Children's Understanding of Illness

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Abstract

Previous research into children's understanding of illness has mainly followed Piaget's cognitive-developmental framework. Most investigations have been concerned with children's beliefs about the causes of illness, and their factual knowledge about diseases. The empirical work presented in this thesis examined children's developing understanding of illness using the more recent naïve theory approach to children's cognitive development. Study 1 investigated children's illness concepts. The findings revealed age-related differences in children's understanding of illness. The individual differences in understanding which were found in Study 1 were investigated for possible links with parental health attitudes and behaviours, and with the children's personal experience of illness, in Study 2. However, no significant links were found. Study 3 was concerned with children's generalisation of illness from three different exemplars (child, dog and duck). It also explored possible individual differences between healthy vs chronically-ill children's responses to the three exemplars. The results showed that the children possessed different understandings of illness at different ages, and also that depending upon exemplar the children exhibited different patterns of illness generalisation. However, no individual differences in children's illness understanding were identified as a function of their health status (healthy vs chronically-ill). Study 4 explored possible links between parental health attitudes, and the presence of health-related objects in the home, and the individual differences in the children's understanding of illness as documented in Study 3. Again, no significant links were found. Study 5 investigated whether children hold an integrated category of living things, one that includes both animals and plants, by looking at their generalisations from four different exemplars (child, dog, duck and rosebush). Age-related differences and differences depending upon exemplar were again revealed. It is concluded that these findings can be best explained by positing that children hold naïve theories of biology, and that the development of these theories does not appear to be affected by the health status of the child, parental health attitudes, or the presence of health-related objects in the child's home.

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Preposterous yet real: one of the first pages of this thesis had to be written last. I suppose that before I could look back and reflect on the time I have spent on this journey of knowledge and experience I had to finish the journey first. The journey was long and difficult yet though I felt scared I never felt lonely for I had good companions who were always ready to help and support me. Hence, this page is dedicated to my companions to whom I would like to express my gratitude.

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Contents

1	Introduction	1
2	Review of the literature on children's conception of illness	5
	2.1 Introduction	5
	2.2 The Piagetian Approach	5
	2.3 Criticisms of the Stage Approach	8
	2.4 The Theory Approach to Cognitive Development	13
	2.5 The Naïve Theory of Biology Approach	14
	2.6 The work of Carey	19
	2.7 The work of Keil and of Hatano and Inagaki	22
	2.8 Studies of Children's Understanding of Illness from a Naïve theory of Biology Approach	27
	2.9 Conclusions	33
	2.10 The Present research	34
3	Children's generalisation of illness across ontological boundaries	35
	3.1 Introduction	35
	3.2 Method	36
	3.3 Results	38
	3.4 Discussion	45
4	Possible influences upon children's understanding of illness	47
	4.1 Introduction	47
	4.2 Method	48
	4.3 Results	50
	4.4 Discussion	58
5	Healthy vs chronically-ill children's generalisation of illness from three different exemplars	61
	5.1 Introduction	61
	5.2 Method	63

5.3	Results	66
5.4	Discussion	86
6	Possible influences upon children's understanding of illness: a theme revisited	94
6.1	Introduction	94
6.2	Method	94
6.3	Results	95
6.4	Discussion	97
7	Children's generalisation of illness from four different exemplars a theme revisited	101
7.1	Introduction	101
7.2	Method	102
7.3	Results	105
7.4	Discussion	129
8	Conclusions	137
8.1	Children's understanding of illness: changes associated with age	137
8.2	Children's understanding of illness: effects of exemplar	140
8.3	Individual differences in children's understanding of illness: healthy vs chronically-ill children	143
8.4	Children's understanding of illness: associations with parental health attitudes and the presence of health-related objects in the home	143
8.5	Theoretical implications of present findings	144
8.6	Limitations of the present research	148
8.7	Conclusion	149
	References	151
	Appendix 1: Chapter 3: ANOVAs	163

Appendix 2: Chapter 4: Parental Questionnaire	179
Appendix 3: Redesigning the Parental Questionnaire	183
Appendix 4: Chapter 5: ANOVAs	217
Appendix 5: Chapter 6: Parental Health Attitudes Questionnaire	254
Appendix 6: Chapter 6: Factor Analysis	259
Appendix 7: Chapter 6: Factor Analysis	264
Appendix 8: Chapter 7: ANOVAs	271

CHAPTER 1

Introduction

The importance of studying children's understanding of health and illness is well recognised. Firstly, the development of children's beliefs about health and illness has significant practical implications for educating chronically-ill children about their disease, medical treatment and hospital admission. In recent years, advances in medical care have resulted in significant changes in the pattern of childhood illness. For example, medical procedures have changed the survival rates for children suffering from life-threatening conditions such as leukaemia, kidney disease and cystic fibrosis (Katz, Kellerman & Siegal, 1980). The considerable threat of loss is replaced by the uncertainty for the future, associated with the improvement in medical treatment and consequently with the better prognosis of the disease. Therefore, parents and children are encouraged to become responsible for many aspects of medical care necessary in helping children and families live with a chronic condition (Eiser, 1989). Furthermore, it is known that one of the children's most distressing life events is hospital admission (Rutter, 1981). Bowlby has emphasised the traumatic event of children's hospitalisation in his own work (Bowlby, 1952). Paediatric patients might benefit from explanations about illness and medical procedures which can result in a better adaptation to the stressful event.

Secondly, it is clear that there is a considerable need to educate all children more generally about self-care, health attitudes and behaviours within the context of health promotion and education (Natapoff, 1978; Michela & Contento, 1984; Eiser, 1989). The practical need to inform children about health and illness is well recognised. Explanations given to children about the reasons for an illness and rationale for treatment assume at least some knowledge about the body and how it works, as well as some awareness about disease processes (Eiser, 1985).

Thus, the empirical work presented in this thesis aimed to investigate the development of children's understanding of illness. It was hoped that by studying children's understanding in this domain, this research would ultimately help to lay the

foundations for the future development of more effective health education programmes for children.

The research which was conducted addressed a number of salient questions concerning children's understanding of illness. These questions included: How does children's understanding of illness change with age? To what extent do children understand that only certain types of entities (biological entities) can get ill? Are there individual differences in how children understand illness? Do chronically-ill children acquire a different understanding of illness from that acquired by their healthy peers? Do parental health attitudes, and the presence of health-related objects in the home, affect children's understanding of illness? These are just some of the questions which were addressed in this research.

The thesis is structured as follows. Chapter 2 reviews the existing research on children's understanding of illness. This chapter gives an overview of the research which has been conducted using a Piagetian Stage approach, and an overview of the more recent research which has instead been based upon the Naïve Theory approach to children's cognitive development.

Chapter 3 reports the first empirical study which was conducted (Study 1), which investigated children's concept of illness. 202 children aged between 5 and 11 years who were recruited from two schools in East Sussex County were the participants of this study. The children were asked to decide which of 30 different entities, drawn from 6 ontological categories, can or cannot get ill. It was found that the children's thinking differed at different ages suggesting that children possess a different understanding at different ages about the ontological boundaries for illness.

Chapter 4 reports the second study, which explored possible links between the children's thinking about illness and their personal experience with illness and their parents' health attitudes and behaviours. The parents of the children interviewed in Study 1 were the participants of Study 2. No systematic links were found between the children's understanding of illness and either their personal experience of disease or their parents' health attitudes or behaviours. This failure to find such links, however,

might have been due to methodological problems associated with the questionnaire which was used, which failed to display the expected factor structure.

Chapter 5 reports Study 3, which was designed to explore healthy vs chronically-ill children's generalisation of illness from three different exemplars a child, a dog and a duck. In order to tap into children's naïve theories of illness, and not their acquired knowledge of a specific disease, a hypothetical illness was presented, namely plinkitis. 291 children, aged 5 to 11 years, who were recruited from the same two schools as in Study 1 (but who had not participated in Study 1), and 91 children suffering from a chronic condition such as asthma, diabetes, cystic fibrosis etc., aged 5 to 11 years, who were recruited from the Royal Alexandra Hospital For Sick Children, in East Sussex, were requested to decide about the illness susceptibility of 30 entities drawn from 6 ontological categories. The results once again showed that the children possessed different understandings at different ages concerning their ontological boundaries for illness. Additionally, in this study it was also found that, depending upon exemplar, the children exhibited different patterns of generalisation. However, no differences were found between healthy and chronically-ill children's understanding of illness.

Study 4 investigated whether the individual differences in the children's thinking found in Study 3 were linked to parental health attitudes and the presence of health-related objects at home. This study is reported in Chapter 6. A redesigned health attitude questionnaire was administered to the parents of the participants of Study 3. The findings, however, did not reveal any consistent links between patterns of generalisation presented by the children and either parental health attitudes or the presence of health-related objects in the home.

Study 5, presented in Chapter 7, investigated children's generalisation of illness from four different exemplars (a child, a dog, a duck and a rosebush). The aim of the study was to investigate children's biological understanding in relation to the category of plants. Again, in order to tap into children's naïve theories of illness, and not their acquired knowledge of a specific disease, a hypothetical illness was presented, namely plinkitis (although the name of the made-up illness was the same as in Study 3, the

illness description differed in order to be suitable for the rosebush exemplar). 280 children, aged 5 to 11 years, who were recruited from a Junior and its adjacent Infant school in East Sussex County (and none of whom had participated in any of the preceding studies) were requested to decide about the illness susceptibility of 30 entities drawn from 6 ontological categories. The results showed that the children possessed different understandings at different ages for their ontological boundaries for illness only for the duck and rosebush exemplars. In addition, the children who participated were reluctant to attribute the hypothetical illness from the human and non-human animal exemplars to the category of plants. On the contrary, plants were included in children's response patterns only when the rosebush was the exemplar used. Overall, the children were willing to generalise from plants to animals and humans, but not from humans and animals to plants.

Finally, Chapter 8 draws together the novel findings from the various studies. It is argued that children aged between 5 to 11 years old do hold naïve theories of biology which they use in order to make judgements about the illness susceptibility of different entities. In addition, the children offered some evidence of an appreciation of the integrated category of living things in relation to illness susceptibility. Furthermore, it is argued that children's judgements in this domain show individual differences, although these differences are not systematically related to either the children's health status, parental health attitudes or the presence of health-related objects in the home.

CHAPTER 2

Review of the Literature on Children's Conception of illness

2.1 Introduction

This chapter reviews the existing body of research which has been conducted into children's understanding of health and illness. Much of this research has been based on a stage model of development suggesting that children's beliefs progress systematically through a series of stages similar to the general cognitive sequence described by Piaget (Harbeck & Peterson, 1992).

The following literature review will give a brief introductory overview of the Stage approach and the cardinal criticisms against this approach. This will then be followed by an overview of a more recent approach to cognitive development, namely the Theory approach, with an emphasis given to children's Naive Theories of Biology. Finally, there will be a review of the research into children's understanding of illness which has been conducted within the Naive Theory of Biology framework.

2.2 The Piagetian Approach

Within Piaget's developmental framework, a considerable amount of work has been concerned with children's understanding of the cause of illness, which has been found to be related to their level of cognitive development (Rubovits & Siegel, 1994). The assumption is that children's beliefs about illness are stage-dependent. According to Piaget's structural model of cognitive development, the child's comprehension of experiences is determined by the characteristics and the limits of thought at each stage (Flavell, 1963; Piaget & Inhelder, 1969). Thus, it was argued that children's concepts of health and illness will parallel the findings of Piaget on the ontogenesis of causal reasoning. The cardinal belief was that a child's explanation of illness reflects his/her current stage of cognitive development, which is also the one that characterises the child's overall cognitive competence. Bibace and Walsh (1981) and Perrin and Gerrity (1981) tried to describe the development of children's illness concepts in terms of a shift from preoperational to formal operational thought. More specifically, the above researchers interviewed children and coded their responses according to the three major types of explanations consistent with Piaget's stages of cognitive

development (preoperational, concrete operational and formal operational). In addition, they identified two subtypes of explanations within each stage (Bibace & Walsh, 1981). Therefore, children's illness conceptualisations have been viewed as developing from global to more logical and differentiated ideas during the child's transition from the preoperational to later stages of cognitive development. As Potter and Roberts (1984) report in their study on children's perception of chronic illness, concrete operational children are more able to comprehend detailed information as opposed to preoperational children who seem to benefit more from global non-specific explanations of diseases. This conclusion is consistent with Bibace and Walsh (1980) since the emphasis is given to the child's stage of cognitive development as reflecting the core predictor for children's comprehension of illnesses.

According to Bibace and Walsh, six subcategories of explanations can be identified within the known stages of cognitive development. *Phenomenism* is the most developmentally immature explanation of illness, according to which the cause of illness is an external concrete phenomenon. Children in that stage seem unable to explain the mechanisms under which the external phenomena can cause an illness. However, the most common explanation given by children in the preoperational stage is *contagion*. Illness can be transmitted from people or objects which are proximate but do not touch the child. For example, colds can be transmitted by magic, from the trees or from God (Bibace & Walsh, 1981). Illness is regarded as a form of punishment which follows a sin and children hold beliefs about illness causation related to immanent justice. Cause-effect relationships for illness explanations are interpreted, by children in the preoperational stage, in magical terms with no evidence that their reasoning could be based on non-observable cues (Bibace & Walsh, 1980; Neuhauser, Hines & Steward 1978; Whitt, Dykstra & Taylor, 1979). It is also believed that children in the latter subcategory cannot differentiate between contagious and non-contagious illnesses. For example, young children believe that toothaches as well as colds are transmittable through contact with a sick person (Siegal, 1988). In addition, Brewster (1982), and Perrin and Gerrity (1981), reported that children aged between 7 and 10 years believed that all illnesses can be caused by germs.

Contamination is the explanation given by the younger children in the next stage of cognitive development defined by Piaget, the concrete-operational. In that stage children can clearly distinguish between what is external and internal to the self. In addition, the child distinguishes between the cause of an illness and the ways in which it is effective. The cause of illness could be an object, a person or an action outside the child but potentially harmful for the body. The child may be infected either through its contact with the object/person or through its physical engagement with the harmful action, resulting in the child's contamination. However, children at this level have no notion of how the human body participates or responds; therefore, when the agent is internalised illness will follow (Sayer, Willett & Perrin, 1993). A more mature explanation offered by older children in the concrete logical stage is *internalisation*. Illness is now located within the body although the cause may still be external. The external cause can be a person or object linked with the internal effect of illness through the process of swallowing or inhaling (Bibace & Walsh, 1980).

Finally, Bibace and Walsh identified two substages of formal logical thought, the *physiological* and the *psychophysiological*. In both subcategories of this stage, the greatest differentiation between the external and internal world occurs. In other words, although the source of illness is located within the body, the cause of it is perceived as an external agent. Brewster (1982), in her study investigating the relationship between cognitive development and children's understanding of the cause of illness, reports that children in the formal operational stage offered multiple explanations for the cause of disease, integrating events such as infection and the body's immune deficiency. The *physiological* explanation is offered by the younger children of the formal operational stage suggesting that the cause is described as a malfunctioning or even non-functioning of an internal organ or process. The most mature conceptualisation of illness is represented by the *psychophysiological* explanations, according to which the child describes illness as the malfunctioning or non-functioning of an internal organ or process but also recognises the alternative psychological cause of the illness. Thus, in this stage, children recognise that heart disease might be the result of heart malfunctions, and the consequence of the individual's intensive work, or the outcome of its exposure to extreme stress (Eiser,

1989). It seems therefore that by that stage children are aware of the association and interaction between one's feelings and bodily function (Bibace & Walsh, 1981).

Understanding of illness causality (which is the capacity to notice and relate external and internal causes of illness) appears to progress from preoperational thought with a child being unable to verbalise a reason, to concrete operational thought with a child verbalising a general external cause, to finally formal operational thought including physiological and psychological causes. Herbeck and Peterson (1992), in their study supporting the cognitive-structural tradition as exemplified by Piaget, claimed that children's understanding of pain causality follows a linear progression similar to their understanding of illness. Therefore, they suggest a developmental progress: on from a child being unable to verbalise a reason why pain hurts, to verbalising a very general external cause of pain, to finally giving physiological or psychological causes. Additionally, Berry, Hayford, Ross, Pachman & Lavigne (1993) in their study on conception of illness, interviewed children with Juvenile Rheumatoid Arthritis about a plethora of aspects of their disease. The authors pointed out that children's understanding of their disease followed a developmental progression, with a proportionally greater number of older children demonstrating a more sophisticated understanding than the younger ones (Berry et al., 1993). Therefore, as in the case of moral, logical, social and ego development, understanding of illness causality is hypothesised to progress with development (Sayer et al., 1993).

2.3 Criticisms of the Stage Approach

One of the major criticisms against the structuralistic approach is its almost exclusive dependence on what are construed as universal and endogenous cognitive processes. Research studies using Piagetian stage theory as the basis for classifying children's conceptions of health and illness have documented a systematic developmental progression in the content and sophistication of children's responses. However, little attention has been paid to individual differences in children's understanding of illness and reasoning about medical and physiological phenomena (Rubovits & Siegel, 1994). The Piagetian approach fails to take account of alternative interpretations of age-trends in children's illness knowledge. Nevertheless, some studies concerned with this matter have claimed that possible explanations for age-differences in illness

knowledge have been the increasing availability, with age, of information about illness and health in general (Bird & Podmore, 1990; Dimigen & Ferguson, 1993). It is also proposed by Goldman, Whitney-Saltiel, Granger and Robin (1991) that there are more specific links between children's illness understanding and their developing concepts of nutrition and knowledge about medical examinations. Furthermore, one of the factors identified as having a significant influence on children's understanding of illness concepts is the child's experience of illness. The degree and the direction of that influence is unclear.

For example, early work in the area suggested that the ill child's understanding of illness causation developed similarly to the healthy children's conceptions (Eiser, 1985). It has been argued that the specific illness and the length of hospitalisation do not affect the child's level of understanding (Brewster, 1982). However, investigators working with chronically ill children or children with acute illnesses have suggested that their exposure to the disease and medical treatment results in a greater understanding of illness-related concepts in comparison to healthy peers (Bibace & Walsh, 1981; Feldman & Varni, 1984; Rubovits & Siegel, 1994). Others, on the contrary, have reported that children who have experience of illness demonstrate a less sophisticated understanding of illness-related concepts than do children lacking similar experience (Nagera, 1978; Simeonsson, Buckley & Monson 1979; Caradang, Folkinns, Hines & Steward, 1979; Eiser, Town & Tripp, 1998; Shagena, Sandler & Perrin 1988; Perrin, Sayer & Willett, 1991). Berry, Hayford, Ross, Pachman, and Lavigne (1993) pointed out a number of children suffering from Juvenile Rheumatoid Arthritis maintaining misconceptions about their condition, in spite of the information given to them. Such a conclusion is consistent with the hypothesis that personal experience of illness results in a retardation of children's development of illness concepts (Eiser, 1988).

There is therefore a disagreement in the literature concerning the importance and the role of illness experience in the formation of children's concepts of health and illness. Until recently the main belief was that the development of children's illness concepts was heavily dependent on cognitive structure, with social, cultural and contextual aspects having only secondary significance. As a consequence, most research

exploring the understanding of illness has focused on the role of children's general level of cognitive development. The impact of experience has received less attention, and available findings are inconsistent. One of the possible reasons resulting in these conclusions might be the methods used for data collection.

A review of the studies of children's conceptions of illness reveals numerous methodological problems that make the findings of Piagetian studies difficult to interpret. Firstly, there is no consensus about reliable criteria for determining which behaviours indicate which type of operational thought in the domain of illness knowledge (Hergenrather & Rabinowitz, 1991). Similar behaviours are cited as evidence for different kinds of operational thought in different studies. Perrin and Gerrity (1981) suggest that a child's view of illness as punishment for misbehaviour is an example of preoperational thought, whereas Bibace and Walsh (1981) claim that this is evidence for concrete operational thought. Moreover, the belief that all illnesses are the result of infection was interpreted as evidence for concrete operational thinking in one study by Kister and Patterson (1980) and for preoperational thinking in another study by Nagy (1951).

Secondly, the ways in which children's cognitive level is measured is another weakness in studies dealing with their understanding of illness. In general, researchers have used the child's performance on standard Piagetian tasks as the measure of the child's level of operational thinking. For example, Harbeck and Peterson (1992) in their study, investigating children's understanding of specific pains, measured their performance on physical conservation-identity tasks in order to relate children's level of operational thinking with their concepts of pain. However, examinations of children's performances on transformations or perspective-taking tasks reveal a lack of correlation, suggesting that the different tasks are unreliable indicators of children's cognitive level (Gelman & Baillargeon, 1983). Overall, research studies have failed to reveal intercorrelations between the various tasks, which suggests that the standard Piagetian tasks do not provide a reliable measure of cognitive development. Therefore, relationships between children's performance on standard Piagetian tasks and illness concepts are difficult to interpret in relation to Piaget's theory.

Thirdly, much research concerned with children's conceptions of health and illness is based on interview data. Little attention has been paid to the validity and reliability of the interview schedules used, with only rare attempts to include questions which could enable comparisons to be made across different studies (Eiser, 1989). In addition, it seems that children's responses do not necessarily reflect the depth of their understanding (Siegal, 1988). The child's possible linguistic inability is interpreted, in the context of Piaget's stage theory, as lack of understanding; something which suggests that children's knowledge might be underestimated. In a study by Dimigen and Ferguson (1993), it is reported that the increased number of concrete logical explanations given by older children regarding their concepts of illness was due to the fact that more questions were answered by these children. Therefore, older children's ability to express verbally their beliefs and illness related-knowledge has been taken to reflect a more sophisticated thinking; something which might be true. However, it is also possible that younger children may not be able to express in words their beliefs about illness and illness-related concepts which does not necessarily imply that they have no knowledge about them. Children rarely can describe in words what they know (Karmiloff-Smith, 1988). Also, although children might have some knowledge about health and illness, they may not be able to consciously access that knowledge from memory (Kail, 1990).

But there have been other fundamental criticisms. Measuring children's understanding of illness concepts involve extensive and repetitive questioning which might lead children to misinterpret the purpose of the interviewer's questions. The stress of repeated questioning may cause the child to change responses if he or she interprets the repetition of the questions as evidence of his or her inability to understand the question the first time that it was asked (Rose & Blank, 1974). There is also potential contrast between the interviewer's expectations and the child's own perception of what is being required from them in an interview (Moston, 1987). It is apparent that children's responses in an interview setting are influenced by what the respondent thinks the questions mean, and by what he or she feels the interviewer will accept as an answer. Furthermore, children usually do not contradict an adult, since the approval from significant adults is very important for the child's maintenance of

self-esteem. Therefore, it is expected that the interviewees will try to protect themselves against the unfavourable judgements of others. For example, when Ross & Ross (1984) asked children what they did when they had a pain so that it hurt less, 4.3% of the participants said they tried to sleep. When the children were asked directly whether they ever tried to sleep when they were in pain, 60.9% agreed that they did.

There is one salient characteristic of interviewing children related to the amount of power and authority exercised in the questions: this is known as *valence*. Children are very sensitive to this feature of adult-child communication. Pure information questions must have a neutral valence; that is they must not have any effect on the status of the interviewer and the respondent. Control questions on the other hand, have a positive valence since they establish a relative dominance of the questioner over the respondent. For example, the parental question ``What are you doing?`` does not request any kind of information about the child's activities but instead means ``Stop doing that``. Caretakers usually expect agreement or behaviour compliance when asking children questions, not information. Thus, children whose primary experience is with caretakers' questions, may not understand that an interviewer's question is a request for information, but instead see it as a direction (Garbarino et al., 1989). On the basis of what has been mentioned above, it seems extremely difficult for adults to ask questions that do not appear to children to have a positive valence. Children may deliberately change their replies, probably because they think that the interviewer is telling them that their answer is wrong, or unacceptable. Therefore, alternative procedures of assessment should be used. This concern with the considerable verbal requirements of interviewing has led to a number of attempts to invent non-verbal or at least less verbally-dependent procedures for investigating children's illness concepts.

Finally, the idea of investigating children's conceptions of illness within the framework of Piaget's theory of cognitive development is itself problematic. Some researchers have suggested that Piaget's general developmental stages refer to the characteristics of the logic available to children (Carey, 1985; Gelman & Baillargeon, 1983). Thus, explaining children's understanding of illness according to the known

stages of cognitive development implies that there is something about the nature of children's thought that limits their understanding (Hergenrather & Rabinowitz, 1991). However, children might not necessarily be radically different kinds of thinkers compared with adults (Chi, Glaser & Rees, 1982), and trying to explain children's knowledge about illness using general stages of cognitive development may confuse domain-general inferential abilities with knowledge in specific domains. More recent research suggests that while children's structural development may affect the organisation of knowledge, a large amount of experience in a specific knowledge domain may influence the development of concepts within that domain (Chi & Ceci, 1987). In other words, the acquisition of domain-specific knowledge may result in more developed conceptions within a domain than would be expected on the basis of the child's cognitive development alone (Nelson, 1986).

2.4 The Theory Approach to Cognitive Development

Investigators within the ``stage`` tradition have considered concepts of health and illness in isolation, without taking into account the influence of experience and the ways in which knowledge of one concept might affect knowledge of another (Eiser, 1990). Piagetian theory describes general stages of thought that apply across widely varying content areas, and explains children's development using a rigid classification system exclusively dependent on cognitive structures. Children are portrayed as being incapable at a structural level of understanding certain concepts. Without taking into account the significant role of social and cultural beliefs and aspects of life, Piaget supports a content-independent and domain-general theory of cognitive development.

In contrast to the Piagetian position, several authors have, in recent years, argued that the child's cognitive system can be much better characterised as consisting of a number of specific areas of knowledge known as *domains* (Wellman & Gelman, 1992, 1998). Concern with domains reflects increased interest in the development of systems of cognition and the acquisition of naïve theories which are specific to some bodies of information and not others, representing a contrast to the Piagetian domain-general approach. Researchers working within this more recent paradigm have proposed that there are two different sorts of theories: framework or naive theories and specific theories (Wellman & Gelman, 1992, 1998). The former theories compel

and guide the development of the latter ones; examples of framework theories within the field of psychology are behaviourism and psychodynamics. Framework theories define a coherent form of reasoning about a group of phenomena. On the other hand, specific theories concern detailed scientific formulations about a delineated set of phenomena. For example, Freud's theory of the Oedipal complex belongs to the latter theoretical category (Wellman & Gelman, 1992, 1998).

Within the theory approach, the child is portrayed as a ``theorist`` (Rosser, 1994) using complex mental structures that function as explanatory systems (Carey 1985). The child's common-sense, non-scientist's everyday understandings of certain bodies of information form what is known as a ``naive theory``. Theories are explanatory systems that inform us about cause and effect and tell us why and how an observed empirical event occurred (Rosser, 1994). Children's naive theories enable them to search for and acquire further information about the world. To hold a naive theory of some domain is to have some elementary explanation and initial hypothesis of how the phenomena in that domain work. The cardinal claim of the naive theory approach is that cognition may differ substantially in different areas or domains; in other words, theories are domain-specific. In that sense, three framework theories have been investigated in depth in children: naive physics, naive psychology, and naive biology. That is to say children's knowledge in these three domains has been investigated from the point of view of its cohesiveness, its internal consistency, and its explanatory value, that is, those characteristics that enable it form a theory-like system of understanding (Rosser, 1994). Because of its direct relevance to the present research this literature review will focus on the research which has been conducted into children's naive theories of biology.

2.5 The Naive Theory of Biology Approach

Researchers working within this paradigm have argued that our everyday understanding of biological phenomena such as life, reproduction, illness, inheritance, and death derives from naive theories of biology. Our naive theory of biology enables us to see the significant commonalities and differences between humans and other species. However, the question is whether children have a naive theory of biology which is distinct from their naive physics and naive psychology. In principle, it could

be the case that biology is confused with psychology, especially as there is some evidence that children explain biological processes in terms of psychological ones. For example, children do suggest that people grow because they want to get bigger (Carey, 1985). According to Carey, children's predictions and explanations about biological phenomena, before the age of 10, are based on their intuitive psychology. In other words, young children use intentional causality in the biological domain because they do not recognise that bodily functions are independent of human intentions nor that biological processes are autonomous.

In contrast to Carey however, many other researchers have argued that young children do have a distinct naïve biological knowledge. For example, it has been found that children as young as 6 years of age recognise that a baby rabbit grows not because its owner wants it to but because it takes food (Inagaki & Hatano, 1987). Such a finding suggests that young children do recognise the autonomous nature of biological processes and distinguish them from psychological ones. The fact that some processes cannot be stopped by intention alone, and thus people cannot prevent an animal from growth just because they like it small and cute, is understandable even by young children (Inagaki & Hatano, 1987).

Yet, if children's understandings are governed by domain-general principles, then biology might fail to function as a distinct domain. For example, children may classify animals and plants using domain-general principles of similarity such as shape and colour, and not specific biological features such as the presence of eyes (Wellman & Gelman, 1992). However, Hatano and Inagaki (1996) in their study into children's understanding of commonalities between animals and plants, found that a great majority of children 5 and 6 years of age mention the commonalities in terms of feeding and growing in size, and hence distinguished animals and plants from inanimate things. These findings indeed seem to suggest that young children do not use domain-general principles of similarity in order to distinguish between animate and inanimate entities; on the contrary they base their decisions upon biological processes of life. Similarly, Springer (1992), in his study about children's awareness of the biological implications of kinship, found that young children use kinship over perceptible similarity as their basis for judgement. This finding counters the

assumption that children are perceptually bound, and suggests that they do hold at least some insights about biological relationships.

More recent research in the area has shown that children treat biology as a distinct domain in the sense that they do have an ontology of biological kinds and hold biologically specific causal beliefs applied to the members of each ontology. Most of the research has focused on children's understanding of core distinctions, showing that children do not honour all of the major distinctions that adults do. For example, their early understanding of biology includes animals but tends to exclude plants (Wellman & Gelman, 1992, 1998). Additionally, the fact that young children treat inanimate entities differently from animals and plants (Hatano & Inagaki, 1996) is not sufficient to conclude that they hold an integrated category of living things. However, these findings do not support the notion that children do not have framework theories but on the contrary emphasise the fact that children's framework theories may differ substantially from those of adults. If children do own framework understandings rather than specific knowledge of concrete phenomena, one should expect the presence of children's understandings and beliefs irrespective of specific knowledge. In that sense, children's conceptualisation might be sensible before being accurate. For example, children seem to understand the distinction between animate and inanimate things at a young age, but very often do not know where different entities fall with regard to this distinction (Richards & Siegler, 1986). However, it has been reported by Hatano and Inagaki (1994) that young children before the age of 6 are able to distinguish plants and animals from non-living things in terms of growth; therefore, young children recognise plants as distinct from non-living things in some respects. As Backscheider, Shatz, and Gelman (1993) showed, 4 year old children assigned to both animals and plants the ability to regrow when damaged, something which they denied to hand-made artifacts.

Moreover, in a study into children's understanding of growth in animals, it has been reported that even 3 and 4 year-olds believe that animals and not inanimate objects increase in size over time (Rosengren, Gelman, Kalish & McCormick, 1991). It is also reported that by age 6 children begin to extend ``growth`` to germs (Au & Romo, 1996): children expect an increase in size with age for animals, while for artifacts they

anticipated them to remain the same size. They also seem to understand that development and growth are constrained in specific ways. For example, animals get bigger not smaller and become structurally more complex not simpler, such as the caterpillar to butterfly, and not vice-versa (Au & Romo, 1996). Investigation into children's knowledge of the consequences of a natural process such as growth, reveals that children have some understanding about natural life cycle changes from the age of 3. In the light of the above, it appears that children from a young age can draw a distinction between animate and inanimate entities, based on a natural biological mechanism, in this case, growth.

However, running counter to such an early emergence view are the results of a study which examined young children's understanding of how and why offspring resemble their parents (Solomon, Johnson, Zaitchik & Carey, 1996). Children were told a story in which a boy was born and adopted; the description of the biological father was given in which he was described as having one set of features while the adoptive father was described as having another set of features. The children were then asked to decide which man the boy would resemble when he grew up. The findings indicated that pre-school children could *not* conceive biological inheritance, since it was not until the age of 7 that they associated the boy with his biological father regarding physical features, and with the adoptive one regarding beliefs. In other words, it was not until the age of 7 that children presented an understanding of inheritance as an essential part of a process which mediates the acquisition of physical traits.

In contrast, however, in another study by Springer (1992), children 4 to 8 year-old were asked to decide whether offspring resemble their parents. The children were presented with a picture of an animal with an unusual property, with "a horse that has hair inside its ears". The interviewer probed for projection of the unusual property to a physically similar horse that was a friend unrelated to the target, and to a physically dissimilar horse, introduced as the target's baby. Children at all ages projected the property more to the baby horse than to the friend horse. In other words, children in the 4-8 year-old age-range recognised kinship as an important condition for property inheritance. This suggests that Solomon et al.'s findings may have been artifactual.

There are two substantial components of biology: the taxonomic component and the component concerning biological process. The taxonomic component refers to the classes of organisms, or the set of individuals who constitute a group of biological entities, and to the interrelationships among them. Species membership is scientifically defined through reference to common chromosomal structure (DNA) shared by the organisms within the same classification. More perceptible shared features of biological functioning, which in turn define organism grouping, are physical structure, reproductive process, and species-typical behaviour. That is about how the organisms of the same species operate and function; in other words, which causal processes are taking place within biological systems. These two major components, taxonomy and function, are related one to the other since functions and causal processes define a specific group of biological objects and vice versa. Thus, in order to construct knowledge of biology children must recognise which groups of organisms share characteristics of appearance and operation. Furthermore, they have to decide which of those characteristics are most relevant to decisions about organism similarity and grouping.

