roof. This may suggest that the child has seen such a visually striking image and drawn an orthogonal view of the houses as he did the school buildings but without questioning him on this point it is impossible to say with certainty. However, such an interpretation of his drawing would be open to challenge since the adjacent lamp posts are isometric in appearance. This could be due to the method chosen to represent the lamp posts though and again without explicit answers from the child it remains conjecture.

Classification using each model

Appleyard's (1969) – Not consistent with any types as it really depicts only a single area. Possibly a Topological Spatial Mosaic, but even this is a categorical stretch.

Ladd (1970) - Low end Type 2 due to absence of label words and impossibility of using it for wayfinding or to identify the location.

Moore (1973) - Low end Level 1 due to the limited correlation between depicted and actual objects.

Hart (1981) – Unable to classify but seems to illustrate argument about the importance of children's independent free-range exploration in developing their ability to organise their isometric experience of the world in ways that allow them to depict it orthogonally.

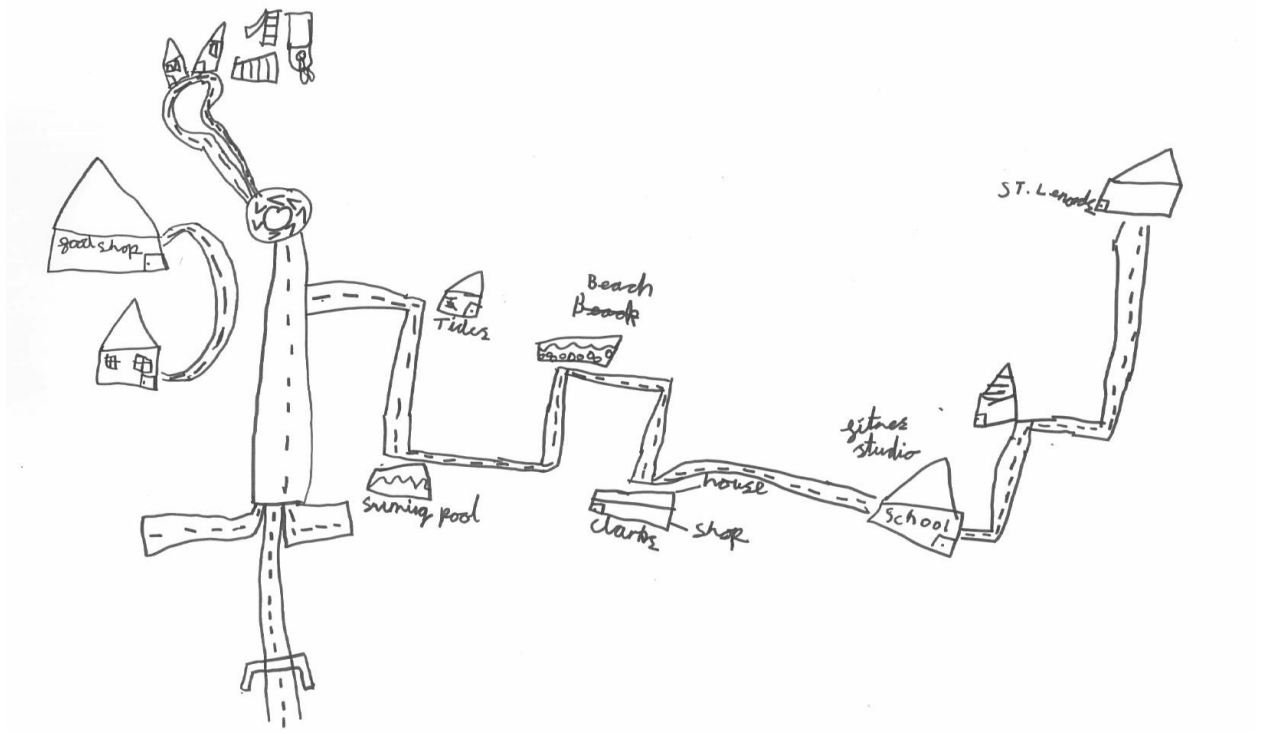
Matthews (1984) - Lower end Grade 1A Pictorial Depiction.

S3G1



Analysis provided within thesis

S3G2



Analysis provided within thesis

S3G3



Interpretation Task – Identified image as a picture of some land. **Right Hand**

Reason – Land is green and rivers are blue. Drew attention to rocks in stream and ripples

First object drawn – House

Drawing Notes – An extremely quick and quite simple map from a quiet child which shows the house of the child and a zigzagging road linking it to the school but again some details of conversation during the colouring in process suggest the child knows more than they can draw which supports Polanyi's (1966) idea of people possessing Tacit knowledge which they cannot adequately represent either graphically or orally.

The features a house number and the school is labelled 'Schol Primary' and first vertical branch of the road to the left of the house features horizontal black lines which represent a pedestrian crossing.

Classification using each model

Appleyard's (1969) - Topological Sequential Fragmented as it features related objects joined by a road.

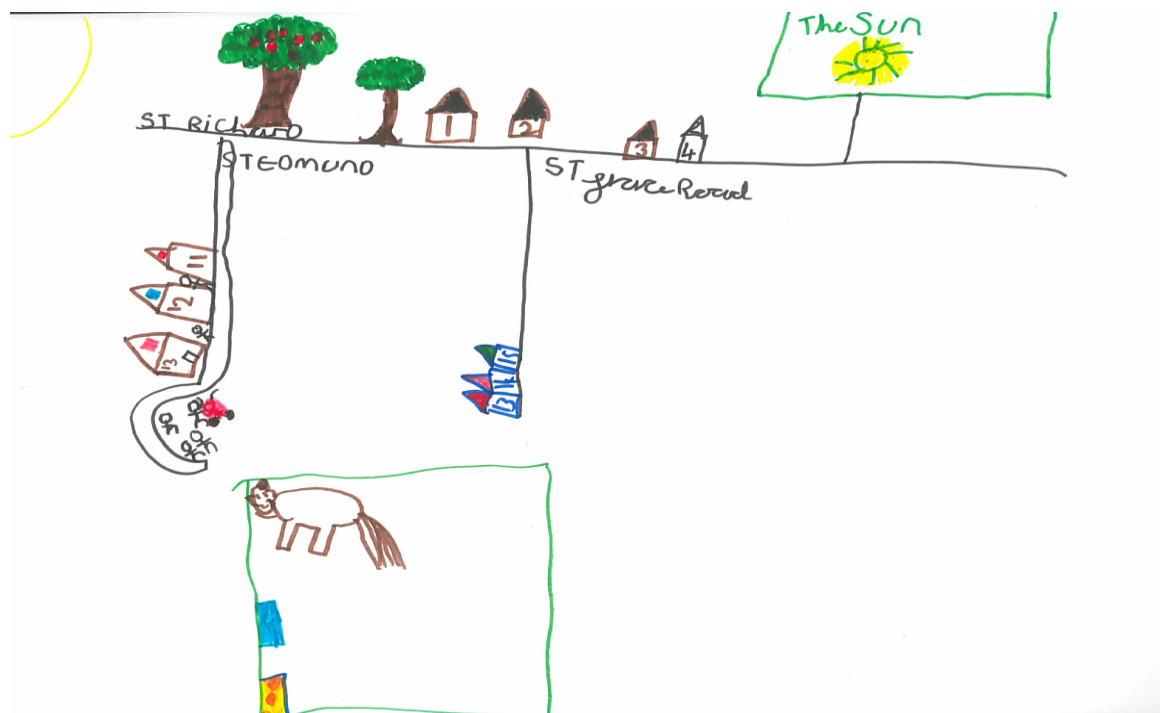
Ladd (1970) - Type 1 Pictorial drawings as the buildings are isometric and it lacks scale and sufficient detail to orient it or use it for even crude navigation. Similarly it falls below the threshold for classification.

Moore (1973) - Below classification threshold for Level I maps.

Hart (1981) – Unable to classify but interaction produced more information than shown in image