The question is whether children have an elementary understanding of biological kinds, such as animal, and bird; biological states, such as alive, and ill; and biological processes, such as breathing and eating. If it is suggested that children do have a naive theory of biology (a basic understanding of biological concepts) it seems necessary to propose a method in order to study the nature of that understanding. As is evident from what has been mentioned above, the traditional interview method for obtaining information and extracting evidence of knowledge and understanding, by asking children for verbal explanations of biological concepts and processes, is very problematic. Therefore, alternative techniques need to be used in assessing children's basic understandings of biology. It seems necessary to design creative tasks less dependent on verbal procedures in eliciting children's implicit understanding of biological principles.

Inductions and *biological transformations* are two procedures which are reported in the literature as the fundamental alternative methods which can be used in order to

study children's understanding of biology. The researchers using inductions assume that children will generalise a fact about one individual only to other individuals in the same category. In that sense, children's judgements about the generalisability of biological facts gives the researcher the potential to conclude that children might organise the biological grouping of individuals according to shared biological functions. Transformations on the other hand, are used in order to assess the sorts of biological transformations that are acceptable by children as plausible. Acceptance of kind-altering transformations might involve different criteria for defining a biological kind than does rejection of the transformation (Rosser, 1994).

2.6 The work of Carey

The most systematic developmental work to date on patterns of induction in young children has been done by Carey (1985). Carey investigated the acquisition of biological knowledge between 4-10 years of age, by questioning children about their concepts of ``living things``, animal properties, the human body and its functioning. A core dimension of her account concerns the child's inexperience compared with that of the adult. According to Carey, children's beliefs about issues such as how the body works do not develop in isolation, but are part of more extensive changes in fundamental biological knowledge. Since children have been taught little explicitly about biological processes that sustain life, and they are ignorant about the internal parts of the human body, they cannot know much about biological knowledge (Carey, 1985). Knowing, for Carey, is the result of experience, and since children have a limited experience with life, they have a limited knowledge of biological principles and therefore cannot have a biological theory. According to Carey, what sustains a theory is the facts. Lack of facts necessitate lack of theory.

More specifically, Carey believes that young children's concrete knowledge of biology is extremely limited and children's conceptual understanding of biological phenomena is restricted to a social theory of human behaviour. This notion was supported by her studies which demonstrated that young children had little knowledge about internal organs, and a tendency to describe biological processes such as eating as significant factors not for health maintenance but for satisfying social requirements. Therefore, she suggests that young children primarily hold social theories of

biological phenomena and only later they differentiate the biological and social domains.

Carey proposes that young children define the biological concept ``animal`` according to actions, behaviours and intentions and therefore, humans, cats, dogs and others that exhibit those attributes will look more alive than plants or bacteria. She also suggests that children attempt to explain the function of the human body in terms of wants and beliefs, and conceive biological processes such as breathing, eating, sleeping, in terms of intentional human behaviours. In a series of studies, she demonstrated that the ways in which children attribute properties to other animals does not reflect an adult-like biological model but the approximation of those animals to humans. Thus, children understand biological functions and processes in terms of anthropocentric psychological principles (Carey, 1985). Carey believes that children's understanding is based upon humans as the prototypical biological entity and then extended to other entities according to their similarity to people.

In one of her studies looking into the similarity function relating people and other animals at each age, she assessed patterns of inductive projection of an unknown internal organ (spleen) from people to other entities. Children were expected to project spleens from people to other animals according to the similarity between each specific animal and humans. If the assertion that children use human beings as the prototypical animal is correct, then when children are presented with exemplars that hold the unknown property belonging to different biological categories (people, dogs and bees), they should generalise more from humans than from any other animal. This would suggest the core role of knowledge related to humans and human activities in governing the child's knowledge of animal properties. The findings revealed that children aged 4 years old projected the unknown property (spleen) to animals only if taught on humans, and not when they were taught on dogs or bees. The asymmetry in projection between the different exemplars was absent at the age of 10, and it was then that the children started to use alternative types of reasoning such as category membership. Consequently, children at very young ages appeared to be using the human being as the prototypical animal. Therefore, according to Carey, children's

understanding of biology is based on humans as the prototypical biological entity and then extended to other entities according to their similarity to people.

According to Carey, young children have coherent theories of biological phenomena, but their theories change qualitatively from psychological to biological ones with the acquisition of biological knowledge. On the basis of the above, it is apparent that Carey (1985) sees young children as being very limited in their ability to reason about biological systems. In that sense, her view is quite conservative and in a way consistent with the Piagetian perspective. However, Piagetians postulate generalised limitations in causal reasoning arguing for domain-general cognitive deficits that constrain biological conceptualisation in young children. For Carey (1985), on the contrary, children's limited reasoning is domain-specific. Children lack biological information which limits their ability to construct a naive theory of biology.

However, Carey's claim according to which an intuitive biology emerges from an intuitive psychology has been largely criticised in recent years (Wellman & Gelman, 1992; Inagaki & Hatano, 1993; Atran, 1994). Based on the existing evidence revealed by a plethora of studies concerned with children's emerge of intuitive biology, Carey (1995) agrees that her previous claim according to which "the ontological kind animal is originally part of an intuitive psychology and children attempt to explain all animal properties in terms of intentional causation" is wrong. This is because it has been shown by researchers that even pre-school children know about phenomena involving animals and people that cannot be explained in terms of intentional causation, hold a knowledge of "innate potential", present an understanding of property inheritance, and finally, have a domain-specific knowledge of disease (Inagaki & Hatano, 1993; Springer & Keil, 1991; Inagaki & Hatano, 1987; Springer, 1992; Rosengren et al., 1991; Springer & Keil, 1989). Based on these recent findings, Carey (1995) concedes that she previously underestimated the age at which children construct their first theory of biology; she suggests that it is around the age of 6 or 7 and not at the age of 10, as she claimed before.

2.7 The work of Keil and Hatano and Inagaki

An alternative perspective, advocated by Keil (1989), suggests that children show biological intuitions about biological kinds from an early age, but that their knowledge becomes increasingly differentiated and theoretically organised with age. Keil argues that young children, while lacking explicit and specific knowledge about biological systems, may still have an elementary understanding about the ways in which biological systems operate and function (Keil, 1989). If children do hold a naive theory of biology, they should exhibit some knowledge and an ability to reason based on that knowledge. Using their basic intuitive understanding, they construct a consistent biological theory that cannot be reduced to an intuitive theory of psychology. In other words, the development of biological knowledge in children does not require theory replacement but theory elaboration and differentiation (Rosser, 1994). According to Keil, children do hold a distinct theory of biology from early childhood (Keil, 1989).

In order to assess implicit biological knowledge, Keil explored children's early biological competence by examining their reactions to transformations. The question is whether children resist these transformations as true kind-altering changes. However, Keil was concerned with children's ontological knowledge structure, a classification system that takes into account similarity in the true nature of things. Using transformations he explored children's reasoning and their ability to make judgements about biological phenomena. He presented children with pictures of various natural kinds and hand-made artifacts. The children heard stories that involved changes of perceptual characteristics of the items presented, and then they were asked to decide about the resulting object's identity. For example, in one of the stories doctors took a racoon (showing picture of a racoon to the child) and by changing specific characteristics such as shaving away some of its fur, dying what is left all black and put in its body a "super smelly yucky stuff" just like a skunk has, the animal looked like this (showing a picture of a skunk to the child). Both pictures were present at the time of the final question about whether the animal that resulted was a racoon or a skunk.

It was found that children clearly resisted changes at ontological boundaries. Although young children 5 years of age were willing to allow for changes within ontological categories, they were less willing to accept changes across ontological boundaries. For example, even young children were unwilling to let a mouse become moss or to attribute life to a toy bird, yet they were willing to accept that a racoon can be turned into a skunk, or a horse to a zebra (Keil, 1989). Therefore, the children intuitively knew that animals have special properties which characterise their biological functioning and distinguish them from other entities. They also reasoned causally and did not look only at appearances when they made biological judgements. Therefore, Keil argues that children do have an intuitive taxonomy for structuring the biological domain and the mechanisms of operation allowable within a biological system. In other words, there are some underlying rules that govern children's decisions to accept some mechanisms or identity transformations as more plausible than others.

Although thinking changes during childhood, there is a continuity even from the pre-school years (Keil, 1992). Children resist impossible biological transformations and reject implausible explanations for biological processes, thereby exhibiting an implicit understanding. Considering what has been mentioned above, it seems that although children might lack explicit and specific knowledge about biological systems, they do have causal beliefs about biology and an elementary understanding of how biological systems operate (Rosser, 1994). It is predicted that young children should reveal an ability to reason based on some knowledge of biology. It is apparent that according to Keil (1989) an immature theory of biology cannot simply be reduced to an intuitive theory of psychology. It is assumed that children have a rudimentary understanding of biological properties, and indeed the bulk of the contemporary empirical evidence suggests that children show an early competence for biological reasoning (see section 2.8 below). Keil's studies indicate that children have naive biological theories which are in many respects ``wrong`` in comparison to adults' ones. However, that a theory is incorrect does not make it any less a theory.

In the natural world there are a number of occurring changes in the normal life span of living things. The plethora of transformations observed concern dramatic changes in

appearance, however these changes are natural and possible. On the contrary the transformation of a zebra into a horse, or a racoon into a skunk, are neither natural nor possible, although dramatic. It is believed that an understanding of biological concepts is related to the understanding of which transformations are possible and which are not. Keil in his research investigated children's understanding of biology through the examination of transformations accepted by children in different ages. Yet, these transformations involved changes that do not occur in nature. As Rosengren et al. (1991) argue, children might be sensitive to whether the biological mechanism which is involved in specific changes is a natural biological transformation or one that defies existing biological laws. In their study, they investigated the beliefs of children aged between 3 and 6 years about naturally occurring transformations. The researchers found that children exhibited an understanding about natural life cycle changes from the age of 3 (Rosengren et al., 1991).

Keil, in order to assess children's implicit biological knowledge, tried to discover what basis the child uses to establish the identity of biological entities by examining children's reactions to transformations. Manipulating the nature of the transformation, he attempted to inspect children's ability to make judgements and to reason about biological phenomena, using the interview method. However, Keil neglected the limitations of the interview when assessing children's understanding of biology, and his research is heavily dependent on verbal procedures.

An additional problem with the tasks used by Keil concerns their reliance on questions about identity, and the association of different criteria for determining identity. It seems that questions about identity are quite complicated and often have no clear intuitive solution. In addition, it is apparent that insides and outsides play an important role into an object's identification. Therefore, the inside parts of an object might be essential to an object's identity without being the only relevant quality. For example, can a person who undergoes a persuasive sex-change operation now be considered as a man, a woman, or a third kind of person (Gelman & Wellman, 1991)? It is possible that children may know that and still fail Keil's tasks. Moreover, in Keil's studies, children were asked to judge which of two identities applies after

changes have been made in the transformation tasks, instead of determining whether such changes influence identity. Finally, Keil's research failed to include items in which the insides were altered and the outsides remained the same, a comparison that might be of importance in gauging the relative significance of outsides versus insides for children. It can be the case that children give credence to the fact that any kind of change affects an object's identity, but that the inside changes are more important than the outside ones.

Current research favours the view that children do have access to a naive theory of biology. It seems that children's biological theories are constrained in ways similar to adults (Keil, 1989). Whatever elementary form these initial theories take they are related to augmenting experience which results in developmental elaboration and adult-like biological theory construction. The naive theory perspective emphasises the acquisition of knowledge in a domain rather than a stage-like cognitive maturation. Despite their other differences, theorists such as Carey (1985) and Keil (1989) agree that the acquisition of domain-specific knowledge produces developmental change and emphasise the central role of intuitive theories in organising knowledge.

This claim is also supported by Inagaki and Hatano (1993) who argue that pre-school children construct an autonomous intuitive biological theory or a vitalist biology. They drew attention to the concept of Japanese vitalism, which is built around the concept of *ki* or life force. *Ki* is analogous to the concept of vital force in Western biology, and it is the extra something that a body must have to be alive (soul). According to Japanese vitalism, internal organs have the agency and work to maintain bodily function by playing a role in the transmission and exchange of vital force. Inagaki and Hatano (1993) propose that Japanese children have constructed a vitalist biology by the age of six.

It should be noted that the existence of individual differences in the formation of children's rudimentary understanding of biology has been neglected in the work of both Carey (1985) and Keil (1989). Experiential factors have also been ignored by these two researchers (Hatano, 1990). However, children might well be engaged in activities provided by culture that results in the construction of particular biological

understandings (Hatano & Inagaki, 1994). For example, it has been claimed that Japanese children are more likely to regard plants or inanimate entities as alive and having properties of living things, than children in the United States or Israel. This finding can be explained by reference to the fact that Japanese culture holds the belief that plants are much like human beings. In addition, within Japanese folk psychology, inanimate objects are believed to have minds (Inagaki & Hatano, 1994).

Similarly, in another recent study, Walker (1999) has also explored the effects of sociocultural context on children's biological thinking. Three groups among the Yoruba population of Western Nigeria (rural, urban and elite) were requested to judge the identity of natural kinds and artifacts that they were familiar with, and which had undergone superficial transformations. Although the three groups selected share the same language, history and some cultural characteristics, still these groups differ in the degree and quality of school education, in the degree of participation in Yoruba ritual beliefs and practices, and finally in their life style with differential level of exposure to Western ways of life. It was expected that these differences would affect the groups' judgements, resulting in different developmental patterns. Children and adults who participated were asked to judge the identity of a hand-made artifact or a natural kind that had undergone a superficial transformation, and to provide an explanation for their decision. The findings suggested that the three groups of participants did indeed show different patterns of judgements and explanations, suggesting that conceptual change takes place within a very specific social and material context by which it may be influenced dramatically. In addition, Walker found that supernatural explanations were given by the children in order to explain the preservation of identity across transformations for animals, but not for plants. This finding can be explained by reference to the fact that animals are more tied to supernatural beliefs than plants in the Yoruba culture. It seems therefore, that the formation of biological understanding may be influenced by certain beliefs which are present in specific social and cultural settings.

In another study conducted by Springer (1999), the importance of individual differences in children's theory of kinship is emphasised. Springer suggests that individual differences in children's theories might well be the result of their own

different experiences and knowledge related to these experiences. For example, having younger siblings, being adopted and having a step-parent may affect the formation of children's theories of kinship or the rate at which they are acquired (Springer, 1999). Thus, Springer in his study examined whether adopted children's reasoning about kinship is less or more coherent than the one portrayed by children raised by their birth parents. Three groups of children, a control group, a group of within race adoptees, and a group of transracial adoptees, aged between 4 and 7 years, participated in a random ordering of three tasks: a definition task, a belonging task and finally a phenotypic surprise task. The purpose of the study was: a. to identify whether children hold a social or biological construal of kinship; b. to explore whether children with different personal experiences hold different theories of kinship; c. to investigate any possible differences in consistency and coherence in children's theories resulting from their different backgrounds. The results revealed that although adopted children were more likely than controls to express a social construal of kin terms and were therefore less sophisticated, their responses were more consistent than those of the control group. In addition, adopted children's responses were more consistent in all tasks with a more coherent understanding of kin relations than non-adopted children (Springer, 1999). The above results support the view that individual differences play a significant role in children's formation of naive theories within the domain of biology.

Thus, the fact that experience might change a child's concept is neglected by both Carey (1985) and Keil (1989), and children are often treated within the naive theory approach as facsimile theorists who do not exhibit any individual differences. However, it is possible that children's beliefs and their elementary understanding of biology are crucially influenced by the context in which that understanding is formed.

2.8 Studies of Children's Understanding of Illness from a Naive Theory of Biology Approach

Whether naive biology gradually emerges from children's naive psychology (Carey, 1985), or is a distinct theory or mode of construal from early years of life (Keil, 1989), is a matter of debate. Carey supports the notion that even young children have coherent theories of biological phenomena such as illness, but their theories change

from psychological to biological ones with the acquisition of biological knowledge. Keil, on the other hand, proposes that young children hold specific biological intuitions about biological kinds, states or processes, nevertheless their knowledge becomes differentiated and theoretically more organised with age. Researchers within the naive theory framework, however, do agree that the acquisition of domain-specific knowledge results in developmental change, with an emphasis given to the immense role of intuitive theories in organising this knowledge.

Within this ‘‘theory’’ perspective, some studies have examined aspects of children’s understanding of illness. For example, Sigelman, Maddock, Epstein and Carpenter (1993) investigated children’s understanding of disease causality, by looking into their understanding of the risk factors involved in ‘catching’ AIDS, colds and cancer. Their findings seem to suggest that although children are knowledgeable about risk factors of diseases, they are much less competent in rejection of non-risk factors. However, one of the main questions is how children of different ages organise their knowledge of distinct diseases. Do children tend to make wrong inferences about one illness based upon their understanding of another? And if this claim is correct, does this imply that young children are atheoretical? Children’s systematic inferential errors might be guided by their intuitive theories. Experiences with common childhood illnesses such as colds and flu may serve as the prototypical diseases for children and therefore, guide their inferences about unknown or less known diseases (Sigelman et al., 1993). Although the researchers favoured the theory approach to cognitive development, in order to investigate understanding of the biological concept of illness they focused on children’s actual knowledge of diseases and more precisely actual knowledge about risk and non-risk factors related to disease causation.

The concepts of contagion and contamination have attracted researchers’ attention, as children conceive both processes as causes of illness (Kalish, 1999). Indeed, most of the illnesses children are affected by, such as colds, measles and chicken-pox, do involve infection. In other words contagion and contamination are the disease processes most familiar to young children since they form the most common aspect of their illness experience. There is ample evidence that children at some points in development do view all illnesses as contagious (Hergenrather & Rabinowitz, 1991).

For example, Kister and Patterson (1980) pointed out that young children believe colds, scraped knees and toothaches to be contagious. Therefore, young children's illness concepts are presented as undifferentiated and superstitious. Previous studies within the ``stage`` approach framework concluded that young children do not understand contagion and contamination as causes of illness. On the contrary, they suggested that young children possess a belief in immanent justice. A more recent investigation looking into children's knowledge of contagion and contamination as possible causes of illness defies the above notion, suggesting that their understanding has been underestimated (Siegal, 1988). Siegal points out that children's inconsistent responses might be the consequence of prolonged or repeated questioning by researchers which departs from the conventions of everyday conversation. He argues that pre-school children present well-developed theories about the ways certain kinds of illnesses are transmitted, including a cold. Hence, knowledge of the causes of illness is within the ability of young children. Young children's model of infection seems to play a core role in their understanding of illness (Kalish, 1999). Is it the case therefore, that children's model of infection is also their model of illness?

One possible suggestion is that contagious illness is the prototypical illness for young children (Kalish, 1999). This implies that when children are thinking of illness they think in terms of contagion and contamination. Acute viral infections are taken as the examples of childhood illnesses that children are more familiar with and therefore might serve as the prototypical or "best" cases of disease (Campbell, Scadding & Roberts, 1979). Keil (1989) proposes that young children's concepts develop from being organised around characteristic features (prototypes) to a later organisation that involves definition or causal features. The implications might be that children's earliest conceptions of illness are heavily influenced by notions of prototypicality. Some evidence from the literature supports this notion since children often report that all illnesses are contagious. Additionally, congenital illnesses may be considered as having the prototypical property of being contagious (Keil, 1992). It is possible therefore that in the absence of any information given a prototype is the default (Kalish, 1999).

Based on the above, one might suggest that beliefs about contagion and contamination reveal a type of reasoning about causality in the case of illness concepts. It has been mentioned that in Western cultures the processes of contagion and contamination, although seen as separate, are also understood as being aspects of a single model of illness transmission known as an infection model of illness (Kalish, 1999). However, the question is: how do young children understand the processes of contagion and contamination? To what degree are their ideas about the above mentioned concepts organised into a coherent model of infection, and what kind of models do children hold? Moreover, how are children's beliefs about infection related to their conception of illness? Do children understand the underlying causal processes which provide the association between contagion and contamination? All the above questions have been raised by researchers investigating children's illness concepts within this line of approach.

Indeed, there are four models of infection presented in the literature, namely the associational model, the physical, the simple-biological and finally the differentiated-biological model (Kalish, 1999). Within the associational model, children are seen as being able to understand contagion and contamination in associational terms according to the principles of magic (Frazer, 1981; Rozin & Nemeroff, 1990). As Bibace and Walsh (1980, p. 36) describe, the child's view of contagion as follows: "the cause of illness is located in objects or people that are proximate to, but not touching the child. The link between the cause and the illness is accounted for only in terms of mere proximity or magic." In addition, Rozin, Fallon, and Augustoni-Ziskind (1985) argue that associational contagion in children reflects the lack of any awareness of physical processes involved. The second model, namely the physical model, refers to infection as resulting from a physical relationship based on the transfer of physical particles. Within this model, the contaminant must physically touch a host in order for infection to take place. The role of germs is considered as being of immense importance, and indeed some research has been conducted on children's understanding of germs as the invisible causal agents of illness (e.g. Solomon & Cassimatis, 1995; Kalish, 1996).

The biological model is the third model of infection, according to which the agents of infection are understood to be living organisms that infect and act on other living entities. It is the living nature of germs and the way they interact with the biological host that causes infection which might result to illness. What differentiates a physical from a biological model of infection seems to be that in the former, the agents of infection are conceived as being material entities, while in the latter, the agents are seen as living things. Finally, there is the differentiated biological model of infection according to which the agents are conceived to have distinct types or species with unique attributes. However, while there is little direct evidence that young children hold a biological concept of infection (Kalish, 1999), Kalish (1996) has argued that children's predictions of contagion involve the idea of an intermediate mechanism and therefore are not purely based on simple associations. The existing evidence suggests that young children may hold a physical rather than a biological model, since the latter seems to involve more detailed and specific knowledge. For example a biological model might entail the acceptance that agents of infection act in certain ways in the body, such as reproducing since they are living entities. More research is needed in order to identify the underlying processes which are conceived by young children as the causes of infection. A better understanding about young children's beliefs of infection will enlighten our understanding concerning their concepts of illness.

There have also been studies which have attempted to compare age-related differences in the organisation of children's knowledge of illness. For example, Hergenrather and Rabinowitz (1991), by using a less verbally dependent procedure and thus avoiding all the relevant problems associated with child interviewing, found that young children have a more accurate knowledge of illness causes, consequences and treatment than most previous studies suggest.

As it has been mentioned above children's beliefs about illness causation have been examined mostly through investigations of children's understanding of the exogenous factors of contagion and contamination. However, it is known that susceptibility to illness is also affected by such activities as diet and regularity of daily routines (Inagaki, 1997). Some researchers, recognising the important role of endogenous factors in illness causation, have tried to clarify pre-school children's understanding of

susceptibility to illness. For example, Inagaki (1997) investigated whether children attribute illness susceptibility either to physical/biological, or to moral/social, or to both biological and social aspects of one's life. The results revealed that the majority of children accepted that physical/biological aspects of daily activities, such as eating few vegetables, might affect susceptibility to illness. Yet, they did not deny the importance of moral/social factors such as pinching a friend or telling a lie, and hence young children claimed that morally bad or unacceptable behaviours were also responsible for the emergence of a disease. However, they did recognise the former factors as more important. The findings seem to suggest that pre-school children hold a substantial understanding of illness causality although they might not yet understand the ways in which specific causal mechanisms operate.

In another study conducted by Inagaki and Hatano (1996), young children's recognition of commonalities between animals and plants was examined by looking into children's understanding of shared animal and plant capacity of being taken ill. The researchers suggested the existence of a generalisation pattern of illness from humans to animals and to a lesser extent to plants. The above findings support the view that even young children have an understanding of the biological domain.

Another study by Finney & Taplin (1998) aimed to determine the age by which children accept that the effects of germs are specific to the domain of living things; in other words, whether animals and plants are susceptible to illness whereas natural kinds and hand-made artifacts are not. The researchers claimed that if young children understand that it is only the category of living things which could be affected by germs, this might be considered as evidence of a theory of illness which is biologically based. Children as young as 5 to 6 years of age did not differ from the 9 and 10 year-olds and the adults in their attribution of illness caused by germs to humans. In addition, the same children did not differ from the older participants in their attribution of lack of illness to non-living things. However, young children were less accurate than older children in attributing the germ theory of illness to other animals. Overall, young children of 5 and 6 years of age did not group animals and plants with humans in the single category of living things and thus separate from the category of non-living kinds. This has been taken as evidence that children at this age

do not hold a theory of illness applicable to the entire domain of biology. The above claim supports Carey's argument that is only later than 5-6 years that children develop a biological domain of thought (Finney & Taplin, 1998).

Finally, it should be noted that Inagaki and Hatano (1996) have also conducted studies into children's understanding of illness using a naïve theory of biology approach.

Their studies have already been reviewed in section 2.7 above.

2.9 Conclusions

Substantial research efforts have been made in order to study children's early biological understanding. From the preceding review of this research, several general conclusions may be drawn, as follows:

1. The Piagetian approach is problematic on methodological grounds.
2. The domain-general approach is difficult to sustain in the light of more recent research which has shown that children's biological understanding is domain-specific.
3. Children appear to have a domain-specific biological understanding by 5 years of age.
4. With the exception of Hatano and Inagaki (1994) and Walker (1999), there has been a neglect of the impact of social and cultural setting on children's biological understanding.
5. There has also been a neglect of individual differences between children; that is, whether different children might have qualitatively different naïve theories of biology.
6. Possible effects of illness experience on illness understanding has mainly been studied using Piagetian measures, not naïve biology ones.
7. Possible effects of parental health attitudes and behaviours and the presence of health-related objects in the home have not been investigated (i.e. whether individual differences might be related to other experiential factors in the home).
8. Studies that have looked at illness concepts have only looked at actual illnesses. It makes it difficult therefore, to know whether such studies are tapping into acquired knowledge about specific diseases or children's more general naïve theories of biology.

The present research

The present study was designed to address some of these limitations in existing research, as follows.

Study 1 used the naïve theory approach, looking at children's concept of illness and the extent to which they apply this concept across ontological boundaries. This study looked both for commonalities in how children apply the concept at different ages, but also for individual differences in patterns of application.

Study 2 looked to see if the individual differences found in study 1 were linked to parental health attitudes.

Study 3 used three exemplars to see if the exemplar affects children's generalisation of illness to other entities. This study also looked for individual differences in how healthy vs chronically-ill children respond to the three exemplars.

Study 4 looked to see if the individual differences found in study 3 were linked to parental health attitudes and to the presence of health-related objects in the children's homes.

Study 5 used three animal exemplars and one plant exemplar in order to investigate whether children hold an integrated category of living things, one that includes both animals and plants.

Thus, the present studies extended previous research by focusing in particular upon individual differences and the possible relationship between these individual differences and parental health attitudes, health-related objects in the home, and experience of chronic illness.

CHAPTER 3

Study 1: Children's generalisation of illness across ontological boundaries

3.1 Introduction

As was seen in Chapter 2, most of the research investigating children's emergence of biological thought has been focused on their appreciation of specific facts about biological kinds, processes, or biological states. In addition, much of the existing literature has focused on concepts of plants and animals. However the exploration of illness understanding in children might offer additional important information about their biological understanding (Kalish, 1996), and an examination of children's beliefs about which entities can and cannot get ill may reveal much about their early biological thought.

Consequently, the present study focused upon children's conceptions of illness by examining children's ideas about which kinds of entities can and cannot get ill. There were four main points of difference from previous investigations into children's understanding of illness. Firstly, children's rudimentary understanding of biology, as examined by Keil (1989), provided the theoretical perspective in contrast to the Piagetian cognitive-developmental approach. Keil (1989) examined children's ontological knowledge of phenomena by exploring their understanding of ontological boundaries through transformations. He proposed that children do refer to biologically specific principles when judging the kind membership of plants and animals undergoing transformations. Therefore, children seem to have an intuitive taxonomy for structuring the biological domain and hence they resist impossible biological transformations while they accept others as more plausible. Young children have biologically specific theories which are more impoverished than those of older children and adults. By using Keil's approach as the theoretical framework, the present study investigated children's understanding of which entities could or could not get ill, thus exploring their ontological boundaries for illness.

Secondly, the present study was concerned with children's conceptual understanding of illness as opposed to their knowledge of the facts of a disease. Thirdly, children's ontological boundaries were tested by card-sorting tasks, rather than interviewing,

therefore avoiding all the problems related to child interviewing. Finally, this study was also concerned with individual differences in children's understanding of illness, since this area of investigation has been neglected by both the Piagetian as well as the more recent Theory approach.

3.2 Method

3.2.1 *Participants*

Two hundred and two children were randomly recruited from years Reception to Year 6 (age range: 56-140 months) in two primary schools in East Sussex County, which is located in south-east England in the UK (School 1: 91 children, School 2: 111 children). For the purpose of the analysis the children were grouped into three age-groups: (1) Young group with 86 children from three school years (Reception, Year 1, and Year 2); 44 girls (mean age = 6.5, age range = 5.2-7.8) and 42 boys (mean age = 6.2, age range = 4.8-8.0). (2) Middle group with 58 children from two school years (Year 3 and Year 4); 31 girls (mean age = 8.9, age range = 8.1-9.8) and 27 boys (mean age = 8.8, age range = 7.9-9.8). (3) Old group with 58 children from two school years (Year 5 and Year 6); 27 girls (mean age = 10.8, age range = 9.8-11.8) and 31 boys (mean age = 10.8, age range = 9.9-11.8). There were thus 3 (age) x 2 (gender) x 2 (school) independent groups.

3.2.2 *Materials*

Thirty cards, each measuring 5 x 2.5 ins, naming five entities from each of six ontological categories, were used in the sorting task. On each card the name of the entity was clearly written. The ontological categories from which the entity names were drawn were (a) *human beings* (man, woman, boy, girl, baby), (b) *mammals* (sheep, cat, dog, elephant, mouse), (c) *non-mammals* (robin, snake, spider, fly, goldfish), (d) *plants* (oak tree, rose bush, dandelion, tomato plant, apple tree), (e) *hand-made artifacts* (car, bicycle, house, cup, computers), and (f) *physical kinds* (river, cloud, sun, pebble, mountain). In addition, three boxes measuring 9 x 6.5 x 7 ins, were used, representing one of the three possible answers given by the children. Each of the three boxes was labelled with the appropriate words, which were clearly written on the front: *can get ill*, *cannot get ill*, *I don't know*.

3.2.3 Procedure

The children who participated were tested individually in a room apart from their regular classroom. Each interview lasted up to fifteen minutes with each individual child. The session began by giving the child an explanation about the purpose of the interview, suggesting that the interviewer was writing a book for children concerning the body and the ways it can be kept strong. The children were reassured that there were no right or wrong answers and that they should feel free to ask for clarifications when they didn't understand the questions.

Task

For the sorting task, the three boxes, with open tops without lids, were put on the table. Each box represented one of the possible answers which could be given by the child: *can get ill*, *cannot get ill*, *I don't know*. The boxes were placed on the table in the above order for the first child and in such a way that the child could clearly see what was written on each box. For the second child the order *cannot get ill*, *can get ill*, *I don't know* was used. These two orders were alternated accordingly throughout the testing in order to control for possible left-right response biases. The interviewer showed the cards to the child, in a different randomised order for each individual child, saying that these were some cards with the names of lots of different things on them (showing to the child some of the cards). The requirement for the child was to put each card into one of the boxes depending on whether the child thought that the entity named on each card can get ill or cannot get ill. For the younger children, cards were read in case there were any difficulties with reading. The exact words used by the interviewer were as follows:

Here are some cards with the names of lots of different things on them. What I would like you to do is put each card into one of these boxes, depending on whether you think that thing can get ill or cannot get ill. For example, if you think that something can get ill, put the card into the box which says 'can get ill' (physically hold a card over the box). If you think that something cannot get ill, put the card into the box that says 'cannot get ill' (physically hold a card over the second box). If you really don't

know whether it can get ill or cannot get ill, put the card in the 'don't know' box (physically hold a card over the 'don't know' box). For the younger children the following words were added: *if you have any difficulty reading some of the cards, tell me and I'll help you to read them.*

3.3 Results

The children's thinking about the ontological categories was analysed first by conducting ANOVAs on the children's basic scores (scores given for each of the six ontological categories representing the number of entities chosen by the children as susceptible to illness); and then by configural frequency analysis on children's patterns of responses across all six ontological categories.

3.3.1 ANOVAs

The total number of cards from within each ontological category which were placed into each of the three individual boxes was calculated; in each case, the scores could therefore range from 0-5. The mean scores obtained by the children were analysed using three separate 3 (age) x 2 (gender) x 6 (type of ontological category) mixed ANOVAs, with independent groups on the first two factors and repeated measures on the third factor. In one ANOVA the dependent variable was "can get ill"; in the second ANOVA, it was "cannot get ill"; and in the third ANOVA, it was "don't know" (see Appendix 1). There were main effects of type of category on all three responses, indicating that children do perceive differences between the various categories of entity.

The results reported here focus specifically on the "can get ill" responses only, as these category-inclusion responses represent the clearest indications of the children's thinking. The children's mean responses to the question "who can get ill" are shown in Table 3.1. The results of the ANOVA which was conducted on these responses is also shown in the same Table.

**Table 3.1: Children’s mean responses to who can get ill
(standard deviations in parentheses)**

Category	can get ill			
	Young	Middle	Old	total
human beings	4.38 (1.3)	4.97 (0.3)	5.00 (0)	4.72 (0.9)
mammals	3.63 (1.5)	4.78 (0.6)	4.78 (0.7)	4.29 (1.2)
non-mammals	2.86 (1.6)	3.91 (1.3)	4.02 (1.3)	3.50 (1.5)
plants	1.08 (1.4)	1.48 (1.9)	1.67 (2.1)	1.37 (1.8)
artifacts	0.58 (1.2)	0.29 (0.7)	0.40 (0.8)	0.45 (0.9)
physical kinds	0.49 (1.0)	0.24 (0.6)	0.22 (0.6)	0.34 (0.8)
mean scores	2.17	2.61	2.68	2.44
ANOVA sign. Effects	age: F (2, 196) = 13.50, p< 0.005 category: F (5, 192) = 492.69, p< 0.005 age x category: F (10, 382) = 5.44, p< 0.005			

Differences associated with category

Post hoc t-tests were conducted to locate precisely where the category effects were occurring (see Table 3.4). The children claimed that the category of human beings was significantly more likely than all the other categories to get ill. After human beings, mammals were the most likely to get ill, followed by non-mammals and then plants. The categories of hand-made artifacts and physical kinds were seen by children in all age-groups as significantly the least likely to get ill. In addition, there was no significant difference between categories. In other words, it seems that even the youngest children have a clear idea about the differential susceptibility to illness of different kinds of entity, including the fact that hand-made artifacts and physical kinds cannot get ill.