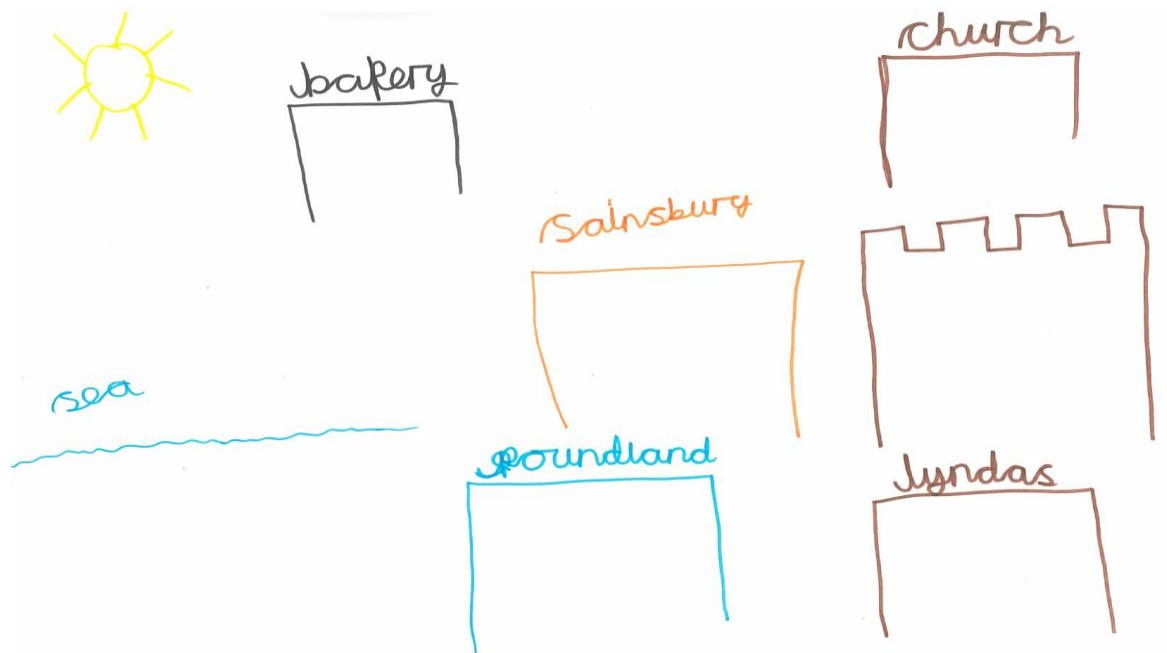
Matthews (1984) - Grade 1 A Pictorial depiction.

S3G4



Analysis provided within thesis

S3G5



Analysis provided within thesis

S3G6



Interpretation Task – Image identified as a map

Right Hand

Reason – It has houses and rivers are blue.

First object drawn – Yellow road at upper right of image

Drawing Notes – As the most overtly map-like of the artefacts from this school it was decided to include a satellite image in the interpretation section as it allows more detailed discussion of the level of spatial awareness possessed by this child. The sea is the blue diagonal lines located in top right corner with a yellow beach beneath it. The purple block with the circles with attached squares is the Tudor castle and the rectangle containing squares around its internal perimeter is the seaward artillery bastion. The smaller purple block filled in green and brown is a park.

Classification using each model

Appleyard (1969) - Positional Spatial Linked.

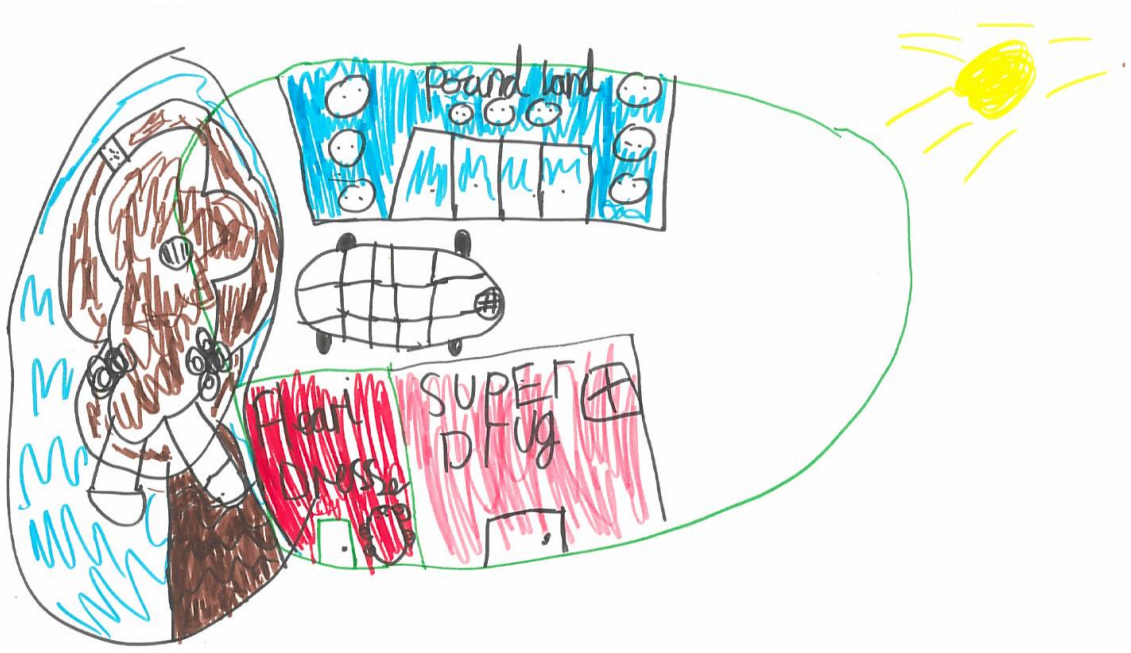
Ladd's (1970) - Between Type 2 Schematic Drawings and Type 3 Image Resembling Map. This latter difficulty is due to the lack of label words and ability to locate it in a wider context. However, if the area were known beforehand then it would be entirely possible to use it for fairly specific local wayfinding.