Table 3.4: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories

	can get ill (t values)
humans v mammals	5.47**
humans v non-mammals	10.35**
humans v plants	23.50**
humans v artifacts	-41.19**
humans v physical kinds	45.71**
mammals v non-mammals	9.02**
mammals v plants	21.31**
mammals v artifacts	-32.28**
mammals v physical kinds	35.40**
non-mammals v plants	15.37**
non-mammals v artifacts	-24.81**
non-mammals v physical kinds	26.42**
plants v artifacts	-7.60**
plants v physical kinds	-8.66**
artifacts v physical kinds	ns

df = 201
p < 0.003** ns = non-significant

Differences associated with age

There was a main effect of age on the “can get ill” task. However, there was also an interaction effect between category and age suggesting that the children possess a different understanding at different ages concerning their ontological boundaries for illness. These interaction effects were explored using post hoc Scheffe tests (see Table 3.5). These revealed that the children in the Young group were significantly less likely to generalise “can get ill” to humans, to mammals, and to non-mammals, than the children in the Middle or Old groups. In other words, the Old and the Middle age-group presented a different range of generalisations from the Young group.

Table 3.5: The significant post hoc Scheffe tests ($p < 0.05$) on children’s category discriminations by age

	Can get ill
humans	young v middle young v old
mammals	young v middle young v old
non-mammals	young v middle young v old
plants	ns
artifacts	ns
physical kinds	ns

ns = non-significant

Differences associated with gender

There were no significant effects involving gender on the “can get ill” responses.

3.3.2 *Configural Frequency Analysis*

In addition to the age and category differences identified in the ANOVA, it was evident that different children presented different response patterns about the susceptibility to illness of entities belonging to different ontological categories. It is of considerable interest to know whether particular patterns of response occur at different ages, and if so, to know what these different patterns of response are.

The children's response patterns were therefore tested across the six ontological categories by using configural frequency analysis (CFA). This form of non-parametric, multivariate analysis of association identifies response patterns which are over-represented (types) and under-represented (anti-types) given the null hypothesis that these patterns are normally and randomly distributed (Krauth, 1985; VonEye, 1988, 1990). Focusing on the children's choices of those entities which can get ill, the children's responses for each category were scored as follows: to those children who chose two or less entities in a category a score of 0 was given; to those children who chose three or more entities in a category a score of 1 was given. Therefore, each child had a score of 0 or 1 for each ontological category. The patterns could be characterised as sequences of 0s and 1s. This scoring resulted in a response pattern for each participant. For example, the response pattern 111000 was given to a child who chose three or more entities from the ontological categories of humans, mammals and non-mammals and two or less entities from the ontological categories of plants, physical kinds and hand-made artifacts. The above was applied to each of the participants. The data were subjected to Configural Frequency Analysis (CFA).

There were 3 significant response patterns across the six ontological categories, which are shown in Table 3.6. Pattern 111000: 97 children said that 3 or more entities can get ill within the human, mammal and non-mammal categories, and 2 or less entities within the plant, physical kind and hand-made artifact categories respectively ($z = 29.663$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.002$). Pattern 111100: an additional 35 children suggested that 3 or more entities can get ill within the human, mammal, non-mammal and plant categories, and 2 or less entities within the physical kind and hand-made artifact categories respectively ($z = 8.721$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.002$). Pattern 110000: finally, there

were 30 children who said that 3 or more entities can get ill within the human and mammal categories, and 2 or less entities within the non-mammal, plant, physical kind and hand-made artifact categories respectively ($z = 7.032, p < 0.0001$, Bonferroni adjustment for p at $0.005 = 0.002$).

Table 3.6: Configural frequency analysis response patterns

	Pattern 110000	Pattern 111000	Pattern 111100
human	1	1	1
mammal	1	1	1
non- mammal	0	1	1
plant	0	0	1
artifact	0	0	0
physical kind	0	0	0
Frequency of Pattern	30	97	35

In order to investigate whether there was an association between the children’s response patterns and their age or gender, a hierarchical log linear analysis was conducted. There was a significant association between children’s response patterns and their age ($\chi^2(4) = 8.63, p < 0.05$). The data are shown in Table 3.9, together with the results of post hoc χ^2 tests which were conducted to locate where the effects involving age occurred. The children in the Young group tended to exhibit pattern 110000 more frequently than the other two age groups, and to exhibit the pattern 111100 less frequently than the other two age groups.

Table 3.9 The number of children from each age-group who produced each of the response patterns

	Age-Group			
Response Patterns	Young	Middle	Old	Total
Pattern 110000	20	5	5	30
Pattern 111000	32	35	30	97
Pattern 111100	5	13	17	35
Total	57	53	52	162

Post hoc χ^2 tests:

a. response pattern 110000

young group vs middle group significant $\chi^2(1) = 8.88, p < 0.01$

young group vs old group significant $\chi^2(1) = 8.59, p < 0.01$

b. response pattern 111100

young group vs middle group significant $\chi^2(1) = 3.89, p < 0.05$

young group vs old group significant $\chi^2(1) = 8.23, p < 0.01$

No other paired comparisons significant.

3.4 Discussion

3.4.1 *The overall generalisation pattern*

This study investigated children's concept of illness. The children's assessments of susceptibility to illness varied across the ontological categories, supporting the view that children do possess an early grasp of biological distinctions (Inagaki & Hatano, 1996). Children's generalisation of illness to the six ontological categories showed that they believed humans were the most vulnerable, followed by mammals, non-mammals, plants, physical-kinds or hand-made artifacts, in that order. It should be noted that this ordering represents the degree of similarity to humans. Thus, the evidence from this study might be used to support Carey's (1985) suggestion that humans are the prototypical biological entity for young children and that biological properties are generalised to other entities to the degree they resemble humans. However, it may well have been the case that the children were implicitly using and generalising from a human exemplar in the present study, prompting them to the above ordering. For this reason, in study 3, three different exemplars were explicitly used, a human and two non-human exemplars (a dog and a duck), in order to explore whether the use of a human exemplar might have biased the children's responses in study 1.

In addition, a minimal generalisation to non-biological entities was made by the children. What is happening with the biological category of plants? In this study, the category of plants represented an interesting intermediate category. According to Carey (1985), young children are considered to have a theory of biology if they possess a grasp of biological properties and processes in plants, as well as in animals and humans. This argument seems to suggest that children can be viewed as having a biological theory only if plants are considered susceptible to illness. However, the plant domain may be an area of conceptualisation in which illness beliefs emerge later, as they do in the case of internal natural causal mechanisms underlying seed growth (Hickling & Gelman, 1995). It is quite plausible that children initially acquire their biological theories in relationship to animals, and only later extend these theories to plants.

3.4.2 *Differences associated with age*

It was apparent from both the ANOVAs and the CFA that children's understanding about illness and ontological category develops with age. Focusing on the response patterns given by the children across the six ontological categories, as revealed by the CFA, there was a difference between the thinking of the youngest children and that of the Middle and Old groups. The majority of children at all three ages exhibited the 111000 pattern, but the children in the Young group were significantly more likely to exhibit the 110000 pattern, whereas both the Middle and Old groups were more likely to exhibit the 111100 pattern.

Thus, the category of plants was included in some children's response patterns., particularly some of the oldest children. This indicates that the oldest children were most likely to have a sense of the biological links between plants and animals. Based on the fact that children sometimes included plants in their response patterns, but rarely included hand-made artifacts, one could argue that their inclusion of plants reflected a true biological interpretation and not a misconception about what "ill" means (perhaps equated to broken or damaged).

Children might hold biological theories and still they may use different patterns of generalisation depending on their developing knowledge of biology. Undoubtedly, the biological category of plants is a difficult one for children to comprehend, probably because of the least similarity with humans in terms of recognisable parts and functions. Thus, with age, children might use their developing knowledge of biology to attribute general susceptibility to illness to all biological entities including plants.

CHAPTER 4

Study 2: Possible influences upon children's understanding of illness

4.1 Introduction

It was argued in Chapter 2 that individual differences in children's understanding of illness is an area of investigation which has been ignored by both the Piagetian as well as the more recent Theory approach. Only rare attempts have been made to compare healthy and chronically-ill children's thinking within the structural framework, with very inconsistent findings having emerged across different studies (Rubovits & Siegel, 1994; Eiser, Town & Tripp, 1998; Shagena et al., 1988). In that respect, some researchers argue that chronically-ill children's illness understanding develops similarly to healthy children's conceptions (Eiser, 1985) while others suggest that exposure to illness and medical treatment results either in a more advanced illness understanding (Feldman & Varni, 1984) or to less sophisticated illness conceptions than the ones presented by healthy children (Shagena et al., 1988; Perrin et al., 1991). Furthermore, in recent years some researchers supporting the Theory approach have compared the biological knowledge of children who have actively been engaged in raising goldfish, for a considerable period of time at home, with others who have never raised an animal (Inagaki, 1990). It was expected that children engaged in raising animals would possess a rich body of knowledge about them which they would then use as a source for analogical predictions and explanations for other biological kinds. This hypothesis was confirmed, suggesting that specific experiences might modify young children's mode of biological inferences (Inagaki, 1990; Hatano & Inagaki, 1992) and therefore, different experiences may produce differently instantiated versions of naive biology (Hatano & Inagaki, 1994).

Study 1 suggested that children possess an early biological understanding and that their thinking about both illness and biological category might differ at different ages, and indeed within particular age groups. In other words, different children presented different illness attribution patterns, indicating the existence of individual differences in their understanding of illness. Taking into account the fact that personal experience might be of some significance in shaping children's framework theories, Study 2 aimed to investigate some of the possible factors that might have affected the

children's thinking about illness. The specific influences which were considered were parental health attitudes and behaviours, as well as the child's own experience with a disease and the child's medical history. If specific experiences modify children's biological inferences and if different experiences produce different versions of naive biology (Hatano & Inagaki, 1994) then differences in parental health attitudes and behaviours could be considered as possible factors influencing children's illness thinking.

4.2 Method

4.2.1 *Materials*

The parents of the children interviewed in Study 1 were the participants in Study 2. A two-part questionnaire was administered to the parents (see Appendix 2). Because of the possible importance of illness experience in the formation of illness understanding it was of interest to explore the children's experiences with either a chronic or an acute condition (infectious or accidental), their contacts with doctors or hospitals because of their health condition or because of the sickness of others, and to investigate whether this experience influenced their thinking about illness. Therefore, Section A of the questionnaire was concerned with

- a.* the child's health history as well as visits to doctors or hospitals and the types of illness suffered (infectious diseases, chronic diseases, and/or accidental injuries), and
- b.* the child's contacts with hospitals or illness through the sickness of others.

Parental health attitudes and behaviours were examined by Section B of the questionnaire which contained 16 items selected and adapted from the Health Attitudes and Behaviours Questionnaire (Vickers, Conway & Herving, 1990). This is a multidimensional health questionnaire with a four factor structure which provides a useful framework for formulating research questions regarding consequences of individual differences in health behaviour (Vickers et al., 1990). Research has shown that health behaviours tend to occur in combinations and therefore can be grouped into categories (Kannas, 1981; McCarthy & Brown, 1985). Vickers et al. argue that the instrument provides a reliable assessment of a healthy or an unhealthy cluster of behaviours that tend to co-occur and encompasses the majority of behavioural groupings suggested by previous research. Four analyses were used by Vickers et al.

to test the instrument for robustness. The combined results produced a well-defined set of health behaviour dimensions suitable for measuring these dimensions (Vickers et al., 1990).

The instrument consists of two broad scales namely Preventive Behaviour and Risk-Taking Behaviour. The Preventive Behaviour scale includes two subscales of behaviours: *a*. Wellness Maintenance and Enhancement and *b*. the Accident Control Risk scale. Similarly, the Risk-Taking Behaviour scale includes two subscales of behaviours: *a*. Traffic-related Risk-Taking and *b*. Risk-Taking through Exposure to Harmful Substances. For the purposes of the present study, the items included in the parental questionnaire were from the Wellness Maintenance and Enhancement and the Risk-Taking Behaviour through Exposure to Harmful Substances subscales. The Accident Control Risk scale as well as the Traffic-related Risk-Taking scale were regarded as being less relevant to children's understanding of illness. The statements considered to be the most appropriate in influencing children's illness understanding were: parental health check-ups, consuming habits (food or alcohol related), parental health preventive regimes, and attitudes towards health information. All the items were rated on a five-point scale: not at all like me = 1, unlike me = 2, not sure = 3, like me = 4, very much like me = 5. Some changes had to be made to the items for the purposes of the study, including adjustments to the contents of some of the items in order to eliminate possible ethical objections, and changes in the wording of some items in order to make them more appropriate for English as opposed to American participants. For example, the statement "*I do not take chemical substances which might injure my health (e.g., food additives, drugs, stimulants)*" was changed to "*I do not eat foods which contain additives and artificial colourings*". In addition, a cover letter was given along with the questionnaire, explaining the purpose of the study and its confidential character. A full copy of the questionnaire is given in Appendix 2.

4.2.2 Procedure and return rate

The questionnaires were sent to the parents via their children, and were returned to the children's form teachers when they were completed. The return rate was 76.7%.

4.3 Results

The responses from the parental questionnaire were analysed first by conducting ANOVAs on the children's health history and experience of illness, and secondly by conducting ANOVAs in order to assess any possible relationships between the parental attitudes and the children's age-groups or schools. In addition, the children's understanding of those entities which could get ill (as measured in Study 1) was further examined first by ANOVAs, in order to assess any links between the children's understanding and their health-history and their age-group and secondly for any correlations with parental attitudes.

4.3.1 Children's Health History

Seven separate variables were derived from the incidences in the child's history and contact with sick others (infectious diseases, chronic diseases, accidental injuries, child's own hospitalisation, child's visit to doctor in the past year, child's visit to other in hospital, and child's contact with sick family member). For each separate category, a score of 1 was given for at least one such incident/event, while a score of 0 was given in the absence of the incident/event. Seven separate one-way ANOVAs were then conducted, with age group as the independent variable and the child's history or illness contact as the seven dependent variables. Although ANOVA is not often used in order to analyse binary data, ANOVA does produce accurate results when used to analyse binary data that have been scored as 0s and 1s (Cochran, 1950; Cox, 1970). No effects of age were revealed in any of these analyses. The seven health scores were then used in a further analysis of the child's understanding of illness.

4.3.2 Parental Health Attitudes and Behaviours

Confirmatory factor analysis was performed on the scores of parental health attitudes and behaviours using principal component analysis (PCA) with oblimin rotation. The participants-to-variables ratio was more than adequate, fulfilling the recommendation

of 2:1 to 10:1 participant/variable ratio (Gorsuch, 1983). The sampling adequacy was checked using the KMO diagnostic measurement which was satisfied. The principal components analysis indicated that two factors accounted for only 35% of the variance. Table 4.1 reports the pattern matrix which was obtained, while Table 4.2 shows the two factors which it had been expected would be obtained on the basis of the work by Vickers et al. (1990). The expected two factors were not replicated. Because of this and the low level of variance explained, a further exploratory factor analysis of the scores of parental health attitudes and behaviours was performed. The principal component analysis indicated six factors that accounted for 64.5% of the variance (eigenvalues greater than one). Table 4.3 reports the pattern matrix. Using the Kaiser 1 (K1) rule and factor interpretability rule (Ferguson & Cox, 1993; Hammond, 1995), this solution was deemed uninterpretable. Because of the failure to replicate the expected factor structure, the scores of the 16 items included in the questionnaire were instead summed and used as an overall measure (Q_{total}) of the parents' health attitudes and behaviours. This single scale had good internal reliability (Cronbach $\alpha = 0.80$). Q_{total} scores could range from 16 to 80. These scores were analysed using a one-way ANOVA to see if the Q_{total} scores varied as a function of the children's age. There were no significant differences between the Q_{total} scores across the three age groups of children.

Table 4.1 Factor analysis pattern matrix of parental health attitude and behaviour questionnaire identifying two factors

	Factor 1	Factor 2
PHAB1	.77	
PHAB2	.75	
PHAB8	.64	
PHAB14	.55	
PHAB15	.50	
PHAB10	.49	
PHAB12	.42	
PHAB3	.42	
PHAB9	.40	
PHAB16	.39	
PHAB4	.37	
PHAB7		.85
PHAB11		.75
PHAB5		.55
PHAB6		.37
PHAB13		.31

Factor 1

- PHAB1 : I exercise to stay healthy
- PHAB2 : I watch my weight
- PHAB8 : I eat a balanced diet
- PHAB14 : I don't smoke
- PHAB15 : I discuss health with friends, neighbours, and relatives
- PHAB10 : I limit my intake of foods like coffee, sugar, fats, etc.
- PHAB12 : I see a dentist for regular checkups
- PHAB3 : I take vitamins
- PHAB9 : I see a doctor for regular checkups
- PHAB16 : I gather information on things that affect my health by watching television and reading books, newspapers, or magazine articles

PHAB4 : I use dental floss regularly

Factor 2

PHAB7 : I avoid areas with high pollution

PHAB11 : I stay away from places where I might be exposed to germs

PHAB5 : I don't eat foods which contain additives and artificial colourings

PHAB6 : I do not drink alcohol

PHAB13 : I take health food supplements (e.g. wheat germ, bran, lecithin)

**Table 4.2 The factor structure expected on the basis of work
by Vickers et al. (1990):**

Factor 1	Factor 2
Wellness Maintenance and Enhancement	Risk-Taking Behaviour through Exposure to Harmful substances
I exercise to stay healthy	I do not drink alcohol
I gather information on things that affect my health by watching television and reading books, newspapers, or magazine articles	I don't take chemical substances which might injure my health (e.g., food additives, drugs, stimulants)
I see a doctor for regular checkups	I don't smoke
I see a dentist for regular checkups	I avoid areas with high pollution
I discuss health with friends, neighbours, and relatives	
I limit my intake of foods like coffee, sugar, fats, etc.	
I use dental floss regularly	
I watch my weight	
I take vitamins	
I take health food supplements (e.g., protein additives, wheat germ, bran, lecithin)	

Table 4.3 Factor analysis pattern matrix of parental health attitude and behaviour questionnaire identifying six factors

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
PHAB3	.67					
PHAB1	.66					
PHAB2	.63					
PHAB10	.56					
PHAB8	.52					
PHAB7		.76				
PHAB5		.71				
PHAB11		.69				
PHAB13			-.78			
PHAB14			.53			
PHAB6				.82		
PHAB9				.65		
PHAB12					.82	
PHAB4					.63	
PHAB15						.80
PHAB16						.79

Factor 1

PHAB3 : I take vitamins

PHAB1 : I exercise to stay healthy

PHAB2 : I watch my weight

PHAB10 : I limit my intake of foods like coffee, sugar, fats, etc.

PHAB8 : I eat a balanced diet

Factor 2

PHAB7 : I avoid areas with high pollution

PHAB5 : I don't eat foods which contain additives and artificial colourings

PHAB11 : I stay away from places where I might be exposed to germs

Factor 3

PHAB13 : I take health food supplements (e.g. wheat germ, bran, lecithin)

PHAB14 : I don't smoke

Factor 4

PHAB6 : I do not drink alcohol

PHAB9 : I see a doctor for regular checkups

Factor 5

PHAB12 : I see a dentist for regular checkups

PHAB4 : I use dental floss regularly

Factor 6

PHAB15 : I discuss health with friends, neighbours, and relatives

PHAB16 : I gather information on things that affect my health by watching television and reading books, newspapers, or magazine articles

4.3.3 Children's understanding of illness as a function of their health history

Using the children's responses from Study 1, involving those entities which could or could not get ill, a new score was computed on the basis of the number of correct answers made by the child; namely that all biological entities (human beings, mammals, non-mammals, plants) could get ill and that all the non-biological entities (hand made artifacts and physical kinds) could not get ill, giving a maximum possible score of 30 and a minimum of 0.

ANOVAs were then conducted with this new computed score as the dependent variable, and with age-group and each of the seven variables derived from the child's health history in Section A of the parental questionnaire as the independent variables. Thus seven 2 (score on health experience item) x 3 (age) ANOVAs were conducted on the illness knowledge scores. There were main effects of age-group on all the ANOVAs. Post-hoc analysis (Scheffe) revealed a significant difference between the Young group and both the Middle and Old groups: Young (mean = 20.88, sd = 4.1) vs Middle (mean = 24.60, sd = 2.7), Old (mean = 24.84, sd = 2.9). Thus, the Middle and Old groups had a significantly more accurate understanding of the biological criteria for those entities which were capable of becoming ill than the Young group. There were no other main or interaction effects in any of these ANOVAs.

4.3.4 Children's understanding of illness as a function of parental health attitudes and behaviours

Possible links between the children's thinking and the health attitudes and behaviours of their parents were examined by several analyses. The children's total illness understanding score from Study 1 was first correlated with the parents' health attitudes total, but there was no significant correlation ($r = -0.04$, ns). On the basis of their parents' health attitudes total score (Q_{total}), the children were assigned to 3 new groups for analysis by ANOVA as follows:

group 1: low parental attitude group (35 children: $Q_{total} = 16-45$);

group 2: middle parental attitude group (59 children: $Q_{total} = 46-55$);

group 3: high parental attitude group (47 children: $Q_{total} = 56-80$). No significant relationships were found between these parental attitude categories and the children's

basic category scores (that is, the scores out of 5 given by the children for each of the six ontological categories, representing the number of entities chosen as susceptible to illness in Study 1), nor with the children’s total illness understanding scores derived from Study 1.

However, although no associations were found between the children’s basic category scores and their parents’ health attitudes and behaviours, it was of interest to examine possible associations between the response patterns given by the children across the six ontological categories in (as determined by the CFA), and age and parental attitude group. Therefore, a hierarchical loglinear analysis was conducted. In addition to the significant association reported in the previous chapter, there was a 3-way association between children’s responses and age-group and parental attitude group ($\chi^2(8) = 21.362, p < 0.01$). The frequencies of children’s responses in relation to age-group and parental attitude group are shown in Table 4.4.

Table 4.4 Frequencies of children’s response patterns by age-group and parental attitude group

PHA-Group		Age-Group			
		Young	Middle	Old	total
Low	110000	3	2	0	5
	111000	5	4	6	15
	111100	0	3	6	9
Middle	110000	4	1	1	6
	111000	10	14	6	30
	111100	2	6	4	12
High	110000	6	0	4	10
	111000	5	9	8	22
	111100	3	1	3	7

Focusing on the frequencies of the children’s response patterns, it appears that for the low parental attitude group there is a shift from pattern 110000 to pattern 111100, as a

function of age. In other words, within the Low attitude group, it is the young group of children who do not produce pattern 111100, and the oldest children who do not produce pattern 110000. Looking at the Middle and High parental attitude groups, no shifting frequencies as a function of age could be identified.

4.4 Discussion

The findings of Study 1 did suggest the presence of individual differences in children's understanding of illness. However, the exploration of possible links between the children's thinking and their own experience of disease did not reveal significant relationships. Based on these results, one might propose that children present different understandings of where the boundaries fall across a variety of ontological categories as indexed by their generalisation of illness; these understandings might be influenced by different experiences but not by their own *illness* experience.

In connection with the children's illness experience, it could be argued that the participants were normally healthy children who tended to report coughs or colds and childhood diseases such as chicken-pox or mumps. There were only a few children who had been unfortunate enough to have had the sort of increased contact with illness which might have resulted in a significant difference in their thinking and consequently in their responses. Most of the population in both schools presented very common diseases as part of their own experiences, which it seems did not result in any major or notable changes in the children's behaviour or environment, and are therefore considered unremarkable events in their lives. It would be of interest to extend this study to examine chronically-ill children who undoubtedly do have a different and greater experience of illness than normally healthy children. It has been reported in previous studies that sick children's thinking is sometimes influenced by their greater and different experience of illness (Bibace & Walsh, 1981; Rubovits & Siegel, 1994; Eiser et al., 1998) which allows for expectancies of a different conceptual understanding from the specific population.

With respect to parental health attitudes and behaviours, no relationship was found between the children's basic category scores and their parents' health attitudes.

Moreover, only one interaction effect emerged between children's CFA response patterns of which ontological categories ``can get ill`` and their parents' healthy attitudes, which indicated that the children in the Low parental attitude group presented different developmental profiles from the children allocated in the Middle and High parental attitude groups respectively.

One of the possible interpretations of the above results might be that an increased parental concern with health and illness matters, which is assumed to be one of the ways in which children's understanding of illness would be affected, has no direct influence in the development of children's thinking generally, but its impact is mediated either via the presence of health-related objects in the home or via parental practices. Although parents might not generally share their beliefs with their children, one might expect that health behaviours to which families are accustomed would contribute in shaping illness understandings at least in an indirect fashion. Thus it could be the case that it is not the health attitudes of parents per se, but perhaps the presence of educational aids in the home environment (such as children's books about the body or medical encyclopaedias), concerning biology and/or health and illness, that most influences children's developing concept of illness.

Finally, it should be noted that there were methodological problems with the parental questionnaire. Although this was developed from existing and validated scales, it failed to reproduce the expected two factor structure. One possible explanation of the failure to display the expected factor structure might be that the instrument which was used was originally tested and validated on a North American population rather than the British population which was used in the present study (see Vickers et al. 1990). If health and illness models are influenced by the social and cultural environment in which they are formed, then different measures might be needed in order to identify health behaviours and attitudes in different populations. It would be worth attempting this investigation again after redesigning the parental questionnaire, since the one used in the present study might have failed to accurately measure the relevant types of parental health beliefs and behaviours in a British population. In addition, as has already been noted, the presence of educational aids in the home such as medical and health books, CD-roms, plastic skeletons and other health-related objects might have a

more direct influence on children's thinking than parental attitudes per se. In the light of the lack of findings from Study 2, it was therefore decided to redesign the parental questionnaire, to try to capture parental attitudes more accurately, and also to try to measure the presence of health-related objects in the home. Details of how a revised parental questionnaire was developed can be found in Appendix 3.

CHAPTER 5

Study 3: Healthy vs chronically-ill children's generalisation of illness from three different exemplars

5.1 Introduction

Previous research into children's biological thinking has suggested that their understanding is based on humans as the prototypical biological entity and is then extended according to the closeness of other biological categories to humans (Carey, 1985). Carey presented evidence to show that young children use their knowledge about people to reason about other biological kinds. Evidence from Study 1 could also be interpreted as implying that children use humans as a prototypical biological entity, as the children in this study were more likely to generalise illness to entities that were more similar to, or closely related to humans. Thus, it was found that they were most likely to generalise illness to humans, then to mammals, then to non-mammals, then to plants, and hardly at all to physical kinds and hand-made artifacts. However, as noted in the discussion to Chapter 3, it may have been the case that the children in Study 1 implicitly used a human exemplar for generating their responses, which might have led to this result. Thus, it is essential to examine whether the use of non-human exemplars results in a lower degree of generalisation, before it is possible to conclude that humans are the prototypical biological entity for the attribution of illness.

In addition, in Studies 1 and 2 an attempt was made to see whether the individual differences in children's generalisation of illness were related to the children's personal health histories. To this end in these two studies, normally healthy children's understanding was assessed in Study 1, and their parents filled in a health history questionnaire about the child in Study 2. However, no relationships were found. It was noted in Chapter 4 that one possible reason for this failure to find a relationship was that Study 1 used a sample of normally healthy children, and there were very few children in this sample who had been unfortunate enough to have had the level of increased contact with illness which might have had a significant impact upon their thinking in this domain. Consequently, it was decided to revisit this issue in Study 3, using a different method of enquiry. In this study, rather than looking for individual differences only within a group of normally healthy children, the participants consisted

of healthy and chronically-ill children instead in order to examine any differences in understanding between the two groups.

It has been suggested in the literature that one of the factors that might have significant effect on children's understanding of illness concepts is the child's experience of illness. As was seen in Chapter 2, some researchers, using the cognitive developmental approach, have suggested that children's exposure to a chronic disease and medical treatment might result in a greater understanding of illness-related concepts in comparison to healthy peers (Bibace & Walsh, 1981; Rubovits & Siegel, 1994) while others have reported that chronically-ill children demonstrate a less sophisticated understanding of illness-related concepts (Nagera, 1978; Shagena et al., 1988; Perrin, Sayer & Willett, 1991). Due to the contradictory findings of these studies it was of interest to investigate whether there are any differences between healthy and chronically-ill children's illness concepts, by using the alternative naive theory approach. It was thought that children suffering from a chronic condition might present different understandings as a consequence of their experience of a major illness.

Consequently, the present study was designed to explore children's generalisation of illness from three different exemplars and to identify possible differences in the thinking between normally healthy and chronically-ill children. In order to tap the children's concepts of illness, as opposed to their acquired knowledge of a specific actual disease, a made-up illness, plinkitis, was presented. Using one of three exemplars of plinkitis, a child, a dog or a duck, the children were asked whether this illness could also afflict a further thirty entities, five from each of six ontological categories.

Finally, it was also decided to incorporate one additional measure into the present study: the children's verbal IQs were also measured using the British Picture Vocabulary Scale (BPVS) (Dunn, Dunn, Whetton & Pintilie, 1982). The purpose of taking this measure was twofold: to ensure that the healthy and chronically-ill children did not differ in their verbal IQ; and to see whether the children's responses were in anyway related to their verbal IQ.

5.2 Method

5.2.1 *Participants*

Two hundred and ninety one children were randomly recruited from years Reception to Year 6 (age range: 59-143 months) in two primary schools in East Sussex County, which is located in south-east England in the UK (School 1: 152 children, School 2: 139 children). The same schools as in Study 1 were chosen; however, none of the children who participated in the present study had previously participated in Study 1. For the purposes of the analysis the children were grouped into three age-groups: (1) Young group with 119 children from three school years (Reception, Year 1, and Year 2): 59 girls (mean age = 76.31 months, age range = 59-94 months) and 60 boys (mean age = 74.92 months, age range = 59-93 months). (2) Middle group with 85 children from two school years (Year 3 and Year 4): 46 girls (mean age = 107.37 months, age range = 95-119 months) and 39 boys (mean age = 106.87 months, age range = 97-119 months). (3) Old group with 87 children from two school years (Year 5 and Year 6): 45 girls (mean age = 129.02 months, age range = 119-142 months) and 42 boys (mean age = 130.83 months, age range = 119-143 months).

In addition, 96 children (age-range: 54-141 months) diagnosed as having a chronic condition participated in the present study: 13 children with cystic fibrosis, 19 children with diabetes, 14 children with epilepsy, 42 children with asthma, and 8 children with other conditions such as leukemia, osteogenesis imperfecta, and retinoblastoma. The children were recruited from the Royal Alexandra Hospital for Sick Children in East Sussex County, which is located in south-east England in the UK. For the purposes of the analysis the children were grouped into three age-groups: (1) Young group with 44 children: 21 girls (mean age = 77.80 months, age-range = 56-94 months) and 23 boys (mean age = 75.96 months, age-range = 54-94 months); (2) Middle group with 31 children: 17 girls (mean age = 105 months, age-range = 97-117 months) and 14 boys (mean age = 108.64 months, age-range = 97-118 months); (3) Old group with 20 children: 6 girls (mean age = 127.66 months, age-range = 121-140 months) and 14 boys (mean age = 124.50 months, age-range = 111-141 months). These children formed the chronically-ill (henceforward CI) group in the experiment.

All the children's IQs were measured by the BPVS (Dunn et al., 1982). A 2 (health status) x 3 (age) ANOVA revealed that there were no significant differences between the BPVS scores obtained by the healthy and by the CI children (Healthy mean score = 102.02, sd = 14.7, CI mean score = 99.53, sd = 18.5), nor between the three age-groups (Young mean score = 100.93, sd = 16.9, Middle mean score = 101.24, sd = 15.3, Old mean score = 100.81, sd = 20.3, and there was no significant interaction between health status and age. Therefore, there were no biases evident on the BPVS in the samples for the study.

5.2.2 Materials

Thirty cards, each measuring 5 x 2.5 ins, naming five entities from each of six ontological categories, were used in the sorting task. On each card, the name of one entity was written clearly. The ontological categories from which the entity names were drawn were (a) *human beings* (man, woman, boy, girl, baby), (b) *mammals* (elephant, cow, sheep, cat, mouse), (c) *non-mammals* (crocodile, tortoise, frog, butterfly, ant), (d) *birds* (turkey, swan, chicken, blackbird, robin), (e) *plants* (oak tree, apple tree, rose bush, daffodil, dandelion) and (f) *hand-made artifacts* (house, car, bicycle, computer, cup). The ontological category of birds was added in this study, instead of the category of physical kinds; firstly in order to see how children operated with this category, and secondly because one of the illness exemplars was drawn from this category (the duck). The category of physical kinds was omitted because it had functioned very similarly in Study 1 to the category of hand-made artifacts. The generalisation entities in this study were also chosen to represent a full range of sizes within each category. In addition, there were three boxes, measuring 9 x 6.5 x 7 ins, representing one of the three possible answers given by the children. Each of the three boxes was labelled with the appropriate words which were clearly written on the front: *can get plinkitis*, *cannot get plinkitis*, *I don't know*. Finally, three additional cards were used, each showing a simple black and white line drawing of one of the exemplars in reference to which the children were taught about the imaginary illness. The three exemplars used were a child, a dog and a duck, belonging to the categories of *human beings*, *mammals* and *birds* respectively. In order to minimise any possible effects on the children's generalisations from the size of the exemplars, the exemplars were

chosen from the midpoint size of each range (midpoint size of humans, mammals, and birds respectively).

5.2.3 Procedure

Children were randomly assigned to either the child, dog or duck condition.

Healthy children: The participants were tested individually in a room apart from their regular classroom. Each interview lasted up to fifteen minutes with each individual child. The session began by giving the child an explanation about the purpose of the interview, suggesting that the interviewer was writing a book for children concerning the body and the ways it can be kept strong. The children were reassured that there were no right or wrong answers and that they should feel free to ask for clarifications when they did not understand the questions. Immediately after the completion of the task, the short form of the BPVS was administered to each of the participants.

Chronically-ill children: The research proposal was reviewed by the Ethics and Research Committee of the Paediatric Hospital which agreed for the children to participate in the study. Children and their families received a letter explaining the nature and rational of the study, before their regular appointment in the clinic at the Outpatients' Department of the Royal Alexandra Hospital for Sick Children. On the day of their appointment, the parents of the children selected to participate in the study were approached by the interviewer and asked about whether they agreed for their children to take part in this research. There were four parents and three children who refused to participate. Ninety six parents and children agreed to take part and after their parents signed a consent form, the children who participated were interviewed individually. Exactly the same procedure was followed as with the healthy children.

The three boxes with open tops without lids were put on the table. Each box represented one of the possible answers which could be given by the child: *can get plinkitis*, *cannot get plinkitis*, *I don't know*. The boxes were placed on the table in the above order for the first child and in such a way that the child could clearly see what was written on each box. For the second child the order *cannot get plinkitis*, *can get plinkitis*, *I don't know* was used. These two orders were alternated accordingly throughout the testing in order to control for possible left-right response biases. The

interviewer showed the cards to the child, in a different randomised order for each individual child, saying that these were some cards with the names of lots of different things on them. The requirement for the child was to put each card into one of the boxes depending on whether the child thought that the entity named on each card can get plinkitis or cannot get plinkitis. For the younger children, cards were read in case there were any difficulties with reading. The exact words used by the interviewer were as follows:

“Have you ever heard of plinkitis? Plinkitis is an illness. Here is a picture of a child (dog or duck; depending on which exemplar the child was taught on). Children (dogs or ducks) can get plinkitis. When children (dogs or ducks) get plinkitis they feel dizzy and have to stay really-really still or they feel worse. They also have a high temperature and they feel very ill. Here are some cards with the names of lots of different things on them. What I would like you to do is put each card into one of these boxes, depending on whether you think that thing can get plinkitis or cannot get plinkitis. For example, if you think that something can get plinkitis, put the card into the box which says ‘can get plinkitis’ (physically hold a card over the box). If you think that something cannot get plinkitis, put the card into the box that says ‘cannot get plinkitis’ (physically hold a card over the second box). If you really don’t know whether it can get plinkitis or cannot get plinkitis, put the card in the ‘don’t know box’ (physically hold a card over the ‘don’t know box)’”. For the younger children the following words were added: “if you have any difficulty reading some of the cards, tell me and I’ll help you to read them”.

5.3 Results

The children’s thinking about the ontological categories was analysed first by conducting ANOVAs on the children’s basic scores (scores given by the children for each of the six ontological categories representing the number of entities chosen as susceptible to plinkitis); secondly (because of the complexity of the ANOVA results) by correspondence analysis on those subgroups of children from each of the three age-groups selecting the majority of entities in each category; and finally by configural frequency analysis on children’s responses for each ontological category for each of

the three exemplars used. In addition, log linear analyses were conducted to investigate for any possible links between children's significant response patterns and age or gender.

5.3.1 ANOVAs

The total number of cards from within each ontological category which were placed into each individual box was calculated; in each case, the scores could therefore range from 0-5. The mean scores obtained by the children were first analysed by using three 5-way 3 (age) x 2 (healthy vs CI) x 2 (gender) x 3 (exemplar) x 6 (type of ontological category) mixed ANOVAs with independent groups on the first four factors and repeated measures on the fifth factor. In one of these ANOVAs, the number of "can get plinkitis" responses was the dependent variable; in the second, the number of "cannot get plinkitis" responses was the dependent variable; and in the third one, the number of "don't know" responses was the dependent variable. These revealed main effects of category as well as category by exemplar and category by group interaction effects. The results of these ANOVAs are shown in Appendix 4.

Because of the category by exemplar interaction effect, the data were also analysed for each exemplar separately using three separate 3 (age) x 2 (gender) x 2 (healthy vs CI) x 6 (type of ontological category) mixed ANOVAs, with independent groups on the first 3 factors and repeated measures on the fourth factor. There were main effects of type of category on all three responses (can get plinkitis, cannot get plinkitis, I don't know) with all exemplars, indicating that children do perceive differences between the various categories of entities when exemplars belong to different ontological categories. The children's mean scores, for each exemplar, on the "can get plinkitis" responses are shown in Tables 5.1- 5.3, and these are discussed further in the following pages. Tables 5.1-5.3 do not separate out the healthy vs chronically-ill children's scores, because there were no significant effects involving the healthy vs CI variable. All of the significant effects which were found in the three ANOVAs are shown at the foot of each table. Analysis was focused on "can get plinkitis" as these category-inclusion responses represent the clearest indications of the children's thinking.

Table 5.1: Child Exemplar: children’s mean responses to who can get plinkitis (standard deviations in parentheses)

	can get plinkitis			
category	Young	Middle	Old	total
human beings	3.93 (1.4)	4.60 (1.0)	4.58 (1.0)	4.32 (1.2)
mammals	2.42 (1.8)	2.30 (1.9)	2.41 (2.0)	2.38 (1.9)
non-mammals	2.01 (1.7)	1.50 (1.7)	1.41 (1.8)	1.68 (1.7)
birds	2.00 (1.7)	1.97 (2.0)	2.13 (2.0)	2.03 (1.9)
plants	0.62 (1.1)	0.17 (0.5)	0.08 (0.5)	0.33 (0.8)
artifacts	0.32 (0.7)	0.02 (0.1)	0.10 (0.4)	0.17 (0.5)
mean scores	1.88	1.76	1.78	1.81
ANOVA sign. Effects	category: F (5, 129) = 96.26, p< 0.001			

Table 5.2: Dog Exemplar: children’s mean responses to who can get plinkitis (standard deviations in parentheses)

	can get plinkitis			
category	Young	Middle	Old	Total
human beings	1.58 (1.9)	2.18(2.3)	2.79 (2.3)	2.15 (2.2)
mammals	3.54 (1.3)	4.04 (1.3)	4.02 (1.1)	3.85 (1.2)
non-mammals	2.60 (1.5)	2.50 (1.7)	1.88 (1.6)	2.34 (1.6)
birds	2.88 (1.6)	3.63 (1.7)	2.56 (1.9)	3.02 (1.8)
plants	0.36 (0.6)	0.18 (0.6)	0.15 (0.8)	0.23 (0.6)
artifacts	0.22 (0.5)	0.04 (0.2)	0.04 (0.2)	0.10 (0.3)
mean scores	1.86	2.09	1.90	1.94
ANOVA	category: F (5, 122) = 119.76, p< 0.001			
sign. Effects	age x category: F(10, 242) = 2.64, p< 0.01			

Scheffe tests: significant differences between age groups

Human beings

Young group vs Old group

Birds

Middle group vs Old group

Table 5.3: Duck Exemplar: children’s mean responses to who can get plinkitis (standard deviations in parentheses)

	can get plinkitis			
category	Young	Middle	Old	Total
human beings	2.33 (2.0)	1.81 (2.2)	2.65 (2.3)	2.29 (2.2)
mammals	3.24 (1.5)	3.05 (1.7)	3.00 (1.8)	3.11 (1.7)
non-mammals	2.85 (1.4)	2.54 (1.7)	2.25 (1.4)	2.57 (1.5)
birds	3.40 (1.3)	4.27 (1.0)	4.02 (1.1)	3.84 (1.2)
plants	0.64 (1.2)	0.37 (0.8)	0.25 (0.8)	0.44 (1.0)
artifacts	0.31 (0.7)	0.05 (0.2)	0.06 (0.3)	0.16 (0.5)
mean scores	2.12	2.01	2.03	2.06
ANOVA	category: F (5, 118) = 131.09, p< 0.001			
sign. Effects	age x category: F(10, 234) = 2.324, p< 0.05			

Scheffe tests: significant differences between age groups

Birds

Young group vs Middle group

Differences associated with category

Child Exemplar

Post hoc t-tests were conducted to locate precisely where the category effects were occurring (see Table 5.4). When the children were taught the imaginary illness (plinkitis) on the child they claimed that humans were significantly more likely than all the other categories to get plinkitis. After human beings, mammals were the most likely to get plinkitis, followed by birds, non-mammals, and then plants in that order. The category of hand-made artifacts was seen by children in all age-groups as significantly the least likely to get plinkitis. However, the differences between plants and hand-made artifacts were not significant.

Dog Exemplar

Post hoc t-tests were conducted to locate where the category effects were occurring (see Table 5.5). When the children were taught that plinkitis is an illness afflicting dogs they claimed that mammals were significantly more likely than all the other categories to get plinkitis. After mammals, birds were the most likely to get plinkitis, followed by non-mammals, humans and then by plants. It was again the category of hand-made artifacts which was seen by children in all age-groups as significantly the least likely to get plinkitis. However, the differences between humans and non-mammals, and between plants and hand-made artifacts, were not significant. The patterns of significant differences for each individual age group separately are also shown in Table 5.5, as these serve to further illuminate the sources of the age x category interaction effect.

Duck Exemplar

Post hoc t-tests were conducted to locate where the category effects were occurring (see Table 5.6). When the children were taught that plinkitis is an illness afflicting ducks they claimed that birds were significantly more likely than all the other categories to get plinkitis. After birds, mammals were the most likely to get plinkitis, followed by non-mammals, and humans, and then by plants. The category of hand-made artifacts was seen by children in all age-groups as significantly the least likely to get plinkitis. However, the differences between humans and non-mammals were not

significant. Table 5.6 also presents the patterns of significant differences for each individual separately to further illuminate the age x category interaction effect.

Table 5.4: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories with the Child exemplar

	Can get plinkitis (t values)
humans v mammals	10.12**
humans v non-mammals	14.37**
humans v plants	25.93**
humans v birds	12.18**
humans v artifacts	31.07**
mammals v non-mammals	5.98**
mammals v plants	12.46**
mammals v birds	3.31**
mammals v artifacts	13.51**
non-mammals v plants	9.49**
non-mammals v birds	-3.13**
non-mammals v artifacts	10.30**
plants v birds	10.32**
plants v artifacts	ns
birds v artifacts	11.41**

df = 144

p < 0.003** ns = non-significant

Table 5.5: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories in each age group with the Dog exemplar

	can get plinkitis all children (t values)	Young Group only (t values)	Middle Group only (t values)	Old Group only (t values)
humans v mammals	-8.40**	-6.89**	-4.90**	-3.16**
humans v non-mammals	ns	-3.39**	ns	ns
humans v plants	7.48**	4.14**	5.41**	6.73**
humans v birds	-3.60**	-3.64**	-3.47**	ns
humans v artifacts	10.26**	4.67**	5.91**	7.50**
mammals v non-mammals	11.22**	4.09**	7.56**	9.14**
mammals v plants	28.77**	14.52**	17.41**	19.64**
mammals v birds	6.20**	ns	ns	5.70**
mammals v artifacts	31.34**	15.07**	19.70**	22.52**
non-mammals v plants	14.08**	9.20**	8.59**	6.62**
non-mammals v birds	-4.95**	ns	-5.23**	ns
non-mammals v artifacts	15.33**	10.11**	9.05**	7.43**
plants v birds	17.36**	9.97**	13.03**	8.11**
plants v artifacts	ns	ns	ns	ns
birds v artifacts	18.15**	10.50**	13.56**	8.49**

df (all children) = 137

df (Young group only) = 49

df (Middle group only) = 43

df (Old group only) = 43

p < 0.003** ns = non-significant

Table 5.6: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories in each age group with the Duck exemplar

	can get plinkitis all children (t values)	Young Group only (t values)	Middle Group only (t values)	Old Group only (t values)
humans v mammals	-4.21**	-3.06**	ns	ns
humans v non-mammals	ns	ns	ns	ns
humans v plants	8.97**	5.51**	3.59**	6.40**
humans v birds	-8.01**	-3.80**	-5.82**	-4.60**
humans v artifacts	11.23**	7.01**	4.96**	7.38**
mammals v non-mammals	4.37**	ns	ns	3.62**
mammals v plants	15.59**	8.97**	9.22**	8.99**
mammals v birds	-5.12**	ns	-3.72**	-4.71**
mammals v artifacts	19.14**	12.08**	10.63**	10.20**
non-mammals v plants	13.94**	9.02**	7.29**	7.57**
non-mammals v birds	-8.73**	ns	-5.09**	-8.31**
non-mammals v artifacts	17.86**	12.74**	8.76**	9.26**
plants v birds	23.25**	10.49**	17.81**	17.71**
plants v artifacts	3.41**	ns	ns	ns
birds v artifacts	30.04**	14.70**	22.14**	21.70**

df (all children) = 133

df (Young group only) = 53

df (Middle group only) = 36

df (Old group only) = 42

$p < 0.003$ ** ns = non-significant

Differences associated with age

There were no main or interaction effects involving age on the “can get plinkitis” responses with the child as exemplar. However, when children were presented with the dog exemplar as the animate object afflicted by plinkitis, an interaction effect between category and age was revealed on the ‘can get plinkitis’ responses. The post-hoc t-tests revealed that it was only the children in the Young group who were significantly more likely to generalise to the category of non-mammals than to the category of humans (see Table 5.5). Additionally, the Middle group of children were more likely than the Old or Young group to generalise to the category of birds than to non-mammals when taught on the dog exemplar (see Table 5.5). Finally, only the Old group of children was significantly more likely to generalise to the category of mammals than to the category of birds. Focusing on the results of the Scheffe tests (see Table 5.2), the Young group of children were less likely to generalise to human beings than the Old group. In addition, the Middle group of children was significantly more likely to generalise to birds than the Old group.

When children were presented with the duck exemplar as the animate object afflicted by plinkitis, an interaction effect between category and age was again revealed on the ‘can get plinkitis’ responses. Post-hoc-tests revealed that only the children in the Old group were significantly more likely to generalise ‘plinkitis’ to the category of mammals than to the category of non-mammals (see Table 5.6). Moreover, only the children in the Young group were significantly more likely to generalise ‘plinkitis’ to mammals than to humans. The Scheffe tests (see Table 5.3) revealed that the Middle group of children was more likely to generalise to birds than the Young group.

Differences associated with gender

There were no main or interaction effects associated with gender on all three exemplars. Because of this, gender was excluded from further analysis.

Differences associated with health status

As has already been noted in passing, there were also no main or interaction effects associated with health status (healthy vs CI) on all three exemplars. Thus, this variable was also excluded from further analysis.

5.3.2 Correspondence Analyses

Because of the complexity of these findings, the individual findings from the ANOVAs were further explored by correspondence analysis, which is a multidimensional method for analysing categorical data (Hammond, 1993). Correspondence analysis was used to examine the relationship between the children's age and their generalisation to the entities from the six ontological categories with each of the exemplars used. By using well-established geometric principles, correspondence analysis supplies a pictorial representation of the relationship between groups of subjects and the types of responses which are most closely associated with those groups. In these pictorial representations, the degree of association between a particular group of subjects and a particular response is represented graphically as the geometric distance between the two points representing the response and group respectively. Thus, those responses which were most exclusively associated with particular age groups were revealed using this method, enabling a detailed explanation of the 2-way interactions between the children's understanding of the ontological categories and their age.

Correspondence analysis uses proportional frequencies as data. For correspondence analysis when 3, 4, or 5 entities were chosen in each ontological category the response was recoded as 1. When 0, 1 or 2 entities were chosen in each ontological category the response was recoded as 0. The correspondence analysis was conducted on the proportion of participants who responded by choosing 3 or more entities from each ontological category as susceptible to plinkitis. Thus, while the ANOVAs examined all the children's responses to individual entities within categories, the correspondence analyses reported only the responses of those children choosing a majority of entities within a category. Therefore, the two analyses present different aspects of the data.

For the interpretation of the plots given by the correspondence analysis it is essential to mention that the first dimension is always the horizontal one: that is, the most

discriminating responses for Dimension 1 are the ones to the extreme left and right in each plot, and those groups which are most closely associated with those responses will be the nearest outermost groups in each case. The vertical dimension is the second dimension; that is the most discriminating responses for Dimension 2 are the ones at the extreme top and bottom of the plot, and are associated with the nearest outermost groups on the vertical dimension. Finally, all those responses which are clustered between the groups are the non-discriminating ones that are made or not-made by similar numbers of children in all groups.

Three correspondence analyses examined the thinking of the children for each exemplar used. Due to the fact that there were no significant differences in children's responses associated with their health status (healthy vs chronically-ill), this variable was not included in the correspondence analyses conducted.

Age trends

Correspondence analyses on children's responses for each exemplar produced significant one-dimensional solutions. In Figure 5.1, which represents the children's "who can get plinkitis" responses with the Child exemplar, Dimension 1: inertia = 97%, $\chi^2 = 18.4$, $df = 7$, $p < 0.05$. In Figure 5.2, which shows the children's "who can get plinkitis" responses with the Dog exemplar, Dimension 1: inertia = 83%, $\chi^2 = 6.6$, $df = 7$, $p < 0.05$. In Figure 5.3, which shows the children's "who can get plinkitis", with the Duck exemplar, Dimension 1: inertia = 91%, $\chi^2 = 15.5$, $df = 7$, $p < 0.05$.

Child Exemplar

In Figure 5.1, the children in the Young age-group were more likely to generalise from the child exemplar to the categories of plants and hand-made artifacts. However, the Young children's thinking did not differ greatly for all the other ontological categories (humans, mammals, non-mammals, and birds). Drawing on these results, it can be proposed that the first dimension differentiated the thinking of the Young group from the other two groups of children.

Dog Exemplar

In Figure 5.2, there was one significant dimension which differentiated the thinking of the children in the Old group from the other two groups. It was the oldest children who tended to generalise more from the dog exemplar to the categories of humans and plants. However, because of the very low frequency responses of the Old group of children to the category of plants, this particular finding should not be overstressed. Finally, it was the children in the Young group who tended to generalise more to non-mammals.

Duck Exemplar

Finally, in Figure 5.3, the one dimensional solution differentiated the thinking of the children in the Young group from that of the Middle and Old groups. It was the youngest children who were the most likely to generalise from the duck exemplar to the categories of plants and hand-made artifacts.

Figure 5.1: Who can get plinkitis analysed by age (Child exemplar)

Dim 1. Inertia=97%, $\chi^2=18.4$, $df=7$, $p<0.05$

Figure 5.2: Who can get plinkitis analysed by age (Dog exemplar)

Dim 1. Inertia=83%, $\chi^2=16.6$, $df=7$, $p<0.05$

Figure 5.3: Who can get plinkitis analysed by age (Duck exemplar)

Dim 1. Inertia=91%, $\chi^2=15.5$, df=7, p<0.05

5.3.3 *Configural Frequency Analysis*

There are indications that the children's generalisations differed at different ages, depending on exemplar. Are there different judgement patterns across children's responses to illness susceptibility when children are taught on different exemplars (child, dog or duck)?

One way of answering the above question is by using Configural Frequency Analysis (CFA). Focusing on the children's choices of those entities which can get plinkitis, the children's responses for each category on each exemplar were scored as follows: for each of the exemplars, to those children who chose two or less entities in a category a score of 0 was given; to those children who chose three or more entities in a category a score of 1 was given. The data consisted only of the responses of those children choosing a majority of entities within a category, as in the correspondence analyses. Therefore, each child had a score of 0 or 1 for each ontological category and only for the exemplar that the child was taught on. The above scoring resulted in a response pattern for each participant. The six ontological categories that were represented in each pattern were in the following order: humans, mammals, non-mammals, birds, plants, and hand-made artifacts. The data were subjected to three Configural Frequency Analyses, one for each of the three exemplars, child, dog and duck.

Child Exemplar

On the "can get plinkitis" responses for the Child exemplar, there were 2 significant response patterns across the six ontological categories. The patterns are shown in Table 5.7. Pattern 100000: 54 children said that three or more entities can get plinkitis within the human category, and 2 or less entities within the mammal, non-mammal, bird, plant and hand-made artifact categories ($z = 6.5$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$). Pattern 111100: an additional 29 children suggested that 3 or more entities can get plinkitis within the human, mammal, non-mammal and bird categories, and two or less entities within the plant and hand-made artifact categories respectively ($z = 7.4$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$).

Table 5.7: Configural Frequency Analysis response patterns presented by children taught on the Child exemplar

	Pattern 100000	Pattern 111100
human	1	1
mammal	0	1
non-mammal	0	1
bird	0	1
plant	0	0
artifact	0	0
Frequency of Pattern	54	29

Dog Exemplar

The results on the “can get plinkitis” responses for the Dog exemplar revealed 4 significant response patterns. These patterns are shown in Table 5.8. Pattern 011100: 28 children suggested that 3 or more entities can get plinkitis within the mammal, non-mammal and bird categories, and two or less entities within the human, plant and hand-made artifact categories ($z = 6.5$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$). Pattern 111100 was significant for 20 children who reported that 3 or more entities can get plinkitis within the human, mammal, non-mammal and bird categories, and two or less entities within the plant and hand-made artifact categories ($z = 5.2$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$). Pattern 010000: 18 children suggested that 3 or more entities can get plinkitis within the mammal category, and two or less entities within the human, non-mammal, bird, plant and hand-made artifact categories ($z = 4.3$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$). Finally, Pattern 000000 was significant for 12 children that suggested that 2 or less entities in each of the six ontological categories can get plinkitis ($z = 8.7$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$).

Table 5.8: Configural Frequency Analysis response patterns presented by children taught on the Dog exemplar

	Pattern 011100	Pattern 111100	Pattern 010000	Pattern 000000
human	0	1	0	0
mammal	1	1	1	0
non-mammal	1	1	0	0
bird	1	1	0	0
plant	0	0	0	0
artifact	0	0	0	0
Frequency of Pattern	28	20	18	12

Duck Exemplar

The findings on the “can get plinkitis” responses for the Duck exemplar revealed significant responses for Patterns 111100 and 000000. The patterns are presented in Table 5.9. Pattern 111100 emerged as significant for 30 children ($z = 3.5$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$): these children suggested that 3 or more entities can get plinkitis within the human, mammal, non-mammal and bird categories. In addition, Pattern 000000 was significant for 9 children ($z = 5.4$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0007$): these children suggested that 2 or less entities can get plinkitis within the human, mammal, non-mammal, bird, plant and hand-made artifact categories.

Table 5.9: Configural Frequency Analysis response patterns presented by children taught on the Duck exemplar

	Pattern 111100	Pattern 000000
human	1	0
mammal	1	0
non-mammal	1	0
bird	1	0
plant	0	0
artifact	0	0
Frequency of Pattern	30	9

The results of the Configural Frequency analyses showed the children’s judgement patterns on all three exemplars. Furthermore, there was a unique pattern Pattern 100000 when the Child exemplar was used, and Patterns 010000 and 011100 when the Dog exemplar was presented. It was of interest to explore possible associations between the judgement patterns given by the children and their age or gender. Are there one or more response patterns proposed by children who belong to a certain age-group? If yes, what kind of assumptions could be made in relation to children’s naive theory of illness? In order to investigate the existence of such associations, a new variable was computed corresponding to whether or not each child presented one of the significant response judgement patterns. Three hierarchical log linear analyses were conducted for each exemplar respectively. The results revealed one significant association between gender and the children’s response patterns for the child exemplar ($\chi^2(1) = 3.84, p < 0.05$). Pattern 100000 was presented by 34 girls and 20 boys; in other words it was the female participants who tended to generalise to humans only when taught on the child exemplar. In addition pattern 111100 was given by 18 boys and 11 girls. It was the male participants who tended to generalise plinkitis to humans, mammals, non-mammals and birds when taught on the child exemplar. No

other significant associations were found between the children's response patterns and their gender or age for the dog and duck exemplars.

5.4 Discussion

5.4.1 Differences associated with children's health status

One of the main aims of the present study was to identify any possible differences in healthy vs chronically-ill children's generalisations of "plinkitis" from the human and non-human exemplars. However, as it became evident from the ANOVAs, there were no main or interaction effects found involving the healthy vs chronically-ill children. These findings support the literature suggesting that the exposure to a chronic disease and medical treatment does not necessarily result in greater understanding of illness-related concepts (e.g. Perrin, Sayer & Willett, 1991), and runs counter to that literature which suggests that health status does affect children's illness concepts (e.g. Rubovits & Siegel, 1994). However, it should be noted that one possible explanation for the lack of differences identified, between healthy and chronically-ill children's illness understanding, might be the comparatively small numbers of chronically-ill children who participated in the study (96 as opposed to 291 healthy children). Unfortunately, this was the maximum number of chronically-ill children that it was possible to recruit for this study from the hospital which participated in the study.

5.4.2 Differences associated with gender

No differences associated with gender were found in any of the ANOVAs conducted. In other words, boys and girls presented similar response patterns. There was one association with gender in the log linear analyses. This suggested that the female participants tended to generalise plinkitis to humans only when taught on the child exemplar. The general lack of gender effects suggests that gender maybe discounted as a significant factor in children's thinking concerning illness concepts within the naïve theory of biology approach.

5.4.3 Differences associated with exemplars

This study explored children's generalisation of illness from three different exemplars. It was found that the children presented different generalisations from different exemplars when asked to decide about the illness susceptibility of entities belonging to

six different ontological categories. Specifically, when children were taught on one of the three exemplars, child, dog or duck, they were significantly more likely to generalise to the same ontological category to which the exemplar itself belonged. In other words, children tended to generalise more to the category of human beings when the child was the exemplar, to the category of mammals when the dog was the exemplar, and to the category of birds when they were taught on the duck exemplar. But did the children use membership categorisation, or did they use similarity in appearance, in order to generalise illness susceptibility significantly more frequently to the entities belonging to the same ontological category as the exemplar?

Some researchers have proposed that young children tend to underattribute unobservable animal properties such as breathing to animals that are phylogenetically far from and physically dissimilar to humans (Carey, 1985; Inagaki & Sugiyama, 1988). Overall, when the children were taught on the child exemplar, they did display the tendency to generalise plinkitis to humans, then to mammals, birds, non-mammals, plants and hand-made artifacts in this order. These findings suggest that the above argument could be supported. In other words, when the human exemplar was used children tended to generalise to the six ontological categories in the above decreasing pattern of attribution which could have been based on how phylogenetically and anatomically different these entities were in comparison to humans. However, with the dog as exemplar, the children were more likely to generalise plinkitis to the category of mammals, than to other entities, while with the duck as exemplar, they were more likely to generalise to birds than other entities. This suggests that humans are not always the prototypical biological entity: instead, the children seemed to be just as capable of generalising from a duck to other birds, and from a dog to other mammals, as they were of generalising from a child to other humans. If phylogenetic or anatomical similarity to humans is the sole criterion used by children when requested to decide about illness susceptibility, this pattern of results is difficult to explain.

Carey showed that both children and adults use the human being as the prototype when they generalised from the human exemplar to other entities. Exploring the inferences made by adults and children with non-human exemplars, she found that 10-year-old children and adults did use the non-human exemplars provided as prototypes upon

which they based their inferences. However, Carey proposed that younger children continue to base their generalisations on the human prototype irrespective of the exemplar they are taught on, precisely because they lack the biological understanding of ontological categories. The findings of the present study contradict Carey's claim. It is evident from Study 3 that the children did generalise significantly more to the ontological category to which the exemplar itself belonged. It would appear that children do hold an implicit knowledge of ontological categories, upon which they base their decisions rather than physical similarity. Children's ontological commitment to exemplar provides evidence for Keil's claim that even young children can differentiate ontological groups within the domain of biology.

Furthermore, this interpretation is consistent with the finding that children regularly draw inductive inferences on the basis of category membership rather than surface or physical appearances (Wellman & Gelman, 1998). Young children at the age of 4 are more likely to generalise on the basis of nonobvious shared category membership rather than on the basis of perceptual obvious shared appearance (Flavell, 1985; Gelman & Markman, 1986). For example, children have been found to draw their inferences from one category member to another very dissimilar category member or even to the entire category (Gelman & Markman, 1986). Gelman and Markman (1986), in their study, presented preschool children with items in which category membership was in conflict with superficial appearances. Specifically, they presented children with a brontosaurus, a rhinoceros and a triceratops labeled as dinosaur, rhinoceros and dinosaur respectively. The category labels and physical appearances conflicted since the triceratops and the brontosaurus are members of the same category, whereas the rhinoceros and triceratops looked more alike. The children were then taught a new property of the brontosaurus and the rhinoceros and they were asked if that property was also true for the triceratops. The findings showed that children from the age of two and a half base their inferences on category membership rather than physical similarity despite conflicting physical appearances (Gelman & Markman, 1986).

Drawing on the CFA results, it was found that when children were taught on the human exemplar they presented two significant judgement patterns. The illness was

either generalised to humans only (Pattern 100000) or to humans, mammals, non-mammals and birds (Pattern 111100). In other words, the children either restricted illness only to the category of human beings or to human and non-human animals. In both patterns, the categories of plants and hand-made artifacts were not included in children's decisions about illness susceptibility. Thus, there is clear evidence that plants and hand-made artifacts are ontologically distinct as far as illness is concerned.

Looking at the children's significant generalisation patterns from the two non-human exemplars (dog and duck) it becomes apparent that they did attribute illness susceptibility to humans, mammals, non-mammals and birds (Pattern 111100). This pattern suggests that the children classified the entities from the six ontological categories into the following two categories when deciding about illness susceptibility: humans and non-human animals vs plants and inanimate objects.

However, focusing on children's generalisations from the dog exemplar, one of the significant patterns revealed is Pattern 010000. The illness was generalised only to the category of mammals. This is a unique pattern presented by the children taught on the dog exemplar. A similar pattern however, was present in children's significant responses (Pattern 100000) when taught on the child exemplar. In other words, the children generalised only to the category that the exemplar belonged. Interestingly, a similar pattern was not revealed in children's responses when taught on the duck exemplar, as one might have expected considering children's significant judgement patterns on the child and dog exemplars. One possible interpretation might be that the children did not identify the duck exemplar as a member of the category of birds. Additionally, according to the CFA results when children were taught on the non-human animals (dog and duck), some did not include any of the six ontological categories, in their responses, as susceptible to illness, not even the category to which the exemplar belonged.

It seems that children do present different attribution patterns for illness susceptibility when taught on different exemplars. These differences in the attribution of plinkitis based on the exemplar taught cannot be due to differences in acquired knowledge of the specific disease, since plinkitis is not an existing disease and therefore children have

no knowledge about it. Instead, they must have been drawing upon a naïve theory of biology in order to help them make these attributions. Moreover, it is possible that children use more than one criterion in deciding which entities can or cannot be afflicted. What determines which criteria children use every time and how these criteria change with different exemplars needs further investigation.

Carey (1985), in her study investigating children's projection of the spleen (an unknown animal property) from one of the three exemplars, people, dogs or bees, found that children attributed spleens to other animals to a much greater extent when they were taught on people than when taught on dogs or bees. While Carey argues for human prototypicality on the basis of her findings, the results of the present study contradict Carey's findings. More specifically, when children were taught on humans, they generalised plinkitis to the other biological categories (mammals, non-mammals, birds, and plants) less than when they were taught on non-human animals (dog or duck). With regard to the profiles of the projection from the dog exemplar, one might propose that, precisely because dogs are good examples of mammals, they would typify the animal kingdom better than do people, who are rather special examples of mammals.

5.4.4 Differences associated with age

Carey (1985) has argued that young children's biological knowledge is very limited and therefore their understanding of biological phenomena is confined to a social theory of human behaviour. Carey supports the notion that children's rudimentary understanding is based upon humans as the prototypical biological entity and then extended to other entities according to their similarity to people (Carey, 1985). Moreover, it has been suggested by other investigators that very young children before schooling use their knowledge of a familiar animate object in order to make predictions for a less familiar one (Inagaki, 1990). In that respect, humans are considered the most familiar animate objects for the majority of young children. Indeed, one might suggest that children know themselves well and they also understand other people through the imaginative projection of the self. In addition, young children have been exposed to people more often than to any other animate entity. On the basis of the above, it is expected that in order to make predictions concerning illness susceptibility of entities

belonging to different ontological categories, young children will indeed use their knowledge of humans as their source of analogical predictions, as Carey has suggested. And it is plausible that, as children grow older and acquire more biological experience, the basis of their predictions begins to change.

Indeed, there were indications in the children's responses that their generalisation patterns did differ at different ages, depending on the exemplar used (although age x category effects were evident only with non-human exemplars). However, if the above assertions are correct, and young children use the human being as the prototypical biological entity to a greater extent than older children, then it would be expected that when presented with the child as the exemplar having plinkitis, young children would be significantly more likely to generalise from the human exemplar than the older children. However, as the results from the ANOVAs indicated, there were no significant differences in children's generalisations associated with age on the child exemplar (no age x category effects). In other words, children in all three age groups made quite similar generalisations when taught on the child exemplar. Therefore, is human prototypicality the basis upon which children make their analogical predictions? If yes, there is no evidence from this study to support the claim that young children are more likely than older children to use this criterion as the one and only basis for their inferences.