Moore's (1973) - Level 3 category provided that the area was known beforehand then it has an almost adult level of scale and distributional accuracy.

Hart (1981) – Unable to classify but illustrative of the view that gender differences disappear from spatial representations when the child has sufficient free-range exploration of their local environment. This girl drew a fairly small patch of the world but it is clearly one that she knows extremely well.

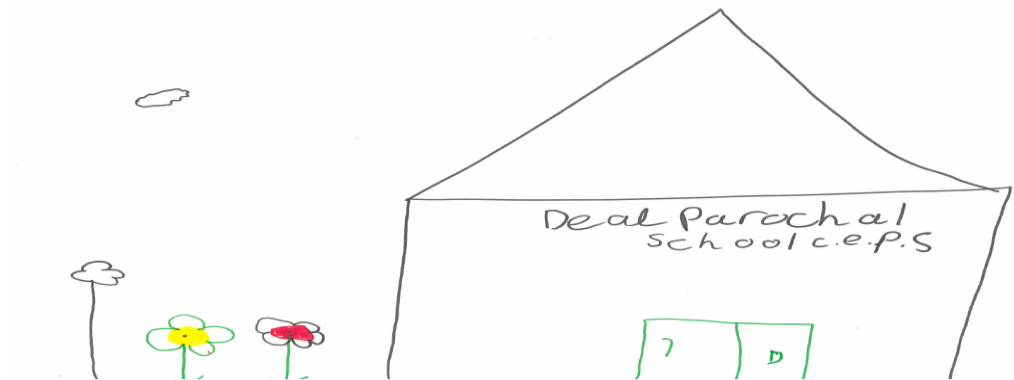
Matthews (1984) - Grade III Plan type images as it is totally orthogonal and has good spatial and distributional accuracy.

S3G7



Analysis provided within thesis

S3G8



Interpretation Task – Image identified as a map

Right Hand

Reason – Water is blue and this has land with green grass

First object drawn – The small irregular oval in centre left of image

Drawing Notes – This child was the last for the day and she was even more obvious than her predecessor in the non-verbal communication of her desire to complete this task and return to the class craft activities. With that in mind, the resulting artefact is interesting for what it shows and what it might have shown had the child been willing to devote more time to it. The drawing began with the small irregular black oval and the child responded to questions by saying that it was an island and that it was far away from her town. Given that the nearest island is the Isle of Wight this raises questions about the reason for the child starting with something absent from the local region of the town. The child refused to be drawn further on the identity of the island and instead began drawing the isometric view of the school. When complete she labelled and decorated it with a yellow and a red flower and a black tree. She then stated she was finished and asked to return to class and the researcher admitted defeat gracefully.

Classification using each model

Appleyard (1969) – Unable to classify as depicts only single building or site.

Ladd (1970) - Type 1 Pictorial Drawing, because despite the label words it is impossible to use it for wayfinding. Similarly it falls below any of

Moore (1973) - Below classification threshold

Hart (1981) – Unable to classify. Illustrates points discussed with the previous artefact and illustrates the human limitations of data collection with children in the final week before summer term ends.

Matthews (1984) – Possibly Grade 1A Pictorial Depiction but this is stretching the classification.

END OF DOCUMENT