Furthermore, it seems that even the oldest children are quite confused about the category of plants. It is true that there are several sources of misconceptions about plants as biological entities. A lot of the time in language we commonly refer to plants as if they have the ability to feel sensation (Hickling & Gelman, 1995). For example, the expressions "the flowers were so thirsty" or "my plant likes sunshine" are used quite often. In addition, plants are often treated as if they are artifacts. It is known that flowers do grow in containers, and that supermarkets and florists sell plants. Undoubtedly, the biological category of plants is a difficult one for children to comprehend.

The children's response patterns revealed in the CFAs showed that plants and hand-made artifacts are excluded irrespective of the exemplar children are taught on. It

might well be that the very specific symptoms of plinkitis might have prompted children to restrict their generalisation to the entities with the appropriate body features. These results contradict the findings of Study 1 in which children included the category of plants when asked about illness in more general terms.

Whether children's plant and animal understandings cohere in a single biological framework or whether they develop as separate domains remains an open question. Do children generalise differently to the category of plants when presented with different exemplars? Looking at the plots of the Correspondence analyses, it could be suggested that children, depending on the exemplar taught, organise their beliefs about plant susceptibility to illness differently. It has been suggested that even very young children at the age of 3 place animals and plants together in the same category and apart from hand-made artifacts (Backscheider et al., 1993). This finding was supported by the results of Study 1. Indeed, when children were asked which entities they believed to be susceptible to illness, they did include the category of plants in their significant judgement patterns. Shared underlying properties between animals and plants allow for classifications into the same category, at least for adults (Wellman & Gelman, 1998). In this respect, animals and plants are classified together into the single category of living things because of the beliefs regarding their biological commonalities such as that both plants and animals grow, reproduce and can heal themselves. Without this knowledge there may be no reason for grouping them together (Wellman & Gelman, 1998). Although the children in Study 1 drew their inferences to both plants and animals, they did not do so when presented with the specific illness taught on different exemplars in Study 3. In other words, overall the children in the present study seemed to be quite reluctant to attribute the unknown illness to the category of plants. One might accept that children recognise the underlying unobservable constructs that can lead to classifications of both animals and plants into the same category, in the case of illness susceptibility. But what happens when the children are presented with the hypothesised illness? What are the reasons that restrict children's willingness to generalise plinkitis from human and non-human animals to plants? There is one possible interpretation. If children use infectious diseases as their prototypical model of illness upon which they base their judgements (Kalish, 1999), they might be thinking in terms of how the illness could be transmitted

from one entity to another. Consumption of contaminated food is one way known to the children by which contagion could take place. However, animals consume either other animals or plants, whereas plants consume neither (with very rare exceptions). This could explain why generalisations were not made to the latter category.

Additionally, it has been suggested that in cases where unusual or novel situations are involved, children are likely to search the stimulus material for cues that can guide application of core theories (Keil, Levin, Richman, & Gutheil, 1999). Because plinkitis is a hypothesised illness and therefore children have no experience with or knowledge of it, they employ different strategies when they are confronted with incomplete information. In order to guide their inferences of “plinkitis” from the three exemplars they might be using the infectious model of illness and therefore the known ways in which a disease can be transmitted from one entity to another. If this assertion is correct, then it would be expected that children’s biological contagion theory might be activated, which will enable them to decide about illness susceptibility. Is it then, that children’s exclusion of the category of plants can be seen as evidence for the absence of a coherent theory of biology? It would have been of interest to know what attribution patterns of illness children would possess when presented with a plant exemplar. This might have enabled us to ascertain whether children’s developing beliefs about plants and animals are indeed related to one another. This is clearly a direction which needs to be pursued in future research.

CHAPTER 6

Study 4: Possible influences upon children's understanding of illness: a theme revisited

6.1 Introduction

As has been noted already in this thesis, researchers investigating children's understanding of biology have proposed that different experiences might produce different versions of naive biology (Inagaki, 1990; Hatano & Inagaki, 1992; Hatano & Inagaki, 1994). Both Study 1 and Study 3 suggest that different children may present different patterns of generalisation. The CFA results, in particular, point to the existence of individual differences in children's generalisation of illness. However, no differences were found in healthy vs chronically-ill children's generalisations of illness from the human and non-human exemplars in Study 3. The aim of this fourth study was to investigate other possible influences on the children's different responses. Parental health attitudes and the presence of health-related objects at home were considered as possible influences which might have affected the children's illness understanding and generalisation patterns. Thus, the present study aimed to explore the possible relationship between the children's responses in Study 3 and: *a.* parental health attitudes; and *b.* the presence of health-related objects in the home environment.

6.2 Method

6.2.1 *Materials*

The parents of the children interviewed in Study 3 were the participants of Study 4. As the parental health attitude questionnaire used in Study 2 had various problems associated with it (see Chapter 4), a new health attitude questionnaire was developed for use in Study 4, which was found to have good internal reliability ($\alpha = 0.74$). Full details of how this new questionnaire was developed are given in Appendix 3. The questionnaire consisted of two sections; Section A contained 11 items measuring parents' attitudes towards health and Section B contained 8 items asking for factual information concerning the presence of health-related objects at home. A full copy of the questionnaire is given in Appendix 5.

6.2.2 Procedure

Healthy children

The parental questionnaires were sent to the parents via their children, and were returned to the children's form teacher when they were completed. The return rate was 60.1% with 175 of the 291 questionnaires being returned. Of the completed questionnaires, 96% were filled in by mothers and 4% by fathers.

Chronically-ill children

The parental questionnaires were given to the parents, on the day of their children's appointment, in the clinic at the Outpatients' Department of Royal Alexandra Hospital for Sick Children. The return rate of the questionnaires was 100%. From the total number of 91 questionnaires, 82 were filled in by the mothers of the participants (90.1%), 6 by their fathers (6.6%) and 3 by other members of the family (either grandmother or oldest brother: 3.3%).

6.3 Results

6.3.1 Parental health attitudes and health-related objects

Section A

A confirmatory factor analysis was performed on the scores of parental health attitudes using principal components analysis (PCA) and forcing two factors which accounted for 38.8% of the variance. The sampling adequacy was checked using the KMO diagnostic measurement which was satisfied. The pattern matrix is given in Appendix 6. Because of the low level of variance explained, a further exploratory factor analysis was conducted using principal components analysis (PCA). The principal components analysis indicated three factors that accounted for the 48.6% of the variance (eigenvalues greater than one). The pattern matrix is given in Appendix 7. Given the relatively low level of variance explained and the fact that this solution was not easy to interpret, using the factor interpretability rule (Ferguson & Cox, 1993; Hammond, 1995), the scores of the 11 items of Section A were instead averaged and used as an overall measure of the parent's health attitudes (PHA). The internal reliability of this scale was good (Cronbach $\alpha = 0.71$, which is similar to the reliability of 0.73 which was obtained when developing the instrument: see Appendix 3). These PHA scores could range between 11 and 55. These scores were analysed by using a 3

(age) x 2 (healthy vs CI) x 2 (gender) ANOVA. The results obtained showed no main or interaction effects of any of these variables on the parental health attitudes score (PHA). The mean PHA score was 42.62 (sd = 5.2).

Section B

The sum of all 8 items concerning the presence of health-related objects at home was calculated to form a parental health-related objects score (PHO), ranging from 0 to 8 depending on the number of the objects reported by the parent as being present in their home. These scores were analysed by using a 3 (age) x 2 (healthy vs CI) x 2 (gender) ANOVA. The results obtained showed no main or interaction effects. The mean PHO score was 4.85 (sd = 1.3).

A correlation analysis was conducted between the PHA and PHO scores. It was expected that parents who presented higher PHA scores would be the ones having more health-related objects in their home environment. This was confirmed ($r = .19$, $p = .003$).

6.3.2 Children's generalisation of illness as a function of parental health attitudes

Possible links between the children's generalisation of illness to the six ontological categories and the health attitudes of their parents were examined. On the basis of their parents' health attitudes total score (PHA), the children were assigned to 3 new groups for analysis by ANOVA as follows: *group 1*: low parental attitude group (60 children: PHA = 23-40); *group 2*: middle parental attitude group (50 children: PHA = 41-45); *group 3*: high parental attitude group (58 children: PHA = 46-55). These ranges were selected on the basis of roughly equal-sized groups. A 2 (healthy vs CI) x 3 (exemplar) x 3 (PHA group) x 6 (type of ontological category) ANOVA was performed, with the number of objects within each category which could get plinkitis being the dependent variable, with independent groups on the first three factors and repeated measures on the fourth, with age partialled out as a covariate (in order to maintain reasonable cell sizes). There were no main or interaction effects involving PHA group.

Although no associations were revealed between children's illness generalisation and their parents' attitudes towards health, an attempt was made to investigate the existence of possible relations between the response profiles given by the children across the six ontological categories (as revealed by the CFAs) and age and PHA group. Three hierarchical log linear analyses were performed for each of the three exemplars respectively, child, dog and duck. There were no significant associations involving PHA group in any of these analyses.

6.3.3 Children's generalisation of illness as a function of the presence of health-related objects in their home

The children's generalisation of illness was also examined for possible associations with the presence of health-related objects in their home environment. The sum of the health-related objects was recoded as follows: *a.* for 0 to 3 objects the score of 1 was given; *b.* for 4 to 8 objects the score of 2 was given. A 2 (healthy vs CI) x 3 (exemplar) x 2 (PHO group) x 6 (type of ontological category) ANOVA was performed, with the number of objects within each category which could get plinkitis being the dependent variable, with independent groups on the first three factors and repeated measures on the fourth, with age again partialled out as a covariate. There were no main or interaction effects involving PHO group.

Finally, three hierarchical log linear analyses were conducted in order to investigate the association between the children's response profiles, their age and PHO groups. However, no significant associations involving PHO group were revealed.

6.4 Discussion

It was clear from Study 3 that the children's understanding of illness did display some individual differences, although no differences were found between healthy and chronically-ill children's illness concepts. Furthermore, one might have expected that the experience of a major illness would have an effect on parental attitudes towards health matters. However, no relationship was found between the parental health attitudes and the children's health status, age or gender. In addition, no associations were revealed between the children's thinking and either parental health attitudes or the presence of health-related objects in their home.

Evidently, the parents of the children with higher health attitudes were the ones who reported as having the most health-related objects in their home. However, no relationship was revealed between either parental health attitudes or health-related objects and the children's understanding. It has been argued earlier in this thesis that the children's thinking may reflect the context in which they are developing. If this assertion is correct, why was it not supported by the findings of this study? One possibility is that parental health attitudes do not have a direct influence upon the development of children's understanding of illness; parental health practices might be much more important instead. Furthermore, actual practices towards health matters in the home might not reflect what parents believe to be appropriate healthy attitudes. Therefore, a possible discrepancy between expressed attitudes and behaviours could be one possible explanation for the lack of associations.

Moreover, one should not overlook the effect of social desirability when completing questionnaires. In other words, it is possible that the parents who wished to present themselves as more health conscious were the ones who were more likely to report an "appropriate" healthy attitude and to report items that should be kept in one's household because of the social desirability of these answers. What one reports is not necessarily what one believes. This is an alternative explanation for the lack of associations between parental health attitudes and the children's thinking.

Thirdly, while it may be that the children's thinking about illness is largely unaffected by their parents' health beliefs, it could also be that the parental questionnaire failed to address those particular parental attitudes which are most directly related to the children's own thinking. In other words, in the questionnaire administered the emphasis was on the parents' personal health attitudes and not on their health beliefs concerning their own children, which might have been of greater relevance to their children's illness understanding.

Fourthly, however, there is the clear possibility that children's biological theories are not affected at all by parental attitudes, practices or beliefs. It could be that school input through the curriculum, such as the type of biological or health-related

information which was made available to the children in school or through school-organised activities, constitutes a more influential factor in children's illness concepts instead. More specifically, lessons on science, activities such as cooking, outings to nature reserves, special talks about health, healthy life-styles, might affect children's knowledge of health and illness or their understanding of biology.

Furthermore, engagement in activities such as raising animals and plants might influence children's understanding within the domain of biology. Indeed, Inagaki (1990) in her study compared the biological knowledge of young children who had been engaged in raising goldfish for a period of time in their home environment with that of same age children who had never raised an animal. The results indicated that although the children in the two groups did not differ in their factual knowledge about mammals, the goldfish-raisers had a richer procedural and conceptual knowledge about goldfish. Additionally, this latter group of children did use their knowledge about goldfish as a source for analogical reasoning in predicting reactions of an unfamiliar "aquatic" animal that they had never raised (e.g. a frog) (Inagaki, 1990). It has also been suggested that children's familiarity with a raised animal helps them to enlarge their conception of animals (Inagaki, 1996). Young children who had raised goldfish attributed biological properties and processes to goldfish, such as having a heart, breathing and excreting at a high rate, which are all possessed by humans. Furthermore, when the same children were asked to attribute those properties to a range of animals (e.g. a tortoise, a frog and a carp), goldfish-raisers were superior in attributing a plethora of biological properties to animals that fall phylogenetically between humans and goldfish (Inagaki, 1996). Consequently, the raised animal served as another prototype for animals. Concluding, one might suggest that children's personal experience and involvement in raising animals does affect their biological understanding.

Another influential factor possibly affecting children's illness understanding could be medical and vet television programmes. An additional possibility might children's endogenous problem-solving by which the child him or herself reflects upon biological issues, and constructs his or her own theoretical understanding of biology with only minimal input from environmental factors.

To conclude, there could be a variety of factors which might be directly related to and influence children's biological understanding. However, data from both Study 2 and 4 are consistent in suggesting that neither parental attitudes and practices nor health experience and health status, are influential factors in the development of biological, health and illness knowledge in this particular domain of cognitive development.

CHAPTER 7

Study 5: Children's generalisation of illness from four different exemplars

7.1 Introduction

One of the criteria for young children to be considered as holding a naïve theory of biology, posited by Carey (1985), is their understanding of shared biological states and processes in plants, as well as in animals and humans. Carey investigated children's projections of an unknown biological organ, namely *Golgi*. She presented children with *Golgi*, an organ unknown to them, by suggesting that both dogs and flowers had *Golgi* inside. Children were asked to say if other things had *Golgi*. The findings showed that children under the age of six did not project the unknown property only to animals and plants and to nothing else, which was taken as evidence of their lack of the concept "living thing". Is it then that young children do not have a distinct biological domain, or can it be that they recognise a biological domain but one that excludes plants? Indeed, when young children were asked whether they believed plants are alive, they often said "no" (Carey, 1985; Hatano et al., 1993; Richards & Siegler, 1986). Contemporary research has focused on specific biological properties rather than asking children to classify items as alive or not alive (Wellman & Gelman, 1998). In contrast to Carey's findings, other researchers have proposed that preschool children recognise that plants, like animals, can grow (Hickling & Gelman, 1995; Inagaki & Hatano, 1996), or heal without any kind of human intervention (Backscheider, Shatz, & Gelman, 1993).

If young children possess a theory of biology, then they will be able to recognise the biological significance of ontological groups and use this understanding to make appropriate inferences concerning biological phenomena. The results of Study 1 showed that children do sometimes include plants in their inferences when asked about illness susceptibility in general terms. However, when children in Study 3 were presented with a hypothetical illness, namely plinkitis, they did not include plants in their attribution patterns irrespective of the exemplar they were taught on. Although some reasons why the children might have restricted their generalisations to human and non-human animals, were given in Chapter 5, it was of interest to investigate children's judgements when taught on a plant exemplar, in order to explore this issue further. In particular, it was of interest to ascertain whether children will generalise from a plant exemplar to other living things. If children do

generalise illness, but only to animals and other plants, this implies that there is a unitary biological domain. If they only generalise to other plants, this suggests that there may be sub-domains within the biological domain such as animals and plants. If they do not generalise even to other plants, then plants are not behaving as other biological organisms do, and would therefore constitute a third non-biological domain, in which illness operates differently (more like a broken physical object).

The following study was designed to identify children's judgement patterns when taught about an unknown illness as afflicting four entities belonging to four different ontological categories (humans, mammals, birds and plants).

7.2 Method

7.2.1 *Participants*

Two hundred and eighty children were randomly recruited from years Reception to Year 6 (age-range: 57-140) located in south-east England in the UK. For the purposes of this study the children were grouped into three age-groups: (1) Young group with 120 children from three school years (Reception, Year 1, and Year 2); 64 girls (mean age = 74.98 months, age range = 57-92 months) and 56 boys (mean age = 74.38 months, age range = 57-93 months); (2) Middle group with 80 children from two school years (Year 3 and Year 4); 35 girls (mean age = 105.46 months, age range = 94-116 months) and 45 boys (mean age = 104.40 months, age range = 93-116 months); (3) Old group with 80 children from two school years (Year 5 and Year 6); 38 girls (mean age = 127.08 months, age range = 119-139 months) and 42 boys (mean age = 129.43 months, age range = 119-139 months). There were thus 3 (age) x 2 (gender) independent groups. None of the participants had participated in any of the previous studies.

7.2.2 *Materials*

Thirty cards, each measuring 5 x 2.5 ins, naming five entities from each of six ontological categories, were used in the sorting task. On each card, the name of one entity was written clearly. The ontological categories from which the entity names were drawn were (a) *human beings* (man, woman, boy, girl, baby), (b) *mammals* (elephant, cow, sheep, cat, mouse), (c) *non-mammals* (crocodile, tortoise, frog, butterfly, ant), (d) *birds* (turkey,

swan, chicken, blackbird, robin), (e) *plants* (oak tree, apple tree, daisy, daffodil, sunflower) and (f) *hand-made artifacts* (house, car, bicycle, computer, cup). Additionally, there were three boxes, measuring 9 x 6.5 x 7 ins, representing one of the three possible answers given by the children. Each of the three boxes was labeled with the appropriate words which were clearly written on the front: *can get plinkitis*, *cannot get plinkitis*, *I don't know*. Finally, four cards were used, each showing a simple black and white line drawing of one of the exemplars in reference to which the children were taught about the imaginary illness. The four exemplars used were a child, a dog, a duck and a rosebush, belonging to the categories of *human beings*, *mammals*, *birds* and *plants* respectively. In order to minimise any possible effects on the children's generalisations from the size of the exemplars, the exemplars were chosen from the midpoint size of each range (midpoint size of humans, mammals, birds and plants respectively).

7.2.3 Procedure

Children were randomly assigned to either the child, dog, duck or rosebush condition. The number of children assigned to each condition at each age are shown in Table 7.1 together with their mean ages. The participants were tested individually in a room apart from their regular classroom. Each interview lasted up to fifteen minutes with each individual child. The session began by giving the child an explanation about the purpose of the interview, suggesting that the interviewer was writing a book for children concerning the body and the ways it can be kept strong. The children were reassured that there were no right or wrong answers and that they should feel free to ask for clarifications when they did not understand the questions.

Table 7.1: Number of children assigned to each condition, broken down by age-group, together with their mean ages in months (standard deviations in parentheses)

	Young	Middle	Old
Child	N=30	N=20	N=20
	73.40	103.80	127.55
	(10.4)	(6.1)	(7.1)
Dog	N=30	N=20	N=20
	76.27	105.85	128.90
	(10.3)	(7.2)	(5.3)
Duck	N=30	N=20	N=20
	74.97	104.95	128.75
	(11.3)	(6.8)	(6.4)
Rosebush	N=30	N=20	N=20
	74.17	104.85	128.05
	(10.0)	(6.7)	(7.7)

The three boxes with open tops without lids were put on the table. Each box represented one of the possible answers which could be given by the child: *can get plinkitis*, *cannot get plinkitis*, *I don't know*. The boxes were placed on the table in the above order for the first child and in such a way that the child could clearly see what was written on each box. For the second child the order *cannot get plinkitis*, *can get plinkitis*, *I don't know* was used. These two orders were alternated accordingly throughout the testing in order to control for possible left-right response biases. The interviewer showed the cards to the child, in a different randomised order for each individual child saying that these were some cards with the names of lots of different things on them showing to the child some of the cards. The requirement for the child was to put each card into one of the boxes depending on whether the child thought that the entity named on each card can get plinkitis or cannot get plinkitis. For the younger children, cards were read in case there were any difficulties with reading. The exact words used by the interviewer were as follows:

“Have you ever heard of plinkitis? Plinkitis is an illness. Here is a picture of a child (dog, duck or rosebush; depending on which exemplar the child was taught on). Children (dogs, ducks or rosebushes) can get plinkitis. When children (dogs, ducks or rosebushes) get plinkitis they go a funny colour and they get spots. They also go very floppy and weak. Here are some cards with the names of lots of different things on them. What I would like you to do is put each card into one of these boxes, depending on whether you think that thing can get plinkitis or cannot get plinkitis. For example, if you think that something can get plinkitis, put the card into the box which says ‘can get plinkitis’ (physically hold a card over the box). If you think that something cannot get plinkitis, put the card into the box that says ‘cannot get plinkitis’ (physically hold a card over the second box). If you really don’t know whether it can get plinkitis or cannot get plinkitis, put the card in the ‘don’t know box’ (physically hold a card over the ‘don’t know box)’”. For the younger children the following words were added: “if you have any difficulty reading some of the cards, tell me and I’ll help you to read them”.

7.3 Results

The children’s thinking about the ontological categories was analysed first by conducting ANOVAs on the children’s basic scores (scores given by the children for each of the six ontological categories representing the number of entities chosen as susceptible to plinkitis); secondly by correspondence analysis on those subgroups of children from each of the three age-groups selecting the majority of entities in each category; and finally by configural frequency analysis on children’s responses for each ontological category for each of the four exemplars used. Additionally, log linear analyses were conducted to investigate for any possible links between children’s significant response patterns and their age or gender.

7.3.1 ANOVAs

The total number of cards from within each ontological category which were placed into each individual box was calculated; in each case, the scores could therefore range from 0-5. The mean scores obtained by the children in each age-group, were first analysed by using 4-way 3 (age) x 2 (gender) x 4 (exemplar) x 6 (type of ontological category) mixed ANOVAs with independent groups on the first three factors and repeated measures on the fourth factor. In one of these ANOVAs, the number of “can get plinkitis” responses was the dependent variable; in the second, the number of the “cannot get plinkitis” responses was the dependent variable; and in the third one, the number of “don’t know” responses was the dependent variable. These revealed numerous main and interaction effects (the full results may be seen in Appendix 8). Because of the complexity of these effects the data were also analysed for each exemplar separately using four separate 3 (age) x 2 (gender) x 6 (ontological category) mixed ANOVAs, with independent groups on the first two factors and repeated measures on the fourth factor. There were main effects of type of category on all three responses (can get plinkitis, cannot get plinkitis, I don’t know) with all exemplars, suggesting that children do perceive differences between the various categories of entities when exemplars belong to different ontological categories. The children’s mean scores, for each of the four exemplars, to “can get plinkitis” are shown in Tables 7.2-7.5, together with the results from the ANOVAs. Analysis was conducted on “can get plinkitis” as these category inclusion responses represent the clearest indications of the children’s thinking.

Table 7.2: Child Exemplar: children’s mean responses to who can get plinkitis (standard deviations in parentheses)

	Can get plinkitis			
Category	Young	Middle	Old	Total
human beings	4.57 (0.9)	4.65 (0.7)	4.20 (1.5)	4.49 (1.1)
mammals	1.70 (1.8)	2.10 (1.9)	2.75 (2.0)	2.11 (1.9)
non-mammals	1.30 (1.6)	1.00 (1.4)	1.90 (1.8)	1.39 (1.6)
birds	1.40 (1.5)	1.55 (1.8)	2.40 (2.1)	1.73 (1.8)
plants	0.47 (0.6)	1.05 (1.6)	0.35 (0.9)	0.60 (1.1)
artifacts	0.13 (0.7)	0.15 (0.4)	0.05 (0.2)	0.11 (0.5)
mean scores	1.59	1.75	1.94	1.73
ANOVA sign. effects	category: F (5, 60) = 121.68, p< 0.0005			

Table 7.3: Dog Exemplar: children’s mean responses to who can get plinkitis (standard deviations in parentheses)

	Can get plinkitis			
Category	Young	Middle	Old	Total
human beings	2.20 (2.3)	2.50 (2.5)	2.15 (2.4)	2.27 (2.3)
mammals	3.40 (1.5)	4.10 (1.1)	3.90 (1.2)	3.74 (1.3)
non-mammals	2.63 (1.7)	2.39 (1.5)	1.55 (1.6)	2.23 (1.7)
birds	2.67 (1.7)	3.00 (1.6)	2.95 (1.9)	2.87 (1.7)
plants	0.70 (0.9)	0.05 (0.2)	0.25 (1.1)	0.46 (0.9)
artifacts	0.23 (0.6)	0.00 (0.0)	0.00 (0.0)	0.10 (0.4)
mean scores	1.97	2.00	1.80	1.94
ANOVA	category: $F(5, 60) = 88.39, p < 0.0005$			
sign. effects				

Table 7.4: Duck Exemplar: children’s mean responses to who can get plinkitis (standard deviations in parentheses)

	Can get plinkitis			
Category	Young	Middle	Old	Total
human beings	2.07 (2.0)	2.65 (2.4)	2.80 (2.2)	2.44 (2.2)
mammals	2.60 (2.0)	3.15 (1.7)	2.60 (1.9)	2.76 (1.9)
non-mammals	2.57 (1.6)	2.85 (1.6)	2.35 (1.7)	2.59 (1.6)
birds	2.87 (1.8)	4.25 (1.0)	4.50 (0.7)	3.73 (1.4)
plants	0.87 (1.1)	1.10 (1.8)	0.35 (1.1)	0.79 (1.3)
artifacts	0.17 (0.5)	0.00 (0.0)	0.00 (0.0)	0.07 (0.3)
mean scores	1.85	2.33	2.10	2.06
ANOVA	category: F (5, 60) = 99.31, p< 0.0005			
sign. effects	age x category: F (10, 118) = 3.21, p< 0.01			

Scheffe tests: significant differences between age groups

Bird category

Young group vs Middle group (p< 0.005)

Young group vs Old group (p< 0.005)

Table 7.5: Rosebush Exemplar: children’s mean responses to who can get plinkitis (standard deviations in parentheses)

	Can get plinkitis			
Category	Young	Middle	Old	Total
human beings	2.37 (2.3)	2.50 (2.3)	1.85 (2.3)	2.26 (2.3)
mammals	1.93 (1.8)	2.25 (2.0)	2.40 (1.9)	2.16 (1.9)
non-mammals	1.73 (1.7)	2.40 (1.9)	1.80 (1.5)	1.94 (1.7)
birds	1.77 (1.9)	2.35 (1.8)	2.55 (2.0)	2.16 (1.9)
plants	3.70 (1.5)	3.70 (1.5)	4.95 (0.2)	4.06 (1.4)
artifacts	0.13 (0.4)	0.25 (1.1)	0.05 (0.2)	0.14 (0.6)
mean scores	1.93	2.24	2.26	2.12
ANOVA	category: $F(5, 60) = 121.68, p < 0.0005$			
sign. effects	age x category: $F(10, 118) = 2.57, p < 0.05$			

Scheffe tests: significant differences between age groups

Plant category

Old group vs Young group ($p < 0.01$)

Old group vs Middle group ($p < 0.05$)

Differences associated with category

Child Exemplar

Post hoc t-tests were conducted to locate precisely where the category effects were occurring (see Table 7.6). When the children were taught the imaginary illness (plinkitis) on the child exemplar, they claimed that humans were significantly more likely than all the other categories to get plinkitis. After human beings, mammals were the most likely followed by birds, non-mammals, plants and hand-made artifacts in that order. However, the difference between birds and non-mammals was not significant. The category of hand-made artifacts was seen by all children as significantly the least likely to get plinkitis.

Dog Exemplar

Post hoc t-tests were conducted to locate where the category effects were occurring (see Table 7.7) When the children were taught that plinkitis is an illness afflicting dogs, they claimed that mammals were significantly more likely than all the other categories to get plinkitis. After mammals they judged birds as most likely to get plinkitis, followed by humans, non-mammals, plants and hand-made artifacts in that order. It was again the category of hand-made artifacts which was seen by all children as significantly the least likely to get plinkitis. However, the differences between plants and hand-made artifacts, between humans and non-mammals, and between humans and birds were not significant.

Duck Exemplar

Post hoc t-tests were conducted to locate where the category effects were occurring (see Table 7.8). When the children were taught that plinkitis is an illness afflicting ducks, they rated birds to be significantly more likely to get plinkitis than the other ontological groups. After birds, mammals were the most likely to get plinkitis, followed by non-mammals, and humans, and then plants. The category of hand-made artifacts was seen by all children as significantly the least likely to get plinkitis. However, the differences between humans and mammals, between humans and non-mammals and between mammals and non-mammals were not significant. In order to explore the interaction effect (between age and category) further, Table 7.8 also shows where the significant differences fell for each age group individually.

Rosebush Exemplar

Post hoc t-tests were conducted to locate where the category effects were occurring (see Table 7.9). When the children were taught that plinkitis is an illness afflicting rosebushes they claimed that plants were significantly more likely than all the other categories to get plinkitis. After plants they rated humans as more likely to get plinkitis followed by mammals and birds together, followed by non-mammals and hand-made artifacts. However, the differences between humans and mammals, humans and non-mammals and humans and birds were not significant. Additionally, the differences between mammals and non-mammals, mammals and birds and non-mammals and birds were not significant. In order to explore the interaction effect between age and category further, Table 7.9 also shows where the significant differences fell for each age group individually.

Table 7.6: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories with the Child exemplar

	can get plinkitis (t values)
humans v mammals	9.41**
humans v non-mammals	12.96**
humans v plants	20.52**
humans v birds	11.08**
humans v artifacts	26.21**
mammals v non-mammals	5.28**
mammals v plants	6.66**
mammals v birds	3.76**
mammals v artifacts	8.07**
non-mammals v plants	3.90**
non-mammals v birds	ns
non-mammals v artifacts	6.22**
plants v birds	5.24**
plants v artifacts	3.35**
birds v artifacts	6.92**

df = 69

p < 0.003** ns = non-significant

Table 7.7: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories with the Dog exemplar

	can get plinkitis (t values)
humans v mammals	-4.76**
humans v non-mammals	ns
humans v plants	6.26**
humans v birds	ns
humans v artifacts	7.50**
mammals v non-mammals	7.60**
mammals v plants	16.02**
mammals v birds	5.65**
mammals v artifacts	21.24**
non-mammals v plants	8.64**
non-mammals v birds	ns
non-mammals v artifacts	10.68**
plants v birds	10.25**
plants v artifacts	ns
birds v artifacts	12.92**

df = 69

p < 0.003** ns = non-significant

Table 7.8: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories in each age group with the Duck exemplar

	Can get plinkitis all children (t values)	Young Group only (t values)	Middle Group only (t values)	Old Group Only (t values)
humans v mammals	ns	ns	ns	ns
humans v non-mammals	ns	ns	ns	ns
humans v plants	5.68**	3.27**	ns	4.45**
humans v birds	-4.90**	ns	ns	-3.79**
humans v artifacts	8.68**	4.79**	4.82**	5.53**
mammals v non-mammals	ns	ns	ns	ns
mammals v plants	7.83**	4.70**	4.61**	4.18**
mammals v birds	-3.96**	ns	ns	-4.87**
mammals v artifacts	11.50**	6.36**	7.89**	6.11**
non-mammals v plants	8.29**	5.39**	4.08**	4.66**
non-mammals v birds	-5.14**	ns	-3.90**	-5.38**
non-mammals v artifacts	12.43**	7.66**	7.66**	6.09**
plants v birds	13.37**	6.95**	7.01**	15.14**
plants v artifacts	4.31**	3.33**	ns	ns
birds v artifacts	18.85**	7.95**	17.76**	26.44**

df (all children) = 69
df (Young group only) = 29
df (Middle group only) = 19
df (Old group only) = 19
p < 0.003** ns = non-significant

Table 7.9: Post hoc t-tests (Bonferroni corrected) to locate differences between ontological categories in each age group with the Rosebush exemplar

	Can get plinkitis all children (t values)	Young Group Only (t values)	Middle Group only (t values)	Old Group Only (t values)
humans v mammals	ns	ns	ns	ns
humans v non-mammals	ns	ns	ns	ns
humans v plants	-5.45**	ns	ns	-5.76**
humans v birds	ns	ns	ns	ns
humans v artifacts	7.54**	5.12**	4.30**	3.38**
mammals v non-mammals	ns	ns	ns	ns
mammals v plants	-6.84**	-3.76**	ns	-5.74**
mammals v birds	ns	ns	ns	ns
mammals v artifacts	9.01**	5.51**	4.47**	5.53**
non-mammals v plants	-8.07**	-4.72**	ns	-8.81**
non-mammals v birds	ns	ns	ns	ns
non-mammals v artifacts	8.95**	5.30**	5.13**	5.04**
plants v birds	-6.82**	-4.03**	ns	-5.27**
plants v artifacts	21.14**	12.45**	8.34**	71.19**
birds v artifacts	8.63**	4.53**	5.12**	5.55**

df (all children) = 69
df (Young group only) = 29
df (Middle group only) = 19
df (Old group only) = 19
p < 0.003** ns = non-significant

Differences associated with age

There were no main or interaction effects involving age for both the child and dog exemplars. However, children taught on the duck and rosebush exemplars presented different generalisations at different ages (the age x category interaction effect was significant in both cases). The age differences for the duck exemplar occurred in the category of birds (see Table 7.8). Only the Old group of children generalised significantly more to birds than to humans and mammals. In addition, only the Young group of children generalise significantly more from the duck to the category of plants than to hand-made artifacts. Finally, the Young group of children did not present any significant differences in their generalisations to non-mammals and birds.

When children were taught on the rosebush exemplar, it was only the Old group that generalised significantly more to plants than to the category of humans. In addition, only the Middle group of children did not show any significant differences between plants and mammals, plants and non-mammals, and plants and birds.

7.3.2 Correspondence Analyses

The individual findings from the ANOVAs were further explored by correspondence analysis, which permitted a multi-dimensional analysis of the relationship between the children's age and their generalisation to the entities from the six ontological categories with each of the exemplars used. Because correspondence analysis uses proportional frequencies as data, children's responses were recoded as follows: When 3, 4 or 5 entities were chosen in each ontological category the response was recoded as 1. When 0, 1 or 2 entities were chosen in each ontological category the response was recoded as 0. The correspondence analysis was conducted on the proportion of participants who responded by choosing 3 or more entities from each ontological category as susceptible to plinkitis. Four correspondence analyses examined the thinking of the children in each age-group for each exemplar used.

Age trends

Correspondence analyses on children's responses for each exemplar produced significant one-dimensional solutions. In Figure 7.1, who can get plinkitis, on the Child exemplar, Dimension 1: inertia = 70.2%, $\chi^2 = 24.7$, $df = 7$, $p < 0.005$. In Figure 7.2, who can get plinkitis, on the Dog exemplar, Dimension 1: inertia = 92%, $\chi^2 = 13.8$, $df = 7$, $p < 0.05$. In Figure 7.3, who can get plinkitis, on the Duck exemplar, Dimension 1: inertia = 88%, $\chi^2 = 20.6$, $df = 7$, $p < 0.005$. Finally, in Figure 7.4, who can get plinkitis, on the Rosebush exemplar, Dimension 1: inertia = 73.3%, $\chi^2 = 23.8$, $df = 7$, $p < 0.005$.

Child Exemplar

In Figure 7.1, the children in the Middle group were more likely to generalise from the child to the category of plants. However, the responses given by the Middle group of children did not differ for the other five ontological categories (humans, mammals, non-mammals, birds and hand-made artifacts). Drawing on these results, it can be proposed that the first dimension differentiated the thinking of the Middle group from the other two groups of children.

Dog Exemplar

In Figure 7.2, there was one significant dimension which differentiated the thinking of the children in the Old group from the other two groups. It was the oldest children who tended to generalise less from the dog to the category of non-mammals. However, the responses given by the Old group of children did not differ for the other five ontological categories namely, humans, mammals, birds, plants and hand-made artifacts.

Duck Exemplar

In Figure 7.3, the one dimensional solution differentiated the thinking of the children in the Old group from that of the Young and Middle groups. It was the oldest children who were the most likely to generalise from the duck to the category of birds and the least likely to generalise to the category of plants.

Rosebush Exemplar

Finally, in Figure 7.4, the one dimensional solution differentiated the thinking of the children in the Middle group from that of the Young and Old groups. It was the Middle group of children who tended to generalise plinkitis to the categories of non-mammals and hand-made artifacts to a greater extent than the other two groups of children. Additionally, the children's thinking in the Middle group did not differ greatly for the other four ontological categories, namely humans, mammals, birds and plants.

Figure 7.1: Who can get plinkitis analysed by age (Child exemplar)

Dim 1. Inertia=70.2%, $\chi^2=24.7$, df=7, p<0.005

Figure 7.2: Who can get plinkitis analysed by age (Dog exemplar)

Dim 1. Inertia=92.5%, $\chi^2=13.8$, df=7, p<0.05

Figure 7.3: Who can get plinkitis analysed by age (Duck exemplar)

Dim 1. Inertia=87.8%, $\chi^2=20.6$, df=7, $p<0.005$

Figure 7.4: Who can get plinkitis analysed by age (Rosebush exemplar)

Dim 1. Inertia=73.3%, $\chi^2=23.8$, $df=7$, $p<0.005$

7.3.3 *Configural Frequency Analysis*

There are indications that the children's generalisations differed at different ages, depending on exemplar. Are there different judgement patterns across children's responses to illness susceptibility when children are taught on different exemplars (child, dog, duck or rosebush)?

One way of answering the above question is by using Configural Frequency Analysis (CFA). Focusing on the children's choices of those entities which can get plinkitis, the children's responses for each category on each exemplar were scored as follows: for each of the exemplars, to those children who chose two or less entities in a category a score of 0 was given; to those children who chose three or more entities in a category a score of 1 was given. Therefore, each child had a score of 0 or 1 for each ontological category and only for the exemplar that the child was taught on. The above scoring resulted in a response pattern for each participant. The six ontological categories that were represented in each pattern were in the following order: humans, mammals, non-mammals, birds, plants, and hand-made artifacts. The data were subjected to four Configural Frequency Analyses, one for each of the four exemplars, child, dog, duck, and rosebush.

Child Exemplar

On the "can get plinkitis" responses for the Child exemplar, there were three significant judgement patterns across the six ontological categories. The patterns are shown in Table 7.10. Pattern 100000: 37 children said that three or more entities can get plinkitis within the human category, and 2 or less entities within the mammal, non-mammal, bird, plant and hand-made artifact categories ($z = 34.6$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 111100: an additional 9 children suggested that 3 or more entities can get plinkitis within the human, mammal, non-mammal and bird categories, and two or less entities within the plant and hand-made artifact categories respectively ($z = 7.6$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Finally, Pattern 110100 was significant for 9 children who said that three or more entities can get plinkitis within the human, mammal and bird categories, and two or less entities within the non-mammal, plant and hand-made artifact categories respectively ($z = 7.6$, $p < 0.0001$, Bonferroni adjustment for p at $0.01 = 0.0008$).

Table 7.10: Configural Frequency Analysis response patterns presented by children taught on the Child exemplar

	Pattern 100000	Pattern 111100	Pattern 110100
human	1	1	1
mammal	0	1	1
non-mammal	0	1	0
bird	0	1	1
plant	0	0	0
artifact	0	0	0
Frequency of Pattern	37	9	9

Dog Exemplar

Overall, there were five significant response patterns presented by the children taught on the dog exemplar. These patterns are shown in Table 7.11. Pattern 111100: 13 children said that three or more entities can get plinkitis within the human, mammal, non-mammal and bird categories, and two or less entities within the plant and hand-made categories respectively ($z = 11.5$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 011100: an additional 11 children suggested that 3 or more entities can get plinkitis within the mammal, non-mammal and bird categories, and 2 or less entities within the human, plant and hand-made artifact categories respectively ($z = 9.5$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 010100 was significant for 10 children, who claimed that 3 or more entities can get plinkitis within the mammal and bird categories, and 2 or less entities within the human, non-mammal, plant and hand-made artifact categories respectively ($z = 8.6$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 010000: an additional 8 children suggested that three or more entities can get plinkitis within the mammal category, and two or less entities within the human, non-mammal, bird, plant and hand-made artifact categories respectively ($z = 6.7$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Finally, Pattern 110000: 7 children said that three or more entities can get plinkitis within the human and mammal

categories, and two or less entities within the non-mammal, bird, plant and hand-made artifact categories respectively ($z = 5.7$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$).

Table 7.11: Configural Frequency Analysis response patterns presented by children taught on the Dog exemplar

	Pattern 111100	Pattern 011100	Pattern 010100	Pattern 010000	Pattern 110000
human	1	0	0	0	1
mammal	1	1	1	1	1
non-mammal	1	1	0	0	0
bird	1	1	1	0	0
plant	0	0	0	0	0
artifact	0	0	0	0	0
Frequency of Pattern	13	11	10	8	7

Duck Exemplar

There were 7 significant patterns of generalisation from the duck exemplar. These patterns are shown in Table 7.12. Pattern 111100: 12 children claimed that 3 or more entities can get plinkitis within the human, mammal, non-mammal and bird categories, and 2 or less entities within the plant and hand-made categories respectively ($z = 10.5$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 000100: 10 children suggested that three or more entities can get plinkitis within the bird category only, and two or less entities within the human, mammal, non-mammal, plant and hand-made artifact categories ($z = 8.6$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). In addition, Pattern 011100 was significant for 7 children who claimed that 3 or more entities can get plinkitis within the mammal, non-mammal and bird categories, and two or less entities within the human, plant and hand-made artifact categories respectively ($z = 5.7$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 000000: an additional 7 children suggested that two or less entities can get plinkitis within all six ontological

categories, namely humans, mammals, non-mammals, birds, plants and hand-made artifacts ($z = 5.7, p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Furthermore, Pattern 100100 was significant for 5 children who suggested that three or more entities can get plinkitis within the human and bird categories, and two or less entities within the mammal, non-mammal, plant and hand-made artifact categories respectively ($z = 3.8, p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 111000: an additional 5 children claimed that 3 or more entities can get plinkitis within the human, mammal and non-mammal categories and two or less entities within the bird, plant and hand-made categories respectively ($z = 3.8, p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Finally, Pattern 111110 was significant for an additional 5 children who claimed that 3 or more entities can get plinkitis within the human, mammal, non-mammal, bird and plant categories, and two or less entities within the category of hand-made artifacts ($z = 3.8, p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$).

Table 7.12: Configural Frequency Analysis response patterns presented by children taught on the Duck exemplar

	Pattern 111100	Pattern 000100	Pattern 011100	Pattern 000000	Pattern 100100	Pattern 111000	Pattern 111110
human	1	0	0	0	1	1	1
mammal	1	0	1	0	0	1	1
non-mammal	1	0	1	0	0	1	1
bird	1	1	1	0	1	0	1
plant	0	0	0	0	0	0	1
artifact	0	0	0	0	0	0	0
Frequency of Pattern	12	10	7	7	5	5	5

Rosebush Exemplar

The findings on the “can get plinkitis” responses for the Rosebush exemplar revealed four significant judgement patterns which are shown in Table 7.13. Pattern 000010 emerged as

significant for 20 children who suggested that three or more entities can get plinkitis within the plant category, and two or less entities within the human, mammal, non-mammal, bird, plant and hand-made artifact categories ($z = 18.2$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). In addition, Pattern 111110 was significant for 7 children who said that 3 or more entities can get plinkitis within the human, mammal, non-mammal, bird and plant categories, and two or less entities within the hand-made artifact category ($z = 5.7$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Pattern 100010 emerged as significant for 6 children who claimed that 3 or more entities can get plinkitis within the human and plant categories, and 2 or less entities within the mammal, non-mammal, bird and hand-made artifact categories respectively ($z = 4.7$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$). Finally, Pattern 011110 was significant for 5 children who suggested that 3 or more entities can get plinkitis within the mammal, non-mammal, bird and plant categories, and two or less entities within the categories of humans and hand-made artifacts ($z = 3.8$, $p < 0.0001$, Bonferroni adjustment for p at $0.05 = 0.0008$).

Table 7.13: Configural Frequency Analysis response patterns presented by children taught on the Rosebush exemplar

	Pattern 000010	Pattern 111110	Pattern 100010	Pattern 011110
human	0	1	1	0
mammal	0	1	0	1
non-mammal	0	1	0	1
bird	0	1	0	1
plant	1	1	1	1
artifact	0	0	0	0
Frequency of Pattern	20	7	6	5

The results of the Configural Frequency analyses showed the children’s judgement patterns on all four exemplars. It was of interest to explore associations between the judgement patterns given by the children and their age or gender. In order to investigate the existence

of such associations, a new variable was computed corresponding to whether or not each child presented one of the significant response judgement patterns. Two hierarchical log linear analyses were conducted for the child and rosebush exemplars only. The children's significant patterns for the dog and duck exemplars were not analysed because, given the large number of patterns generated, the cell sizes would have been very small. The results from the child and rosebush exemplars showed that no significant associations with age or gender emerged.

7.4 Discussion

7.4.1 *Differences associated with exemplars*

The present study explored children's biological understanding by using "plinkitis", a hypothetical illness, as a biological cue to examine children's generalisations from four different exemplars across six ontological categories. In particular, children's biological understanding was investigated in relation to the category of plants as previous studies have suggested that their thinking did not extend to plants. Are plants recognised by children as belonging to the living kingdom? What are the criteria upon which children base their generalisations?

According to Carey (1985), children use the human being as the prototypical biological entity. Therefore, children's projection of an unknown biological property or state to various entities would depend on their assessment of the similarity between the generalisation entity with the human being. Carey showed that when asked to project an unknown biological property from a human exemplar both children and adults generalise to various entities based on their similarity to humans. Carey was therefore able to assess how similar to humans children judged each ontological category to be. In the present study, when children were taught on the child exemplar, they generalised mostly to humans then mammals, birds, non-mammals, plants and hand-made artifacts in that order. In that respect, one might suggest that children base their inferences on human prototypicality. However, the question is, what is happening when children are taught on non-human exemplars?

Carey (1985) argued that young children will continue to base their judgements on the human prototype irrespective of the exemplar they are taught on exactly because they do

not yet understand the biological importance of ontological categories. The findings of the present study, however, do not support Carey’s claim. When children were presented with the dog exemplar they generalised significantly more to the category of mammals. Children’s commitment to ontological categories was also evident in their generalisations from the duck and rosebush exemplars respectively; in both cases the children generalised significantly more to the category to which the exemplar itself belonged. The present findings are consistent with the findings of Study 3, providing further evidence for Keil’s claim that even young children are able to differentiate ontological groups within the biological domain. Examining the pattern of significant differences between the categories across the four conditions (see Table 7.14), there were discontinuities between every category and its adjacent categories in at least one condition, depending on the exemplar concerned. In other words, children clearly do acknowledge the distinctiveness of all of these biological and non-biological categories.

Table 7.14: Pattern of discontinuities between categories for all four exemplars: asterisks show the location of the significant differences between adjacent ontological categories

	humans		mammals		non-mammals		birds		plants		artifacts
Child		*		*				*		*	
Dog		*		*				*			
Duck						*		*		*	
Rose-bush								*		*	

Focusing on the results from the ANOVAs, with all four exemplars, children very infrequently generalised to the category of hand-made artifacts and did so significantly less frequently than to all the other categories in every comparison and in every condition except one (the plant vs artifact comparison with the dog exemplar). Consequently, this finding strongly supports the claim that young children are able to separate inanimate from animate objects within the biological domain (Inagaki & Hatano, 1999). However, in

order to assess children's understanding of the living - non-living distinction, it is also necessary to investigate their concepts concerning the category of plants. It is evident that children generalised to plants significantly more than to hand-made artifacts when taught on the child, duck and rosebush exemplars respectively. In addition, looking at the results from the CFAs, one might suggest that children tended to exclude the category of plants in their significant judgement patterns, in most of the cases. It was only when children were taught on the rosebush exemplar that plants were included in all significant patterns presented. Children's willingness to attribute plinkitis from the rosebush exemplar to other living things was also clearly supported by the results from the CFAs. After generalising to just the category of plants, children tended to generalise either to all living things, to humans and plants only or to non-human animals and plants. However, when they were taught on the child, dog or duck exemplars, plants were not included in their significant response patterns. Why then were the children willing to generalise from plants to animals and humans but not from humans and animals to plants?

Indeed, there are five possible interpretations. First, children may believe that the illnesses affecting plants are more widespread and therefore can affect all living things, whilst animal illnesses are specific to the animal kingdom. The above belief might not be biologically correct but as Keil (1989) suggested, children's thinking can be sensible before being accurate. Secondly, a further possible interpretation of the above findings can be related to the fact that, when children are presented with a novel situation, they search the stimulus material for cues that can guide the application of their core theories (Keil et al., 1999). In the specific case of plinkitis, which is a hypothetical illness and therefore children have no experience with or knowledge of it, they may employ different strategies upon which to base their inferences. If the infectious model of illness is being activated, then one might propose that the children are thinking in terms of the known ways in which a disease can be transmitted from one entity to another. Whilst animals consume either other animals or plants and plants (with very rare exceptions) consume neither, this could explain why generalisations were made only one way. Additionally, there is a third possibility as to why children generalised from the rosebush exemplar to human and non-human animals but not from the human and non-human animal exemplars to plants. The children might have associated the illness description used more with animal illnesses than with plant illnesses. Indeed, although the illness description was selected to be equally

applicable to both animals and plants, it is possible that for children it seemed to be more applicable to the human and non-human animal categories. If this assertion is correct, then one might explain why the children did not generalise to the category of plants when taught on the human and non-human animals.

A fourth possibility explaining why children generalised to the categories of human and non-human animals from the rosebush exemplar, but not to the category of plants when taught on the child, dog or duck exemplars, might be related to the fact that they did not actually believe that plants can get illnesses, yet because they were presented with information supporting the contrary (rosebush exemplar afflicted by plinkitis), they revised their inferences accordingly. Indeed, this possibility cannot be excluded as a possible interpretation of the obtained results. However, if this was the case, then one would expect that the children would have been rather reluctant to judge the plant entities as being susceptible to illness. On the contrary, children generalised substantially to the plant entities when presented with the rosebush exemplar.

Finally, an additional possibility might be related to the expression “the plant is ill” which is not typically used in the English language; instead it is more usual to say that a plant has a disease. It is possible therefore, that the verbal description of plinkitis in association with the human and non-human animal exemplars used, influenced the children to deny the generalisation of the illness to the category of plants. In other words, it is possible that linguistic factors influenced the children’s attributional judgements when they were presented with the child, dog and duck exemplars. However, if that is the case, then one might question why the same language used did not affect children’s judgements the same way when presented with the rosebush exemplar? Although the procedure adopted to investigate children’s illness concepts in this study was not verbally dependent, the interviewer introduced the made-up illness to the children at the beginning of the task. Consequently, it is possible that the children presented with the rosebush exemplar were faced with the dilemma of accepting the information given by the interviewer as valid or dismissing it because of the above mentioned linguistic contradiction. However, it is known that children usually do not contradict an adult, since the approval from significant adults is very important for the child’s maintenance of self-esteem. Therefore, the children

taught on the rosebush exemplar might have overlooked the language used and made their inferences purely on the basis of the information offered by the interviewer.

It has been suggested that correct biological understanding requires us to integrate the categories of humans and other animals into the category of animals, and those of animals and plants into the category of living things (Hatano & Inagaki, 1999). According to Carey (1985) young children do not possess an integrated category of living things, since they are ignorant of the shared histological and physiological bases of animals and plants. In her experiment with *Golgi*, Carey argues that when a property is shared by a flower and a particular animal, then it is likely to be shared by all living things. Young children do not show this understanding and therefore cannot be credited with the concept of “living thing” (Carey, 1985). However, the fact that a property is shared by both plants and animals is not a very strong justification for inferring its universality among plants and animals (Richards, 1989). For example, nettles and bees possess stings but that does not mean that stings are shared by all living things. Moreover, despite the fact that it was known to biologists that *Golgi* are found in animals, it was not until later that they determined that *Golgi* were present in plants as well. The question might be: why should one should expect children to generalise *Golgi* to all living things when, until recently, scientists were unwilling to make this extension (Richards, 1989)?

Although Carey did show that children do not project an unknown property from plants to other living things, the results of the present study suggest that this is not the case when children are asked to attribute an unknown illness. Furthermore, some researchers claimed that young children do attribute “being taken ill” to plants (Inagaki & Hatano, 1996). The results of the present study support the claim that children may be able to recognise the commonalities of plants and animals to the extent that they believe that certain biological illness can be shared between the two groups. In other words, it could be suggested that children do conceptualise plants as similar to animals in terms of their susceptibility to illness.

To conclude, children seemed to be able to commit to ontological categories when taught about an unknown illness as afflicting four different exemplars. Human prototypicality is not the only basis upon which young children make their inferences, since they are able to

attribute illness susceptibility using a basic taxonomy and therefore respect ontological differences within a biological framework. Finally, the children who participated in the present study gave some evidence of an appreciation of the integrated category of living things in relation to illness susceptibility.

7.4.2 *Differences associated with age*

It has been suggested by Carey (1985) that children before the age of 10 perceive humans as the prototypical animal and hence they generalise more to other ontological categories when taught on a human exemplar than when taught on other non-human animals. Results from the present study on the child exemplar did not reveal any age x category effects suggesting that children's generalisations to the six ontological categories did not differ significantly at different ages. If young children use human prototypicality as the sole criterion upon which they base their inferences, then one would expect that when presented with the child exemplar as afflicted by plinkitis, young children would be significantly more likely to generalise from the human exemplar than the older children. The above assertion is not supported by the findings from the present study since there were no significant differences in children's generalisations associated with age on the child exemplar. The present findings, which are consistent with the findings from Study 3, offer evidence against Carey's claim about the human prototypicality effect in young children.

Moreover, the results from the ANOVAs showed age differences only on the duck and rosebush exemplars. When the former exemplar was used, the age differences occurred in the category of birds. Indeed, it was the Middle and Old groups of children who generalised significantly more to the category of birds than the Young group. This finding is further supported by the results from the Correspondence Analysis conducted on the duck exemplar, which showed that the Old group was more likely than the other groups to generalise plinkitis to the category of birds. Although the Young group generalised more to birds than all other categories, further analysis using paired t-tests showed that the difference in generalisation between birds and other animal categories (humans, mammals and non-mammals) was not significant. Consequently, the above results suggest that even the Young group of children in the present study was able to generalise mostly to the category to which the exemplar belonged, although they showed difficulty in separating

birds from other animals within the biological domain. In other words, Keil's claim that even young children recognise ontological boundaries within the biological domain is supported.

In addition, when the rosebush was the exemplar presented, the Old group of children tended to generalise significantly more to the category of plants than both the Young and Middle groups. Furthermore, the difference in generalisation between plants and the other five ontological categories was highly significant. It is possible then that children's ability to recognise ontological categories improves with age. Indeed, there is some evidence that children are able to identify entities belonging to the plant category more clearly with age (Ochiai, 1989). Ochiai found that young children were more accurate in their biological attributions to the term 'plant' than the term 'grass'. According to Ochiai, this finding suggests that young children do not fully appreciate that grass belongs to the category of plants.

The CFA results revealed different significant judgement patterns given by the children, when taught on the rosebush exemplar. However, there were no associations between these patterns and the children's age. In other words, children from all three age groups suggested that plants are susceptible to plinkitis. Therefore, age could not be considered as the factor affecting children's responses in this specific case of illness susceptibility.

In addition, according to the CFA results, one of the significant judgement patterns for all four exemplars is the one in which the children generalised the hypothetical illness only to the category that the exemplar belonged. Do children have any reason to believe that specific illnesses are common to different ontological groups? However, it is possible that children do not know that a particular attribute of living things is categorically extended. In other words, children might be able to recognise ontological groups, to appreciate some shared commonalities between different animals and plants but still fail to generalise plinkitis across ontological groups. This might explain why children restricted their generalisations only to the category that the exemplar belonged, as revealed by the CFA results.

Overall, children do organise their beliefs about plant susceptibility to illness differently at different ages. As mentioned above, it is possible that children's ability to recognise ontological groups improves with age. In addition, human prototypicality is not the only criterion upon which children base their inferences at least in this case of illness generalisation. However, the critical question is: what criteria do children use to decide about illness susceptibility? Do they differ from the ones that older children or adults base their inferences upon? This is especially the case with generalisations of illness, as there is no reason to believe that specific illnesses are common to different ontological groups. There are few biological attributes that are distributed categorically, and this is a possible reason why generalisations between animals and plants were only made in one direction (Richards, 1989). Finally, children did integrate plants into the category of living things. Future studies may investigate the effect that the illness description had on the present findings.

CHAPTER 8

Discussion

8.1 Children's understanding of illness: changes associated with age

The research reported in this thesis has investigated children's understanding of illness using the naïve theory of biology approach. Given the existing research agenda, an important hypothesis of the study was that children do develop an ontology of biological kinds, hold biologically specific beliefs about ontological categories, and therefore have a naïve theory of biology although their framework understanding might well differ from that of adults (Keil, 1989).

Focusing on the results of Study 1, children's generalisation of illness to the six ontological categories effectively ranged across the categories in a descending order, supporting the view that children do possess an early grasp of biological distinctions. The children showed that they believed humans were the most vulnerable, followed by mammals, non-mammals, plants, physical kinds or hand-made artifacts, in that order. In the light of the above it could be suggested that children construct an understanding of illness which is based primarily on humans and is then extended to other biological categories on the basis of the closeness between human and non-human entities (Carey, 1985).

The response patterns from the CFAs for the "can get ill" task revealed that it was the children in the young group who were more likely to generalise to humans and mammals only whereas both the middle and the old groups showed a significant increase in their choices of alternative responses. It has been argued that the closer a target object is to a human biologically, the more likely that children will recognise its similarity and consequently apply the person analogy, as Carey (1985) showed in her work on patterns of induction in young children. Some researchers have found that young children attribute human characteristics or properties to objects in proportion to the extent that they are phylogenetically similar to humans (Carey, 1985; Inagaki & Sugiyama, 1988) in a constrained way (Inagaki & Hatano, 1991).

In other words implausible predictions are eliminated by means of a factual check which is primarily based on children's knowledge about observable attributes of the object in question (Inagaki & Hatano, 1991). Therefore, the suggestion is that children do not use the person analogy about humans indiscriminately. Is it then human prototypicality, possibly used in a constrained way, which explains the observed differences between younger and older children's response patterns when deciding about illness generalisation from human to non-human entities?

Although the findings from the ANOVAs in Study 1 might be used to support Carey's (1985) claim that humans are the prototypical biological entity for young children, and that human prototypicality, in a constrained way, possibly guides children's decisions, the ANOVA results from Studies 3 and 5 offer evidence for the contrary. If the assertion that young children use the human being as the prototypical biological entity to a greater extent than older children is correct, then one would expect that, when presented with the child as the exemplar having plinkitis, young children would be significantly more likely to generalise from the human exemplar than older children. However, in both Studies 3 and 5, as the findings indicated, there were no significant differences in children's generalisations associated with age on the child exemplar. Therefore, human prototypicality might not be the sole criterion upon which children draw their inferences.

Carey (1985) argues that young children's understanding of biological phenomena and processes is initially organised solely on the basis of naïve psychology. Only when children realise that biological processes may not be psychologically driven will they include the category of plants in their biological understanding. So Carey (1985) claims that young children do not possess an integrated category of living things because they are ignorant of the underlying physiological shared bases of animals and plants. If the above assertion is correct, then it is expected that young children will not include the category of plants when deciding about illness susceptibility. However, the findings from the CFAs of Study 1 showed that plants were sometimes included in children's significant response patterns.

On the other hand, plants were excluded from children's significant judgement patterns in the case of the hypothetical illness presented in Study 3. It might be, therefore, that children have an understanding that could be biologically driven and hold certain criteria upon which they base their decisions for plant inclusion, and these criteria may have been invoked by the description of the hypothetical illness.

It is possible that young children might grasp commonalities between animals and plants at a functional level which could be taken as biological before they recognise physiological or histological commonalities (Inagaki & Hatano, 1996). For example, young children attribute growth to plants and animals but not to hand-made artifacts. In that respect, the fact that children included plants but not hand-made artifacts as being susceptible to illness could be taken as reflecting a true biological interpretation about what "ill" means. However, the log linear findings on the CFA response patterns in Study 1 suggest that it was the oldest group of children who were the most likely to generalise to the category of plants, whereas the youngest children were the least likely to include them in their response judgements. Therefore, it is the oldest children that have the clearest sense of the biological links.

Focusing on the ANOVAs of Study 5, when children were taught on the rosebush exemplar as being afflicted by plinkitis, they then generalised mainly to the category of plants. Additionally, the difference in generalisation between plants and the other five ontological categories was highly significant. However, it was again the Old group of children who were significantly more likely to generalise plinkitis to the category of plants than the Middle and Young groups respectively. Possibly, children's ability to recognise ontological categories improves with age.

Overall, there are age differences in children's generalisations of illness, suggesting that children's illness understanding differs at different ages. In addition, human prototypicality might not be the only criterion used by children when deciding about illness susceptibility of entities within the biological domain.

The inclusion or exclusion of the category of plants in children's decisions depending on the exemplar presented, would suggest some appreciation of the significance of ontological categories which seems to improve with age.

8.2 Children's understanding of illness: effects of exemplar

Carey's (1985) proposal that children's thinking about biology is based on humans as the prototypical biological entity and is then extended according to the closeness of other biological categories has already been mentioned. However, in the present studies, when children were taught on one of four exemplars, a child, a dog, a duck and a rosebush they tended to generalise most to the ontological category to which the exemplar itself belonged. It remains an open question whether the children used membership categorisation, or whether they used similarity in appearance, in order to generalise illness susceptibility significantly more frequently to the entities belonging to the same ontological category as the exemplar on which they were taught.

Is it possible that even young children sometimes use category membership in their decisions? It has been reported by some researchers that, although young children present perceptual biases and hold a rather rudimentary biological knowledge, they base inductions about ontological categories mainly on category membership and not on perceptual appearances (Gelman & Markman, 1987). One piece of evidence that children do not depend solely on perceptual similarity when drawing inferences comes from work by Carey herself (1985). Children, as young as 4 years of age, who knew that a monkey can breathe, eat, and have baby monkeys, denied that a mechanical monkey possesses these animate properties. In other words, despite the striking perceptual similarity of these two types of objects, the children refused to generalise animal properties from the one to the other. Furthermore, there is some evidence that even 3 years old children understand that some categories are more than a set of features but instead include deeper, non-obvious or unforeseen properties as well.

These expectations concerning category structure held by very young children seem not to be dependent on any kind of formal schooling or acquired scientific knowledge (Gelman & Markman, 1987).

Carey's proposal is that children use human beings as the prototypical animal, and that when children are presented with different exemplars from different ontological categories that hold an unknown property, they generalise more from humans than from any other animal. This asymmetry in projection between different exemplars was not present in the older children's choices. This would suggest that knowledge related to humans and human activities is the one that plays the greatest role in governing young children's knowledge of animal properties. In other words, Carey's findings on children's projection of an unknown property support the notion that humans are the prototypical animals in younger children's inductive projection reasoning.

However, the lack of age differences for the child exemplar, from both Studies 3 and 5, does not allow for any support to be drawn concerning human prototypicality in young children. If human prototypicality was the only criterion used by children when deciding about illness susceptibility, then one would expect age differences to be identified on the child exemplar, with the younger children generalising to humans significantly more than older children. In the absence of findings of this sort, the human prototypicality effect is not endorsed.

Looking at the results of the CFA for all three exemplars (child, dog and duck) in Study 3, it is evident that plants were excluded from the children's patterns. Is this evidence that children lack a theory of biology since the biological category of plants is not included in their judgement patterns even when they are taught on the human exemplar? Or do these results instead indicate that the children have a deeper biological understanding of biological boundaries and for this reason they did not tend to attribute plinkitis to plants? Indeed, although plants can get a disease, attributing plinkitis to plants would not be scientifically correct. In addition, it might well be that the very specific symptoms of plinkitis used in Study 3 might have prompted children to restrict their generalisation only to the entities to which sensation could be attributed (feel dizzy).

Although it maybe argued that children's limited knowledge of "mental properties" will not allow them to judge predictions like "a plant can feel dizzy" as implausible, is it possible that children, at least in this specific case of illness generalisation, recognised that oak-trees, dandelions and daffodils cannot feel dizzy? Furthermore, the expression "the plant is ill" is not typically used in the English language; instead it is more usual to say that a plant has a disease. Is it possible, therefore, that the verbal description of plinkitis influenced the children to deny the generalisation of the illness to the category of plants? In other words, is it possible that linguistic factors influenced the children's attributional judgements? This might also explain the non-significant differences between plants and hand-made artifacts for two of the exemplars in Study 3 and one exemplar in Study 5.

Furthermore, the results of the CFA for all four exemplars (child, dog, duck and rosebush) in Study 5 suggest that plants were included in children's response patterns only with the rosebush exemplar. This finding seems to be consistent with the findings from Study 3, in which plants were not considered as susceptible to plinkitis. However, the reasons which guided children to exclude plants might differ in the two studies. It is possible that in Study 3, the very specific description of plinkitis influenced children's choices for the above mentioned reasons. On the contrary, the very general illness description given in Study 5, might have forced children to search the stimulus material for cues that can guide the application of their core theories (Keil et al., 1999). Since plinkitis is a hypothetical illness, children have no experience or knowledge of it. Infection is considered to be the most typical, thus default, illness. In other words, when children think of illness they tend to think of a process involving contagion and contamination (Kalish, 1999). Consequently, in this specific case of plinkitis the general illness description offered might have prompted children to think of the ways in which a disease could be transmitted from one entity to another. Perusal of the possible mechanics of contagion or contamination in the transmission of plinkitis from human and non-human animal entities to plants might have caused the children to conclude that this was an extremely unlikely occurrence. To conclude, it was found that the children did use different generalisation patterns when taught on different exemplars. One might argue that children show biological intuitions about biological kinds and that their knowledge becomes more differentiated with age.

Although young children lack specific knowledge of biological systems, they still have certain biological commitments when deciding about the illness susceptibility of entities belonging to different ontological categories. It is also evident that their responses concerning the category of plants can change, depending on the illness and exemplar presented, revealing some understanding which is probably biologically-based.

Although the explanatory mechanisms used by the children might force them to include some ontological categories and to exclude others, and to change their predictions about a category depending on the illness presented in cases where illness susceptibility is not known, there still might be some underlying biological rules that govern their decisions.

8.3 Individual differences in children's understanding of illness: healthy vs chronically ill children

One of the factors which has been argued to have a role in influencing children's illness concepts is the child's experience of illness (Eiser, 1985). There is a research agenda, within the Piagetian cognitive-developmental paradigm, which has produced very contradictory findings about the degree and the direction of that influence in children's illness understanding. In order to explore possible effects on children's conceptions of illness that might emanate from their additional exposure to illness and medical procedures, healthy vs chronically-ill children's generalisations were investigated. However, no significant differences were identified, suggesting that children's health status does not constitute one of the possible factors influencing children's illness concepts. This finding supports the literature suggesting that the exposure or experience of a major disease does not necessarily result in greater understanding of illness-related concepts (Perrin, Sayer & Willet, 1991; Eiser, 1990).

8.4 Children's understanding of illness: associations with parental health attitudes and the presence of health-related objects in the home

Despite expectations, no associations were found between the children's thinking and the health attitudes of their parents. It therefore appears that the children's thinking was largely unaffected by their parents' health attitudes, at least as these were measured in the present studies. In addition, no associations were found between the children's illness understanding and the presence of health-related objects in the

children's homes. These findings indicate that other factors are probably driving the appearance of the individual differences in children's biological understanding. As noted at the end of Chapter 6, one possibility might be the school input through the curriculum; another is the children's personal experience with raising a pet; a third is watching TV medical and vet programmes; a fourth possibility is that children's understanding of illness is relatively impervious to environmental inputs.

8.5 Theoretical implications of present findings

A naive or framework theory is characterised by the set of phenomena in its domain, by the ontological commitment which it entails, and by the causal mechanisms that are used to explain these phenomena. Two questions of major importance are whether children do hold a naive theory of biology, and when they first construct it during their development. Researchers such as Carey (1985), Keil (1989), Wellman and Gelman (1992, 1998) and Inagaki and Hatano (1996) all present evidence of when children first acquire an intuitive theory of biology. Keil argues that even pre-school children hold a naive theory of biology although their biological knowledge is impoverished in comparison with the one held by older children or adults. Wellman and Gelman propose that pre-school children make the distinction between animals and inanimate objects and therefore argue that they hold a separate ontology of biological kinds. Inagaki and Hatano claim that young children have grasped commonalities between animals and plants at a functional level which could be taken as biological. Finally, Carey claims that in order for children to be acknowledged as holding an intuitive biology, they should present an integrated category of living things which, according to Carey, young children do not possess since they are ignorant of the physiological and histological commonalities between animals and plants.

Carey's (1985) claim that an intuitive theory of biology emerges from an intuitive psychology has been subject to a plethora of critical commentary. According to Carey (1985), children before the age of 10 use an intuitive psychology as the basis of their

explanations of biological phenomena; therefore children by that age attempt to explain all animal properties in terms of intentional causation because they are ignorant of the physiological mechanisms involved. However, research in the area has revealed that young children know about phenomena involving animals and people that cannot be explained by intentional causation. For example, researchers investigated whether children's understanding of bodily processes is believed to be under a person's intentional control (Inagaki & Hatano, 1993). Children were asked whether a boy who has eaten a full main course can make his stomach digest the food faster so that he will have appetite for dessert. Even pre-school children claimed that a process like this is not subject to a person's desires. In addition, it has been found that children can recognise that one's desire cannot affect the growth of other animals (Inagaki & Hatano, 1987). For example, a person cannot keep a kitten small however much he may want to. In addition, Gelman and Kremer (1991) have presented evidence that very young children recognise that human action and consequently human intention is not involved in such processes as the change in the colour of leaves in autumn. Based on the above, one might suggest that even young children can explain certain biological phenomena and processes without using intentional causality. Because of the ample evidence on young children's ability to understand phenomena involving animals and people that cannot be explained in terms of intentional causality, Carey (1995) has more recently suggested that perhaps children do develop a naïve theory of biology much earlier, possibly around the age of 6. She agrees that her argument that children interpret *all* animal properties in terms of intentional causation may be wrong.

The results of the present study strongly suggest that young children do indeed hold biological commitments and use more than one criterion upon which to base their decisions about the illness susceptibility of entities belonging to different ontological categories. It appears that plants were considered to be a biological category by the children, since they were judged as susceptible to illness, at least in some instances. As shown in Study 1, children included plants when deciding about illness susceptibility in general terms. This finding further supports previous evidence according to which children do attribute 'being taken ill' to plants (Inagaki & Hatano, 1996).

Furthermore, drawing on the findings from children's generalisations from hypothetical diseases with different exemplars, it could be suggested that the children in the present studies attributed illness to the category of plants differently depending upon the exemplar presented (child, dog, duck and rosebush). The fact that the attribution of illness susceptibility to plants was not used indiscriminately but instead was dependent on the specific illness description used and exemplar presented, might be taken as reflecting children's understanding of biology. Although children decided that plants can get ill, they accepted or refused illness susceptibility from the hypothetical disease presented (plinkitis) depending partly on the illness description and the exemplar on which they were taught. Do children perceive plants as similar to humans and animals in biological terms? In other words, do children have an appreciation of the living-non-living distinction? Carey showed that children do not project an unknown property from plants to other living things. On the other hand, the findings of the present studies suggest that this might not always be the case when attributing an unknown illness. The results from Studies 1 and 5 propose that children may also be able to recognise and appreciate the commonalities of plants and animals to the extent that they believe that certain biological illness can be shared between the two groups.

The findings of the present study support the view that children hold some ontological commitments, that they possibly have an integrated category of living things, and finally that they have more than one criterion upon which to base their decisions about illness attribution. Although one might argue in favor of human prototypicality from the results of Study 1, no conclusions of this nature can be drawn from both Studies 3 and 5, since no interactions between age and category were found on the child exemplar. In addition, it is possible that children use alternative criteria when deciding about illness susceptibility. As mentioned earlier, contagious illnesses may serve as the prototypical or "best" cases of disease for children (Campbell et al., 1979). In other words, in the absence of any information given, a prototype may be considered as the default (Kalish, 1999), and their understanding of contagion might explain differences in children's generalisations between human and non-human animals and plants.

Indeed, infection seems to be part of both children's and adults' prototype for illness (Bishop, 1991). If children's infectious model of illness can also serve as their model of disease, then it can be suggested that this default model might constitute one more criterion upon which children base their inferences.

However, the existence of such a domain does not constitute evidence for an intuitive biology without positive evidence that children do hold specifically biological mechanisms which they use in order to understand and explain either bodily or other biological phenomena (Carey, 1995). There is a debate about whether the judgements that children make about bodily properties or processes are the outcome of knowledge of biologically-specific causal mechanisms, or whether they simply reflect what the child has learned about people or other species but for which the child has no explanation. Carey proposes that a child's knowledge might be the result of mere input-output relations and not the outcome of a causal understanding.

However, it was for this very reason that the present studies used the made-up illness, plinkitis, so that the children's performance could not simply be attributed to the acquisition of isolated facts about particular real diseases. So, if children's biological thinking is based solely upon isolated acquired facts, how can one explain the children's increased number of response patterns on the hypothetical illness when compared with illness in general? How can input-output relations explain children's judgements for a hypothetical disease?

Most investigators suggest that young children possess a form of biology which is differentiated from psychology, since children recognise that there are biological phenomena which cannot be explained by intentional causality. However, the question is whether this body of knowledge held or presented by children is truly biological. Yet, what are the criteria for defining the domain of biology? It has been proposed earlier that a naïve theory of biology should include the integrated category of living things, and causal explanatory biological mechanisms. It is possible, however, that young children might have ontological commitments, and an understanding of how some biological phenomena work, although their knowledge of biological causal mechanisms is impoverished in comparison to the one held by older children or adults.

It is evident from the results of Study 5 that children present a commitment to ontological categories. Children were shown to possess clear boundaries across ontological groups which varied depending on the exemplar taught on. Based on the present studies, it is possible to conclude that even the youngest children studied showed ontological commitments, and a biological understanding which became more differentiated with age. In addition, one of the senses in which children's knowledge of disease is domain-specific concerns children's knowledge that only biological entities become ill. This is supported by the results of Studies 1, 3 and 5 since physical kinds and hand-made artifacts were hardly ever included in children's judgement patterns.

8.6 Limitations of the present research

The present studies explored children's illness understanding and investigated individual differences in their generalisation of illness between human, non-human and plant entities. Parental health attitudes, the presence of health-related objects and personal experience with illness were all examined as possible explanations for the individual differences identified in children's illness concepts, but no links were found. However, it is possible that other influential factors are at work. Future studies could examine possible links between children's illness understanding and their experience with raising a pet, school activities, and exposure to biological information from TV medical or vet programmes.

As mentioned above, this study investigated whether any individual differences in children's responses were associated with parental health attitudes. The findings suggested the lack of association between children's illness understanding and their parents attitudes towards health. However, the instrument administered to the parents of the participants consisted of items in which the emphasis was on the parents' personal health attitudes and behaviours and not on their health beliefs or practices concerning their children. In other words, it might be that the parental questionnaire failed to address those parental beliefs and practices which are most directly related to the children's thinking about illness. The fact that the present research study did not measure either health behaviours or parental health attitudes specifically concerning one's children, constitutes one of its limitations.

The present research aimed to explore children's biological understanding of ontological categories by using illness as a contextual cue. The findings suggest that generalisations to the category of humans were separated from other entities belonging to the three animal ontological categories. However, if children believed that illness is species-specific, then this might explain the above mentioned separation made by the children, since this is the only group included in all studies that consisted of only one species. Future research might clarify this by examining children's attribution of illness susceptibility within different members of a species in comparison to generalisations across ontological groups.

One of the possible reasons why children in the studies tended not to generalise from humans and non-human animals to plants could be related to linguistic cues. Firstly, concerning the use of the term 'illness', if children associate this term with people whilst they use the term 'disease' for other entities, that might give a better insight into the fact that generalisations were not made from humans and other animals to plants. In future research this problem can be resolved by replacing the term 'illness' with the term 'disease'. However, it first needs to be established whether children are acquainted with this latter term. Thus, it may be the case that a more appropriate illness description for plants might produce different generalisation patterns.

Finally, it ought to be noted that the studies which have been reported in this thesis have all involved children who were aged 5-11. It has been found that a rudimentary biological understanding was already in place at the age of 5. There is clearly a need to study younger children as well, in order to ascertain the approximate age at which children's biological theories first emerge.

8.7 Conclusion

This research has revealed several findings which build on and extend previous research:

1. 5-11 year olds have naïve theories of biology which they use when they are asked to judge about susceptibility to illness.

2. Their judgements show individual differences, as revealed by the different patterns from the configural frequency analysis.
3. These individual differences are not systematically related to either parental health attitudes or health-related objects in the home. In addition, no associations were found between children's illness understanding and their health status.

It is for future studies to explore some of the other possible factors which might have contributed to the individual differences in the understanding of illness that have been documented in these studies.

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Appendix 1
Chapter 3

GE1

FILE='A:\Mariangl.sav'.

EXECUTE .

GLM

humcill mamcill nmamcill placill handcill phcill BY gender group

/WSFACTOR = category 6 Polynomial

/METHOD = SSTYPE(3)

/CRITERIA = ALPHA(.05)

/WSDESIGN = category

/DESIGN = gender group gender*group .

164

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMCILL
2	MAMCILL
3	NMAMCILL
4	PLACILL
5	HANDCILL
6	PHCILL

Between-Subjects Factors

	Value Label	N
GENDER	1 male	100
	2 female	102
GROUP	1.00	86
	2.00	58
	3.00	58

Multivariate Tests^c

Effect		Value	F	Hypothesis df	Error df	Sig.
CATEGORY	Pillai's Trace	.928	492.690 ^a	5.000	192.000	.000
	Wilks' Lambda	.072	492.690 ^a	5.000	192.000	.000
	Hotelling's Trace	12.830	492.690 ^a	5.000	192.000	.000
	Roy's Largest Root	12.830	492.690 ^a	5.000	192.000	.000
CATEGORY * GENDER	Pillai's Trace	.017	.667 ^a	5.000	192.000	.649
	Wilks' Lambda	.983	.667 ^a	5.000	192.000	.649
	Hotelling's Trace	.017	.667 ^a	5.000	192.000	.649
	Roy's Largest Root	.017	.667 ^a	5.000	192.000	.649
CATEGORY * GROUP	Pillai's Trace	.224	4.867	10.000	386.000	.000
	Wilks' Lambda	.777	5.157 ^a	10.000	384.000	.000
	Hotelling's Trace	.285	5.445	10.000	382.000	.000
	Roy's Largest Root	.280	10.795 ^b	5.000	193.000	.000
CATEGORY * GENDER * GROUP	Pillai's Trace	.042	.819	10.000	386.000	.611
	Wilks' Lambda	.959	.819 ^a	10.000	384.000	.611
	Hotelling's Trace	.043	.819	10.000	382.000	.611
	Roy's Largest Root	.037	1.417 ^b	5.000	193.000	.220

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c.

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
CATEGORY	.203	309.800	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Epsilon ^a		
Within Subjects Effect	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CATEGORY	.678	.709	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b.

Design: Intercept+GENDER+GROUP+GENDER * GROUP
Within Subjects Design: CATEGORY

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	3944.179	5	788.836
	Greenhouse-Geisser	3944.179	3.391	1163.297
	Huynh-Feldt	3944.179	3.545	1112.467
	Lower-bound	3944.179	1.000	3944.179
CATEGORY * GENDER	Sphericity Assumed	6.120	5	1.224
	Greenhouse-Geisser	6.120	3.391	1.805
	Huynh-Feldt	6.120	3.545	1.726
	Lower-bound	6.120	1.000	6.120
CATEGORY * GROUP	Sphericity Assumed	95.047	10	9.505
	Greenhouse-Geisser	95.047	6.781	14.017
	Huynh-Feldt	95.047	7.091	13.404
	Lower-bound	95.047	2.000	47.524
CATEGORY * GENDER * GROUP	Sphericity Assumed	7.310	10	.731
	Greenhouse-Geisser	7.310	6.781	1.078
	Huynh-Feldt	7.310	7.091	1.031
	Lower-bound	7.310	2.000	3.655
Error(CATEGORY)	Sphericity Assumed	1206.044	980	1.231
	Greenhouse-Geisser	1206.044	664.542	1.815
	Huynh-Feldt	1206.044	694.905	1.736
	Lower-bound	1206.044	196.000	6.153

Measure: MEASURE_1

Source		F	Sig.
CATEGORY	Sphericity Assumed	640.988	.000
	Greenhouse-Geisser	640.988	.000
	Huynh-Feldt	640.988	.000
	Lower-bound	640.988	.000
CATEGORY * GENDER	Sphericity Assumed	.995	.420
	Greenhouse-Geisser	.995	.401
	Huynh-Feldt	.995	.404
	Lower-bound	.995	.320
CATEGORY * GROUP	Sphericity Assumed	7.723	.000
	Greenhouse-Geisser	7.723	.000
	Huynh-Feldt	7.723	.000
	Lower-bound	7.723	.001
CATEGORY * GENDER * GROUP	Sphericity Assumed	.594	.820
	Greenhouse-Geisser	.594	.756
	Huynh-Feldt	.594	.763
	Lower-bound	.594	.553
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	3691.456	1	3691.456	2259.876	.000
	Quadratic	1.123	1	1.123	.758	.385
	Cubic	217.625	1	217.625	222.594	.000
	Order 4	3.155	1	3.155	4.493	.035
	Order 5	30.821	1	30.821	22.691	.000
CATEGORY * GENDER	Linear	.503	1	.503	.308	.580
	Quadratic	.146	1	.146	.099	.754
	Cubic	1.253	1	1.253	1.282	.259
	Order 4	4.059E-02	1	4.059E-02	.058	.810
	Order 5	4.176	1	4.176	3.075	.081
CATEGORY * GROUP	Linear	58.223	2	29.112	17.822	.000
	Quadratic	18.469	2	9.234	6.232	.002
	Cubic	17.079	2	8.540	8.735	.000
	Order 4	1.273	2	.637	.907	.405
	Order 5	2.915E-03	2	1.457E-03	.001	.999
CATEGORY * GENDER * GROUP	Linear	1.041	2	.520	.319	.728
	Quadratic	1.816	2	.908	.613	.543
	Cubic	.390	2	.195	.199	.819
	Order 4	.428	2	.214	.305	.738
	Order 5	3.635	2	1.818	1.338	.265
Error(CATEGORY)	Linear	320.162	196	1.633		
	Quadratic	290.402	196	1.482		
	Cubic	191.625	196	.978		
	Order 4	137.623	196	.702		
	Order 5	266.232	196	1.358		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	7197.355	1	7197.355	2948.446	.000
GENDER	1.179	1	1.179	.483	.488
GROUP	65.924	2	32.962	13.503	.000
GENDER * GROUP	6.566	2	3.283	1.345	.263
Error	478.449	196	2.441		


```
GLM
humctill mamctill nmamctil plactill handctil phctill BY gender group
/WSFACTOR = category 6 Polynomial
/METHOD = SSTYPE(3)
/CRITERIA = ALPHA(.05)
/WSDESIGN = category
/DESIGN = gender group gender*group .
```

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMCTILL
2	MAMCTILL
3	NMAMCTIL
4	PLACTILL
5	HANDCTIL
6	PHCTILL

Between-Subjects Factors

	Value Label	N
GENDER 1	male	100
2	female	102
GROUP 1.00		86
2.00		58
3.00		58

Multivariate Tests^c

Effect		Value	F	Hypothesis df	Error df	Sig.
CATEGORY	Pillai's Trace	.906	368.586 ^a	5.000	192.000	.000
	Wilks' Lambda	.094	368.586 ^a	5.000	192.000	.000
	Hotelling's Trace	9.599	368.586 ^a	5.000	192.000	.000
	Roy's Largest Root	9.599	368.586 ^a	5.000	192.000	.000
CATEGORY * GENDER	Pillai's Trace	.021	.831 ^a	5.000	192.000	.529
	Wilks' Lambda	.979	.831 ^a	5.000	192.000	.529
	Hotelling's Trace	.022	.831 ^a	5.000	192.000	.529
	Roy's Largest Root	.022	.831 ^a	5.000	192.000	.529
CATEGORY * GROUP	Pillai's Trace	.208	4.478	10.000	386.000	.000
	Wilks' Lambda	.792	4.738 ^a	10.000	384.000	.000
	Hotelling's Trace	.262	4.997	10.000	382.000	.000
	Roy's Largest Root	.260	10.039 ^b	5.000	193.000	.000
CATEGORY * GENDER * GROUP	Pillai's Trace	.051	1.019	10.000	386.000	.426
	Wilks' Lambda	.949	1.018 ^a	10.000	384.000	.428
	Hotelling's Trace	.053	1.016	10.000	382.000	.429
	Roy's Largest Root	.041	1.569 ^b	5.000	193.000	.171

a. Exact statistic
b. The statistic is an upper bound on F that yields a lower bound on the significance level.
c.

Design: Intercept+GENDER+GROUP+GENDER * GROUP
Within Subjects Design: CATEGORY

Measure: MEASURE_1

	Mauchly's W	Approx. Chi-Square	df	Sig.
Within Subjects Effect				
CATEGORY	.201	311.044	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Epsilon ^a		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Within Subjects Effect			
CATEGORY	.654	.683	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b.

Design: Intercept+GENDER+GROUP+GENDER * GROUP

Within Subjects Design: CATEGORY

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	3864.825	5	772.965
	Greenhouse-Geisser	3864.825	3.270	1181.932
	Huynh-Feldt	3864.825	3.417	1131.118
	Lower-bound	3864.825	1.000	3864.825
CATEGORY * GENDER	Sphericity Assumed	6.519	5	1.304
	Greenhouse-Geisser	6.519	3.270	1.993
	Huynh-Feldt	6.519	3.417	1.908
	Lower-bound	6.519	1.000	6.519
CATEGORY * GROUP	Sphericity Assumed	93.626	10	9.363
	Greenhouse-Geisser	93.626	6.540	14.316
	Huynh-Feldt	93.626	6.834	13.701
	Lower-bound	93.626	2.000	46.813
CATEGORY * GENDER * GROUP	Sphericity Assumed	9.579	10	.958
	Greenhouse-Geisser	9.579	6.540	1.465
	Huynh-Feldt	9.579	6.834	1.402
	Lower-bound	9.579	2.000	4.789
Error(CATEGORY)	Sphericity Assumed	1329.479	980	1.357
	Greenhouse-Geisser	1329.479	640.904	2.074
	Huynh-Feldt	1329.479	669.697	1.985
	Lower-bound	1329.479	196.000	6.783

Source		F	Sig.
CATEGORY	Sphericity Assumed	569.776	.000
	Greenhouse-Geisser	569.776	.000
	Huynh-Feldt	569.776	.000
	Lower-bound	569.776	.000
CATEGORY * GENDER	Sphericity Assumed	.961	.441
	Greenhouse-Geisser	.961	.416
	Huynh-Feldt	.961	.419
	Lower-bound	.961	.328
CATEGORY * GROUP	Sphericity Assumed	6.901	.000
	Greenhouse-Geisser	6.901	.000
	Huynh-Feldt	6.901	.000
	Lower-bound	6.901	.001
CATEGORY * GENDER * GROUP	Sphericity Assumed	.706	.719
	Greenhouse-Geisser	.706	.657
	Huynh-Feldt	.706	.663
	Lower-bound	.706	.495
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	3517.309	1	3517.309	1744.284	.000
	Quadratic	19.966	1	19.966	14.361	.000
	Cubic	263.964	1	263.964	265.971	.000
	Order 4	33.313	1	33.313	47.197	.000
	Order 5	30.273	1	30.273	18.041	.000
CATEGORY * GENDER	Linear	6.110E-02	1	6.110E-02	.030	.862
	Quadratic	4.851E-03	1	4.851E-03	.003	.953
	Cubic	1.697	1	1.697	1.710	.193
	Order 4	2.347E-02	1	2.347E-02	.033	.855
	Order 5	4.732	1	4.732	2.820	.095
CATEGORY * GROUP	Linear	54.955	2	27.478	13.627	.000
	Quadratic	25.529	2	12.764	9.181	.000
	Cubic	9.722	2	4.861	4.898	.008
	Order 4	3.153	2	1.577	2.234	.110
	Order 5	.267	2	.133	.080	.924
CATEGORY * GENDER * GROUP	Linear	3.717	2	1.859	.922	.400
	Quadratic	1.095	2	.547	.394	.675
	Cubic	2.122	2	1.061	1.069	.345
	Order 4	1.128	2	.564	.799	.451
	Order 5	1.517	2	.758	.452	.637
Error(CATEGORY)	Linear	395.229	196	2.016		
	Quadratic	272.504	196	1.390		
	Cubic	194.522	196	.992		
	Order 4	138.340	196	.706		
	Order 5	328.884	196	1.678		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	5855.181	1	5855.181	2502.499	.000
GENDER	.511	1	.511	.218	.641
GROUP	56.582	2	28.291	12.091	.000
GENDER * GROUP	5.930	2	2.965	1.267	.284
Error	458.588	196	2.340		

GLM

humilldt mamilldt nmamilld plailldt handilld philldt BY gender group

174

/WSFACTOR = category 6 Polynomial

/METHOD = SSTYPE(3)

/CRITERIA = ALPHA(.05)

/WSDESIGN = category

/DESIGN = gender group gender*group .

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMILLDT
2	MAMILLDT
3	NMAMILLD
4	PLAILLDT
5	HANDILLD
6	PHILLDT

Between-Subjects Factors

	Value Label	N
GENDER 1	male	100
2	female	102
GROUP 1.00		86
2.00		58
3.00		58

Multivariate Tests^c

Effect		Value	F	Hypothesis df	Error df	Sig.
CATEGORY	Pillai's Trace	.338	19.635 ^a	5.000	192.000	.000
	Wilks' Lambda	.662	19.635 ^a	5.000	192.000	.000
	Hotelling's Trace	.511	19.635 ^a	5.000	192.000	.000
	Roy's Largest Root	.511	19.635 ^a	5.000	192.000	.000
CATEGORY * GENDER	Pillai's Trace	.040	1.604 ^a	5.000	192.000	.161
	Wilks' Lambda	.960	1.604 ^a	5.000	192.000	.161
	Hotelling's Trace	.042	1.604 ^a	5.000	192.000	.161
	Roy's Largest Root	.042	1.604 ^a	5.000	192.000	.161
CATEGORY * GROUP	Pillai's Trace	.065	1.297	10.000	386.000	.230
	Wilks' Lambda	.935	1.303 ^a	10.000	384.000	.227
	Hotelling's Trace	.069	1.310	10.000	382.000	.223
	Roy's Largest Root	.061	2.361 ^b	5.000	193.000	.042
CATEGORY * GENDER * GROUP	Pillai's Trace	.077	1.542	10.000	386.000	.122
	Wilks' Lambda	.924	1.554 ^a	10.000	384.000	.118
	Hotelling's Trace	.082	1.566	10.000	382.000	.115
	Roy's Largest Root	.074	2.851 ^b	5.000	193.000	.017

- a. Exact statistic
- b. The statistic is an upper bound on F that yields a lower bound on the significance level.
- c.

Design: Intercept+GENDER+GROUP+GENDER * GROUP
Within Subjects Design: CATEGORY

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
CATEGORY	.151	366.437	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Epsilon ^a		
Within Subjects Effect	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CATEGORY	.594	.619	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b.

Design: Intercept+GENDER+GROUP+GENDER * GROUP
Within Subjects Design: CATEGORY

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	49.919	5	9.984
	Greenhouse-Geisser	49.919	2.968	16.820
	Huynh-Feldt	49.919	3.095	16.127
	Lower-bound	49.919	1.000	49.919
CATEGORY * GENDER	Sphericity Assumed	1.103	5	.221
	Greenhouse-Geisser	1.103	2.968	.372
	Huynh-Feldt	1.103	3.095	.356
	Lower-bound	1.103	1.000	1.103
CATEGORY * GROUP	Sphericity Assumed	3.194	10	.319
	Greenhouse-Geisser	3.194	5.936	.538
	Huynh-Feldt	3.194	6.191	.516
	Lower-bound	3.194	2.000	1.597
CATEGORY * GENDER * GROUP	Sphericity Assumed	8.060	10	.806
	Greenhouse-Geisser	8.060	5.936	1.358
	Huynh-Feldt	8.060	6.191	1.302
	Lower-bound	8.060	2.000	4.030
Error(CATEGORY)	Sphericity Assumed	408.478	980	.417
	Greenhouse-Geisser	408.478	581.684	.702
	Huynh-Feldt	408.478	606.677	.673
	Lower-bound	408.478	196.000	2.084

Measure: MEASURE_1

Source		F	Sig.
CATEGORY	Sphericity Assumed	23.953	.000
	Greenhouse-Geisser	23.953	.000
	Huynh-Feldt	23.953	.000
	Lower-bound	23.953	.000
CATEGORY * GENDER	Sphericity Assumed	.529	.754
	Greenhouse-Geisser	.529	.660
	Huynh-Feldt	.529	.668
	Lower-bound	.529	.468
CATEGORY * GROUP	Sphericity Assumed	.766	.662
	Greenhouse-Geisser	.766	.595
	Huynh-Feldt	.766	.600
	Lower-bound	.766	.466
CATEGORY * GENDER * GROUP	Sphericity Assumed	1.934	.037
	Greenhouse-Geisser	1.934	.074
	Huynh-Feldt	1.934	.071
	Lower-bound	1.934	.147
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	2.221	1	2.221	8.657	.004
	Quadratic	30.301	1	30.301	45.476	.000
	Cubic	2.038	1	2.038	6.487	.012
	Order 4	15.354	1	15.354	36.680	.000
	Order 5	4.862E-03	1	4.862E-03	.011	.915
CATEGORY * GENDER	Linear	.993	1	.993	3.869	.051
	Quadratic	8.382E-02	1	8.382E-02	.126	.723
	Cubic	1.340E-02	1	1.340E-02	.043	.837
	Order 4	8.331E-04	1	8.331E-04	.002	.964
	Order 5	1.248E-02	1	1.248E-02	.029	.865
CATEGORY * GROUP	Linear	.494	2	.247	.963	.383
	Quadratic	.625	2	.313	.469	.626
	Cubic	1.388	2	.694	2.209	.113
	Order 4	.352	2	.176	.421	.657
	Order 5	.335	2	.167	.390	.677
CATEGORY * GENDER * GROUP	Linear	.877	2	.438	1.709	.184
	Quadratic	.261	2	.131	.196	.822
	Cubic	2.592	2	1.296	4.125	.018
	Order 4	.540	2	.270	.645	.526
	Order 5	3.790	2	1.895	4.423	.013
Error(CATEGORY)	Linear	50.280	196	.257		
	Quadratic	130.595	196	.666		
	Cubic	61.578	196	.314		
	Order 4	82.046	196	.419		
	Order 5	83.978	196	.428		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	89.075	1	89.075	97.026	.000
GENDER	3.259	1	3.259	3.550	.061
GROUP	.351	2	.175	.191	.826
GENDER * GROUP	4.042E-02	2	2.021E-02	.022	.978
Error	179.939	196	.918		

Appendix 2
Chapter 4
Study 2: Parental Questionnaire

Study of children’s Understanding of Illness
Your Child’s Details

Your child’s full name

Your child’s date of birth

Your child’s gender

Section A-Child’s Health History

1. Which of the following illnesses has your child had? (please tick boxes)

chicken-pox []	asthma []	accidental injury (e.g. broken bones) []
mumps []	eczema []	other (please specify)
flu []	hay fever []	

2. (a) Has your child ever been hospitalised? Yes [] No []

(b) (If yes) For what?

(c) (If yes) For how long?

(d) (If yes) When (which year)?

3. (a) Has your child visited the doctor during the past year?

Yes [] No []

(b) (If yes) For what?

- (c)** (If yes) When did the visits take place (which year)?

- ## Section B-Parental Health Attitudes and Behaviours

	Not at all like me	Unlike me	Not sure	Like me	Very much like me
1. I exercise to stay healthy	[]	[]	[]	[]	[]
2. I watch my weight	[]	[]	[]	[]	[]
3. I take vitamins	[]	[]	[]	[]	[]
4. I use dental floss regularly	[]	[]	[]	[]	[]
5. I do not eat foods which contain additives and artificial colourings	[]	[]	[]	[]	[]
6. I do not drink alcohol	[]	[]	[]	[]	[]

7. I avoid areas with high pollution	[]	[]	[]	[]	[]
8. I eat a balanced diet	[]	[]	[]	[]	[]
9. I see a doctor for regular checkups	[]	[]	[]	[]	[]
10. I limit my intake of foods like coffee, sugar, fats, etc.	[]	[]	[]	[]	[]
11. I stay away from places where I might be exposed to germs	[]	[]	[]	[]	[]
12. I see a dentist for regular checkups	[]	[]	[]	[]	[]
13. I take health food supplements (e.g. wheat germ, bran, lecithin)	[]	[]	[]	[]	[]
14. I do not smoke	[]	[]	[]	[]	[]
15. I discuss health with friends, neighbours, and relatives	[]	[]	[]	[]	[]

16. I gather information on [] [] [] [] []
things that affect my health by
watching television and reading
books, newspapers, or magazine
articles

Appendix 3

Redesigning the Parental Questionnaire

A3.1 Introduction

As reported in Chapter 4, Study 2 tried to investigate possible links between the children's understanding of illness and both their own experience of disease and their parents' health attitudes and behaviours. As part of the study, a parental questionnaire was used to collect data about parents' health behaviours and attitudes. Although all of the items used to measure parental attitudes were derived from an existing validated instrument, the data which were collected from parents failed to display the expected factor structure, and relatively few relationships were found between parental attitudes and the children's illness understanding.

As noted in Chapter 4, one possible reason why the instrument failed to display the expected factor structure might be that it was originally validated upon a North American population. In addition, there were other methodological problems with the instrument as well. First, and perhaps surprisingly in an existing validated instrument which is used quite widely in the field of health psychology, all the items are unidirectional and no reverse items are included in the instrument; thus, there is a possibility of a response bias affecting the results. Second, all the statements concern health behaviours rather than attitudes per se; it is possible, however, that health attitudes are more important for influencing children's understanding of illness. Third, it is also possible that stronger statements might have elicited a better spread of responses. Finally, although it is believed that the mothers of the participants completed the questionnaire, this information was not explicitly elicited in Study 2. For all the above reasons, and because of the lack of associations between parental beliefs and children's thinking which were found in Study 2, a redesign of the questionnaire was attempted.

A3.2 Questionnaire Development Study 1

A3.2.1 Method

Materials

In the group of children who participated in Study 1, there were very few who had an increased contact with illness or experience of hospitalisation. Therefore, Section A of the previous questionnaire, concerning the child's medical history, was excluded from the new questionnaire. The aim instead was to include *a.* statements concerning health attitudes and behaviours towards one's self; and *b.* statements concerning health attitudes and behaviours towards one's children.

Because of the decision to include not only behavioural but also "pure" attitudinal items in the questionnaire, an initial set of 60 statements was first generated, containing 20 good behavioural, 20 bad behavioural, 20 good attitudinal and 20 bad attitudinal statements. A panel of three judges working together then selected 5 statements from each category for inclusion in the questionnaire (see end of Appendix). In choosing these items, care was taken to ensure: *a.* equal number of behavioural and attitudinal items; *b.* equal number of good and bad behavioural and attitudinal items; *c.* equal number of positive and negative statements (reverse scoring); and *d.* naturalness of language. In addition, seven further items were then generated concerning health attitudes and behaviours towards one's children. The redesigned questionnaire was expected to present a two-factor structure (parental health attitudes and behaviours towards oneself, and parental health attitudes and behaviours towards one's children). The twenty seven items included were rated on a five point scale on which strongly agree = 5, agree = 4, uncertain = 3, disagree = 2 and strongly disagree = 1. This wording was considered as more appropriate than that used in the Vickers et al. instrument, since attitudinal statements were also included. A copy of the final questionnaire is shown at the end of this Appendix.

Procedure

The questionnaires were administered to 105 students and staff from the Departments of Psychology and Sociology at the University of Surrey. The participants had to have one or more children, since some of the items concerned parental health attitudes and behaviours towards their children.

A3.2.2 Results

The data from the 105 questionnaires collected were subjected to three factor analyses. First, a confirmatory factor analysis was performed using principal components analysis (PCA) with oblimin rotation. The participants-to-variable was adequate, fulfilling the recommendation of 2:1 to 10:1 participant/variable ratio (Gorsuch, 1983). The sampling adequacy was checked using the KMO diagnostic measurement which was satisfied. The principal components analysis indicated that the two factors accounted for only 30.5% of the variance. Table A3.1 reports the pattern matrix. Furthermore, using the Kaiser 1 (K1) rule and factor interpretability rule (Ferguson & Cox, 1993; Hammond, 1995) this solution was deemed uninterpretable. Therefore, an additional confirmatory factor analysis was conducted using principal components analysis with oblimin rotation forcing for three factors which were hypothesised to be: *a. General Behaviour factor b. Neuroticism factor and c. Dentistry factor*. Table A3.2 reports the pattern matrix. The three factors accounted for only 38.2% of the variance. Using the K1 rule and factor interpretability rule this solution was also deemed uninterpretable. Consequently, a final exploratory factor analysis using principal components analysis was performed with oblimin rotation. The principal components analysis revealed eight factors that accounted for the 64.7% of the variance (eigenvalues greater than one). Table A3.3 reports the pattern matrix. However, the results from this third analysis were also deemed uninterpretable using the K1 and factor interpretability rules (Ferguson & Cox, 1991; Hammond, 1995).

The internal reliability of the 27 items treated as a single scale was then examined. The very low Cronbach $\alpha = 0.3272$ suggested that item intercorrelation was very low and therefore the instrument could not be treated as a single scale. Hence, some changes were needed in order to produce a reliable instrument.

Table A3.1 Factor analysis pattern matrix of parental questionnaire identifying two factors

	Factor 1	Factor 2
PHAB24	-.654	
PHAB13	-.606	
PHAB19	.585	
PHAB9	-.569	
PHAB23	.559	
PHAB6	-.552	
PHAB15	.551	
PHAB4	.504	
PHAB27	-.467	
PHAB8	.440	
PHAB25	-.384	-.356
PHAB7		.696
PHAB16		-.679
PHAB14		-.652
PHAB10		.614
PHAB3		.595
PHAB20		-.575
PHAB5		-.514
PHAB21		.442
PHAB11		.342

Factor 1

- PHAB24 : I only see the dentist when I have toothache
- PHAB13 : I think dental flossing is a waste of time
- PHAB19: I'm always interested in anything about health on television and in magazines and newspapers
- PHAB9 : I'd rather not know too much about health matters
- PHAB23 : I believe it's important to take regular exercise
- PHAB6 : I think people should be more tolerant of smokers

PHAB15 : I make sure that I eat a well-balanced diet

PHAB4 : I think regular dental check-ups are important

PHAB27: I don't worry about eating the right sort of food

PHAB8 : I use dental floss regularly

PHAB25: I never think about the vitamins in my child's diet

Factor 2

PHAB25: I never think about the vitamins in my child's diet

PHAB7 : I worry about whether my child remembers to wash his/her hands after going to the toilet

PHAB16: I don't worry about picking up germs from other people

PHAB14 : I rarely weigh myself

PHAB10 : I'm always concerned about my weight

PHAB3 : I worry about getting the right vitamins in my diet

PHAB20 : I never worry about the effects of drinking alcohol

PHAB5 : I don't worry about my child's diet

PHAB21 : It's important to keep an eye on my child's weight

PHAB11: I'm careful about the amount of alcohol I drink

Table A3.2 Factor analysis pattern matrix of parental questionnaire identifying three factors: General Behaviour, Neuroticism and Dentistry

	Factor 1	Factor 2	Factor 3
PHAB6	-.673		
PHAB9	-.667		
PHAB15	.640		
PHAB23	.620		
PHAB27	-.597		
PHAB19	.545		
PHAB26	.527		
PHAB24	-.472		
PHAB7		.750	
PHAB16		-.696	
PHAB14		-.569	
PHAB10		.532	
PHAB3		.522	
PHAB21		.514	.453
PHAB20		-.504	
PHAB5		-.468	
PHAB13			-.692
PHAB4			.662
PHAB2			.577
PHAB8			.492
PHAB12			-.479

Factor 1

PHAB6 : I think people should be more tolerant of smokers

PHAB9 : I'd rather not know too much about health matters

PHAB15: I make sure that I eat a well-balanced diet

PHAB23 : I believe it's important to take regular exercise

PHAB27 : I don't worry about eating the right sort of food

PHAB19: I'm always interested in anything about health on television and in magazines and newspapers

PHAB26: I don't smoke

PHAB24: I only see the dentist when I have toothache

Factor 2

PHAB7: I worry about whether my child remembers to wash his/her hands after going to the toilet

PHAB16: I don't worry about picking up germs from other people

PHAB14: I rarely weigh myself

PHAB10: I'm always concerned about my weight

PHAB3: I worry about getting the right vitamins in my diet

PHAB21: It's important to keep an eye on my child's weight

PHAB20: I never worry about the effects of drinking alcohol

PHAB5: I don't worry about my child's diet

Factor 3

PHAB21: It's important to keep an eye on my child's weight

PHAB13: I think dental flossing is a waste of time

PHAB4: I think regular dental check-ups are important

PHAB2: My child needs to understand the importance of brushing his/her teeth every day

PHAB8: I use dental floss regularly

PHAB12: It isn't important for my child to take regular exercise

Table A3.3 Factor analysis pattern matrix of parental questionnaire identifying eight factors

	Factor 1	Factor 2	Factor 3	Factor 4
PHAB24	-.774			
PHAB9	-.641			
PHAB21	-.510		.438	
PHAB19	.423			
PHAB7		.788		
PHAB16		-.626		
PHAB3		.583		
PHAB18		-.529		
PHAB5		-.482		
PHAB12			-.878	
PHAB2			.416	
PHAB25			-.409	
PHAB4			.411	
PHAB22				.768
PHAB17				.710
PHAB11				.650

	Factor 5	Factor 6	Factor 7	Factor 8
PHAB8	-.774			
PHAB13	-.641			
PHAB4	-.510			
PHAB26		.824		
PHAB6		-.725		
PHAB27		-.497		
PHAB18			.438	
PHAB14			-.780	
PHAB10			.693	
PHAB1				-.920
PHAB23				.752
PHAB15				.435

Factor 1

- PHAB24 : I only see the dentist when I have toothache
- PHAB9 : I'd rather not know too much about health matters
- PHAB21 : It's important to keep an eye on my child's weight
- PHAB19 : I'm always interested in anything about health on television and in magazines and newspapers

Factor 2

- PHAB7 : I worry about whether my child remembers to wash his/her hands after going to the toilet
- PHAB16 : I don't worry about picking up germs from other people
- PHAB3 : I worry about getting the right vitamins in my diet
- PHAB18 : I don't take any vitamin supplements
- PHAB5 : I don't worry about my child's diet

Factor 3

- PHAB21 : It's important to keep an eye on my child's weight

PHAB12: It isn't important for my child to take regular exercise

PHAB2: My child needs to understand the importance of brushing his/her teeth every day

PHAB25: I never think about the vitamins in my child's diet

Factor 4

PHAB22 : I stay away from people with coughs and colds

PHAB17: I think it's important to avoid artificial colourings in my child's diet

PHAB11: I'm careful about the amount of alcohol I drink

Factor 5

PHAB8: I use dental floss regularly

PHAB13 : I think dental flossing is a waste of time

PHAB4 : I think regular dental check-ups are important

Factor 6

PHAB26: I don't smoke

PHAB6: I think people should be more tolerant of smokers

PHAB27: I don't worry about eating the right sort of food

Factor 7

PHAB18: I don't take any vitamin supplements

PHAB14 : I rarely weigh myself

PHAB10 : I'm always concerned about my weight

Factor 8

PHAB1: I never take any physical exercise

PHAB23: I believe it's important to take regular exercise

PHAB15: I make sure that I eat a well-balanced diet

A3.3 Questionnaire Development Study 2

A3.3.1 Method

Materials

Based on a hypothesised three-factor structure (*cognitive concern, neurotic concern, and behaviour*), a revised questionnaire was then developed which included the following two sections:

Section A contained 11 items referring to attitudes towards health. Six of the items were positive and five were negative. The negative items were all reversed when being scored. All of the items were assigned to measure concern or lack of concern about health matters. Within *Section A*, an attempt was made to measure two factors. One was a *cognitive factor*, measured by statements such as “I think”, “I believe”, “I find” and the other was a *neuroticism factor* towards health matters including statements such as “I worry”, “I am concerned” or “I am very concerned”. All the items were rated on a five-point scale where strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, and strongly disagree = 1. A further change was made to the five-point scale that had been used in the first questionnaire development study: the wording “neither agree nor disagree” was used instead of “uncertain” to represent the midpoint. The change was made because the latter wording was considered to reflect a more appropriate neutral mid point within the scale.

Section B contained 13 items referring to health behaviours. The statements concerned consuming habits (food and alcohol-related) and health preventive habits such as vitamin consumption and physical exercise. Seven of the items were positive and six items were negative. All the negative items were reversed when being scored. The items were rated on a four-point scale *never, rarely, sometimes and often*. A full copy of the questionnaire is given at the end of this Appendix.

Procedure

The questionnaires were given to 109 adults. These participants were students and staff, having one or more children, from the University of Surrey and the University of Sussex, and employees of Primary Schools in East Sussex County and in the London area. The questionnaires, which were anonymous, were returned directly to the researcher.

A3.3.2 Results

The data from the 109 questionnaires were subjected to factor analysis. For *Section A*, two factor analyses were conducted on the attitudes towards health. The first was a confirmatory analysis using principal components analysis with oblimin rotation. The principal components analysis indicated two factors that accounted for the 41.1% of the variance. Table A3.4 reports the pattern matrix. Therefore, an exploratory factor analysis was conducted with oblimin rotation. The principal components analysis indicated a four factor structure (eigenvalues greater than one), that accounted for the 60.9% of the variance. Table A3.5 reports the findings of the pattern matrix. However, the K1 rule and the factor interpretability rule suggested that the solutions from both factor analysis were uninterpretable. Reliability analysis of the data of *Section A* produced a Cronbach $\alpha = 0.7366$, suggesting that all the items were intercorrelated and therefore all 11 questions could be treated as a single scale.

Table A3.4 Factor analysis pattern matrix of parental health attitude questionnaire identifying two factors

	Factor 1	Factor 2
ATTQ3	.798	
ATTQ1	.655	
ATTQ9	.634	
ATTQ11	.541	
ATTQ5	.518	
ATTQ4	.355	
ATTQ6		.781
ATTQ2		.668
ATTQ8		.602
ATTQ10		.576
ATTQ7		.475

Factor 1

- Attitudinal question 3: I believe it is very important to take care over my diet
- Attitudinal question 1: I think people should stop counting calories and just eat what they want
- Attitudinal question 9: I am very concerned about breathing in the smoke from other people's cigarettes
- Attitudinal question 11: I never worry about eating fatty foods
- Attitudinal question 5: I think the importance of taking regular exercise is overrated
- Attitudinal question 4: I don't worry about catching germs from other people

Factor 2

- Attitudinal question 6: I am concerned that sunbathing can trigger skin cancer
- Attitudinal question 2: I find reports about BSE in humans very disturbing
- Attitudinal question 8: I never worry about the effects of drinking alcohol
- Attitudinal question 10: I think it is very important to be well-informed about health matters
- Attitudinal question 7: I think it is very important to take notice of government health campaigns

Table A3.5 Factor analysis pattern matrix of parental health attitude questionnaire identifying four factors

	Factor 1	Factor 2	Factor 3	Factor 4
ATTQ10	.747			
ATTQ8	.708			
ATTQ7	.685			
ATTQ11	.536			
ATTQ2		.813		
ATTQ6		.786		
ATTQ1			.843	
ATTQ3			.690	
ATTQ5			.559	
ATTQ4				.896
ATTQ9				.416

Factor 1

Attitudinal question 10: I think it is very important to be well-informed about health matters
Attitudinal question 8: I never worry about the effects of drinking alcohol
Attitudinal question 7: I think it is very important to take notice of government health campaigns
Attitudinal question 11: I never worry about eating fatty foods

Factor 2

Attitudinal question 2: I find reports about BSE in humans very disturbing
Attitudinal question 6: I am concerned that sunbathing can trigger skin cancer

Factor 3

Attitudinal question 1: I think people should stop counting calories and just eat what they want
Attitudinal question 3: I believe it is very important to take care over my diet
Attitudinal question 5: I think the importance of taking regular exercise is overrated

Factor 4

Attitudinal question 4: I don't worry about catching germs from other people
Attitudinal question 9: I am very concerned about breathing in the smoke from other people's cigarettes

For *Section B*, an exploratory factor analysis using principal components analysis (PCA) with oblimin rotation was performed. The principal components analysis indicated three factors (eigenvalues greater than one) that accounted for the 54.5% of the variance. Reliability analysis gave a Cronbach $\alpha = 0.5220$. By deleting 5 items, Cronbach α increased to 0.6236.

A3.4 Questionnaire Development Study 3

A3.4.1 Method

Because of the low reliability of Section B, a final attempt was made to design a behavioural questionnaire in which four positive and four negative items were included (see end of Appendix). All the items indicated healthy and unhealthy behaviours such as eating habits (e.g. I eat red meat, I eat butter) and preventive health behaviours (e.g. I floss my teeth, I take vitamin supplements). This time, the items were rated on a six-point scale: *never, less than once per week, once per week, three times per week, five times per week, more than five times per week*. The questionnaires were administered to undergraduate and postgraduate students in the Department of Psychology at the University of Surrey. Forty five questionnaires were collected.

A3.4.2 Results

A reliability analysis was completed, which resulted in a very low Cronbach $\alpha = 0.0272$. The scores were then converted to z scores, and the reliability analysis was conducted on the new computed z scores. This resulted in a Cronbach $\alpha = 0.1730$. The lack of item intercorrelations suggested that the 8 items could not be treated as a single scale.

A3.5 Conclusions

Because of these difficulties in constructing a reliable instrument to measure health behaviours, it was decided to omit a measure of health behaviours from the final instrument. Instead, an additional section was added to the questionnaire concerning the existence of health-related objects in the home (see end of Appendix). This was added because it was thought that the presence of educational aids in the child's home environment, such as medical and health books, CD-roms, plastic skeletons, medical

and exercise equipment (e.g. medical thermometer and exercise bike), might affect on children's thinking in this domain. That is, children who are brought-up in an environment in which the importance of knowing about the human body and the ways in which it can be kept healthy is emphasised, might present a different understanding about illness from children who are brought-up in a less health-orientated environment.

Thus, the final redesigned parental questionnaire consisted of two sections: Section A concerning parental health attitudes and Section B concerning the presence of health-related objects at home (see end of Appendix). This questionnaire was then used in Study 4.

Questionnaire development Study 1

Parental Health attitudes and Behaviours Questionnaire

What is your relationship to the child? (please circle) Mother Father

Below is a series of statements. You will agree with some and disagree with others. Sometimes you may agree strongly and sometimes you may disagree strongly and sometimes you may be uncertain. Please respond to each statement by putting a ring around the number which is right for you. For example, if you strongly agree with a statement, put a ring around the number 5. If you are uncertain, put a ring around the number 3, and so on.

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1. I never take any physical exercise	5	4	3	2	1
2. My child needs to understand the importance of brushing his/her teeth every day	5	4	3	2	1
3. I worry about getting the right vitamins in my diet	5	4	3	2	1
4. I think regular dental checkups are important	5	4	3	2	1
5. I do not worry	5	4	3	2	1

about my child’s
diet

6. I think people should be more tolerant of smokers	5	4	3	2	1
7. I worry about whether my child remembers to wash his/her hands after going to the toilet	5	4	3	2	1
8. I use dental floss regularly	5	4	3	2	1
9. I’d rather not know too much about health matters	5	4	3	2	1
10. I’m always concerned about my weight	5	4	3	2	1
11. I’m careful about the amount of alcohol I drink	5	4	3	2	1

12. It is not important for my child to take regular exercise	5	4	3	2	1
13. I think dental flossing is a waste of time	5	4	3	2	1
14. I rarely weigh my self	5	4	3	2	1
15. I make sure that I eat a well-balanced diet	5	4	3	2	1
16. I do not worry about picking-up germs from other people	5	4	3	2	1
17. I think it is important to avoid artificial colourings in my child's diet	5	4	3	2	1
18. I do not take any vitamin supplements	5	4	3	2	1

19. I'm always interested in anything about health on television and in magazines and newspapers	5	4	3	2	1
20. I never worry about the effects of drinking alcohol	5	4	3	2	1
21. It is important to keep an eye on my child's weight	5	4	3	2	1
22. I stay away from people with coughs and colds	5	4	3	2	1
23. I believe it is important to take regular exercise	5	4	3	2	1
24. I only see the dentist when I have a toothache	5	4	3	2	1
25. I never think about the vitamins in my child's diet	5	4	3	2	1

26. I do not smoke	5	4	3	2	1
27. I do not worry about eating the right sort of food	5	4	3	2	1

Questionnaire development Study 2
Parental Health Attitudes and Behaviours Questionnaire
Section A

Below is a series of statements. You will agree with some and disagree with others. Sometimes you may agree strongly and sometimes you may disagree strongly and sometimes you may neither agree nor disagree. Please respond to each statement by putting a ring around the number which is right for you. For example, if you strongly agree with a statement, put a ring around the number 5. If you neither agree nor disagree, put a ring around number 3, and so on.

	Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
1. I think people should stop counting calories and just eat what they want	5	4	3	2	1
2. I find reports about BSE in humans very disturbing	5	4	3	2	1
3. I believe it is very important to take care over my diet	5	4	3	2	1

4. I do not worry about catching germs from other people	5	4	3	2	1
5. I think the importance of taking regular exercise is overrated	5	4	3	2	1
6. I am concerned that sunbathing can trigger skin cancer	5	4	3	2	1
7. I think it is very important to take notice of government health campaigns	5	4	3	2	1
8. I never worry about the effects of drinking alcohol	5	4	3	2	1
9. I am very concerned about breathing in the smoke from other people's cigarettes	5	4	3	2	1
10. I think it is very important to be well-informed about health matters	5	4	3	2	1

11. I never worry about eating fatty foods	5	4	3	2	1
--	---	---	---	---	---

Section B

Below is another series of statements about behaviours. Please circle the word which best describes how frequently you do each one.

1. I take some form of physical exercise	Never	Rarely	Sometimes	Often
2. I eat fried food	Never	Rarely	Sometimes	Often
3. I weigh myself	Never	Rarely	Sometimes	Often
4. I smoke	Never	Rarely	Sometimes	Often
5. I floss my teeth	Never	Rarely	Sometimes	Often
6. I eat butter	Never	Rarely	Sometimes	Often
7. I take vitamin supplements	Never	Rarely	Sometimes	Often
8. I eat 5 pieces of fruit or vegetables per day	Never	Rarely	Sometimes	Often
9. I eat red meat	Never	Rarely	Sometimes	Often
10. I use a high-factor sun cream	Never	Rarely	Sometimes	Often
11. I eat between meals	Never	Rarely	Sometimes	Often
12. I eat breakfast	Never	Rarely	Sometimes	Often

13. I drink more than the
recommended units of alcohol

Never Rarely Sometimes Often

Questionnaire Development Study 3
Parental Health Behaviour Questionnaire

Below is a series of statements about behaviours. For each statement, please tick the box which most closely describe how frequently you do each one.

	Never	less than once per week	once per week	three times per week	five times per week	more than five times per week
1. I take some form of physical exercise	[]	[]	[]	[]	[]	[]
2. I eat fried food	[]	[]	[]	[]	[]	[]
3. I weigh myself	[]	[]	[]	[]	[]	[]
4. I floss my teeth	[]	[]	[]	[]	[]	[]
5. I eat butter	[]	[]	[]	[]	[]	[]
6. I take vitamin supplements	[]	[]	[]	[]	[]	[]
7. I eat red meat	[]	[]	[]	[]	[]	[]
8. I drink alcohol	[]	[]	[]	[]	[]	[]

Health-related objects Questionnaire

Do you or your children have any of the following items in your home?

1. Medical book/encyclopedia	Yes []	No []
2. Children’s book about the human body	Yes []	No []
3. Plastic toy human skeleton	Yes []	No []
4. Computer programs about health or the body for children	Yes []	No []
5. Medical box/cabinet/cupboard	Yes []	No []
6. Medical thermometer (or other way of measuring body temperature)	Yes []	No []
7. Bathroom scales	Yes []	No []
8. Exercise bike/step/other exercise equipment	Yes []	No []

Parental Health Attitudes Questionnaire

Please give:

Your child’s full name

Your child’s date of birth

Your relationship to the child (please circle): mother/father/other

Section A

Below is a series of statements. You will agree with some and disagree with others. Sometimes you may agree strongly and sometimes you may disagree strongly and sometimes you may neither agree nor disagree. Please respond to each statement by putting a ring around the number which is right for you. For example, if you strongly agree with a statement, put a ring around the number 5. If you neither agree nor disagree, put a ring around number 3, and so on.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I think people should stop counting calories and just eat what they want	1	2	3	4	5
2. I find reports about BSE in humans very disturbing	1	2	3	4	5

3. I believe it is very important to take care over my diet	1	2	3	4	5
4. I do not worry about catching germs from other people	1	2	3	4	5
5. I think the importance of taking regular exercise is overrated	1	2	3	4	5
6. I am concerned that sunbathing can trigger skin cancer	1	2	3	4	5
7. I think it is very important to take notice of government health campaigns	1	2	3	4	5
8. I never worry about the effects of drinking alcohol	1	2	3	4	5
9. I am very concerned about breathing in the smoke from other people's cigarettes	1	2	3	4	5

10. I think it is very important to be well- informed about health matters	1	2	3	4	5
--	---	---	---	---	---

11. I never worry about eating fatty foods	1	2	3	4	5
--	---	---	---	---	---

Section B
Health-related objects Questionnaire

Do you or your children have any of the following items in your home?

1. Medical book/encyclopedia	Yes []	No []
2. Children’s book about the human body	Yes []	No []
3. Plastic toy human skeleton	Yes []	No []
4. Computer programs about health or the body for children	Yes []	No []
5. Medical box/cabinet/cupboard	Yes []	No []
6. Medical thermometer (or other way of measuring body temperature)	Yes []	No []
7. Bathroom scales	Yes []	No []
8. Exercise bike/step/other exercise equipment	Yes []	No []

Appendix 4
Chapter 5

GET

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EXECUTE .

GLM

humcpln mammcpli nmamcpli birdcpli plancpli handcpli BY gender exemplar

group2 hs

/WSFACTOR = category 6 Polynomial

/METHOD = SSTYPE(3)

/CRITERIA = ALPHA(.05)

/WSDESIGN = category

/DESIGN = gender exemplar group2 hs gender*exemplar gender*group2 exemplar

*group2 gender*exemplar*group2 gender*hs exemplar*hs gender*exemplar*hs

group2*hs gender*group2*hs exemplar*group2*hs gender*exemplar*group2*hs .

218

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMCPLIN
2	MAMMCPLI
3	NMAMCPLI
4	BIRDCPLI
5	PLANCPLI
6	HANDCPLI

Between-Subjects Factors

		Value Label	N
Child's gender	1.00	male	189
	2.00	female	192
Exemplar taught to the child (child:1, dog:2, duck:3)	1.00	child	135
	2.00	dog	128
	3.00	duck	118
GROUP2	1		163
	2		121
	3		97
variable for defining healthy and sick children from studies 3 &5	1.00	healthy children	291
	2.00	sick children	90

Effect		Value	F	Hypothesis df
CATEGORY	Pillai's Trace	.655	129.838 ^a	5.000
	Wilks' Lambda	.345	129.838 ^a	5.000
	Hotelling's Trace	1.898	129.838 ^a	5.000
	Roy's Largest Root	1.898	129.838 ^a	5.000
CATEGORY * GENDER	Pillai's Trace	.016	1.134 ^a	5.000
	Wilks' Lambda	.984	1.134 ^a	5.000
	Hotelling's Trace	.017	1.134 ^a	5.000
	Roy's Largest Root	.017	1.134 ^a	5.000
CATEGORY * EXEMPLAR	Pillai's Trace	.335	13.804	10.000
	Wilks' Lambda	.686	14.191 ^a	10.000
	Hotelling's Trace	.427	14.577	10.000
	Roy's Largest Root	.337	23.120 ^b	5.000
CATEGORY * GROUP2	Pillai's Trace	.105	3.807	10.000
	Wilks' Lambda	.897	3.812 ^a	10.000
	Hotelling's Trace	.112	3.817	10.000
	Roy's Largest Root	.078	5.359 ^b	5.000
CATEGORY * HS	Pillai's Trace	.009	.596 ^a	5.000
	Wilks' Lambda	.991	.596 ^a	5.000
	Hotelling's Trace	.009	.596 ^a	5.000
	Roy's Largest Root	.009	.596 ^a	5.000
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	.029	1.007	10.000
	Wilks' Lambda	.971	1.006 ^a	10.000
	Hotelling's Trace	.029	1.005	10.000
	Roy's Largest Root	.022	1.488 ^b	5.000
CATEGORY * GENDER * GROUP2	Pillai's Trace	.027	.943	10.000
	Wilks' Lambda	.973	.945 ^a	10.000
	Hotelling's Trace	.028	.947	10.000
	Roy's Largest Root	.026	1.751 ^b	5.000
CATEGORY * EXEMPLAR * GROUP2	Pillai's Trace	.038	.660	20.000
	Wilks' Lambda	.963	.657	20.000
	Hotelling's Trace	.038	.655	20.000
	Roy's Largest Root	.020	1.401 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * GROUP2	Pillai's Trace	.071	1.238	20.000
	Wilks' Lambda	.931	1.238	20.000
	Hotelling's Trace	.073	1.236	20.000
	Roy's Largest Root	.040	2.782 ^b	5.000
CATEGORY * GENDER * HS	Pillai's Trace	.014	.983 ^a	5.000
	Wilks' Lambda	.986	.983 ^a	5.000
	Hotelling's Trace	.014	.983 ^a	5.000
	Roy's Largest Root	.014	.983 ^a	5.000
CATEGORY * EXEMPLAR * HS	Pillai's Trace	.029	1.010	10.000
	Wilks' Lambda	.971	1.012 ^a	10.000
	Hotelling's Trace	.030	1.013	10.000
	Roy's Largest Root	.026	1.792 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * HS	Pillai's Trace	.039	1.353	10.000
	Wilks' Lambda	.962	1.354 ^a	10.000
	Hotelling's Trace	.040	1.355	10.000
	Roy's Largest Root	.032	2.191 ^b	5.000

Effect		Value	F	Hypothesis df
CATEGORY * GROUP2 * HS	Pillai's Trace	.032	1.127	10.000
	Wilks' Lambda	.968	1.129 ^a	10.000
	Hotelling's Trace	.033	1.131	10.000
	Roy's Largest Root	.029	1.986 ^b	5.000
CATEGORY * GENDER * GROUP2 * HS	Pillai's Trace	.022	.769	10.000
	Wilks' Lambda	.978	.767 ^a	10.000
	Hotelling's Trace	.022	.766	10.000
	Roy's Largest Root	.015	1.031 ^b	5.000
CATEGORY * EXEMPLAR * GROUP2 * HS	Pillai's Trace	.047	.824	20.000
	Wilks' Lambda	.953	.823	20.000
	Hotelling's Trace	.048	.822	20.000
	Roy's Largest Root	.029	1.996 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Pillai's Trace	.027	.629	15.000
	Wilks' Lambda	.973	.627	15.000
	Hotelling's Trace	.028	.625	15.000
	Roy's Largest Root	.016	1.125 ^b	5.000

Effect		Error df	Sig.
CATEGORY	Pillai's Trace	342.000	.000
	Wilks' Lambda	342.000	.000
	Hotelling's Trace	342.000	.000
	Roy's Largest Root	342.000	.000
CATEGORY * GENDER	Pillai's Trace	342.000	.342
	Wilks' Lambda	342.000	.342
	Hotelling's Trace	342.000	.342
	Roy's Largest Root	342.000	.342
CATEGORY * EXEMPLAR	Pillai's Trace	686.000	.000
	Wilks' Lambda	684.000	.000
	Hotelling's Trace	682.000	.000
	Roy's Largest Root	343.000	.000
CATEGORY * GROUP2	Pillai's Trace	686.000	.000
	Wilks' Lambda	684.000	.000
	Hotelling's Trace	682.000	.000
	Roy's Largest Root	343.000	.000
CATEGORY * HS	Pillai's Trace	342.000	.703
	Wilks' Lambda	342.000	.703
	Hotelling's Trace	342.000	.703
	Roy's Largest Root	342.000	.703
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	686.000	.435
	Wilks' Lambda	684.000	.436
	Hotelling's Trace	682.000	.438
	Roy's Largest Root	343.000	.193
CATEGORY * GENDER * GROUP2	Pillai's Trace	686.000	.492
	Wilks' Lambda	684.000	.491
	Hotelling's Trace	682.000	.489
	Roy's Largest Root	343.000	.122
CATEGORY * EXEMPLAR * GROUP2	Pillai's Trace	1380.000	.868
	Wilks' Lambda	1135.236	.870
	Hotelling's Trace	1362.000	.872
	Roy's Largest Root	345.000	.223
CATEGORY * GENDER * EXEMPLAR * GROUP2	Pillai's Trace	1380.000	.213
	Wilks' Lambda	1135.236	.214
	Hotelling's Trace	1362.000	.215
	Roy's Largest Root	345.000	.018
CATEGORY * GENDER * HS	Pillai's Trace	342.000	.428
	Wilks' Lambda	342.000	.428
	Hotelling's Trace	342.000	.428
	Roy's Largest Root	342.000	.428
CATEGORY * EXEMPLAR * HS	Pillai's Trace	686.000	.433
	Wilks' Lambda	684.000	.432
	Hotelling's Trace	682.000	.430
	Roy's Largest Root	343.000	.114
CATEGORY * GENDER * EXEMPLAR * HS	Pillai's Trace	686.000	.198
	Wilks' Lambda	684.000	.198
	Hotelling's Trace	682.000	.197
	Roy's Largest Root	343.000	.055

Effect		Error df	Sig.
CATEGORY * GROUP2 * HS	Pillai's Trace	686.000	.339
	Wilks' Lambda	684.000	.337
	Hotelling's Trace	682.000	.336
	Roy's Largest Root	343.000	.080
CATEGORY * GENDER * GROUP2 * HS	Pillai's Trace	686.000	.659
	Wilks' Lambda	684.000	.660
	Hotelling's Trace	682.000	.662
	Roy's Largest Root	343.000	.399
CATEGORY * EXEMPLAR * GROUP2 * HS	Pillai's Trace	1380.000	.686
	Wilks' Lambda	1135.236	.687
	Hotelling's Trace	1362.000	.688
	Roy's Largest Root	345.000	.079
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Pillai's Trace	1032.000	.853
	Wilks' Lambda	944.513	.855
	Hotelling's Trace	1022.000	.856
	Roy's Largest Root	344.000	.347

- a. Exact statistic
- b. The statistic is an upper bound on F that yields a lower bound on the significance level.
- c. Design: Intercept+GENDER+EXEMPLAR+GROUP2+HS+GENDER * EXEMPLAR+GENDER * GROUP2+EXEMPLAR * GROUP2+GENDER * EXEMPLAR * GROUP2+GENDER * HS+EXEMPLAR * HS+GENDER * EXEMPLAR * HS+GROUP2 * HS+GENDER * GROUP2 * HS+EXEMPLAR * GROUP2 * HS+GENDER * EXEMPLAR * GROUP2 * HS
Within Subjects Design: CATEGORY

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Mauchly's W	Approx. Chi-Square	df	Sig.
Within Subjects Effect				
CATEGORY	.193	566.343	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Measure: MEASURE_1

Within Subjects Effect	Epsilon ^a		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
CATEGORY	.666	.739	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b. Design: Intercept+GENDER+EXEMPLAR+GROUP2+HS+GENDER * EXEMPLAR+GENDER * GROUP2+EXEMPLAR * GROUP2+GENDER * EXEMPLAR * GROUP2+GENDER * HS+EXEMPLAR * HS+GENDER * EXEMPLAR * HS+GROUP2 * HS+GENDER * GROUP2 * HS+EXEMPLAR * GROUP2 * HS+GENDER * EXEMPLAR * GROUP2 * HS
Within Subjects Design: CATEGORY

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	1417.888	5	283.578
	Greenhouse-Geisser	1417.888	3.330	425.762
	Huynh-Feldt	1417.888	3.697	383.533
	Lower-bound	1417.888	1.000	1417.888
CATEGORY * GENDER	Sphericity Assumed	17.880	5	3.576
	Greenhouse-Geisser	17.880	3.330	5.369
	Huynh-Feldt	17.880	3.697	4.836
	Lower-bound	17.880	1.000	17.880
CATEGORY * EXEMPLAR	Sphericity Assumed	411.962	10	41.196
	Greenhouse-Geisser	411.962	6.660	61.852
	Huynh-Feldt	411.962	7.394	55.717
	Lower-bound	411.962	2.000	205.981
CATEGORY * GROUP2	Sphericity Assumed	70.413	10	7.041
	Greenhouse-Geisser	70.413	6.660	10.572
	Huynh-Feldt	70.413	7.394	9.523
	Lower-bound	70.413	2.000	35.206
CATEGORY * HS	Sphericity Assumed	4.867	5	.973
	Greenhouse-Geisser	4.867	3.330	1.461
	Huynh-Feldt	4.867	3.697	1.316
	Lower-bound	4.867	1.000	4.867
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	15.061	10	1.506
	Greenhouse-Geisser	15.061	6.660	2.261
	Huynh-Feldt	15.061	7.394	2.037
	Lower-bound	15.061	2.000	7.530
CATEGORY * GENDER * GROUP2	Sphericity Assumed	11.368	10	1.137
	Greenhouse-Geisser	11.368	6.660	1.707
	Huynh-Feldt	11.368	7.394	1.537
	Lower-bound	11.368	2.000	5.684
CATEGORY * EXEMPLAR * GROUP2	Sphericity Assumed	23.363	20	1.168
	Greenhouse-Geisser	23.363	13.321	1.754
	Huynh-Feldt	23.363	14.788	1.580
	Lower-bound	23.363	4.000	5.841
CATEGORY * GENDER * EXEMPLAR * GROUP2	Sphericity Assumed	30.435	20	1.522
	Greenhouse-Geisser	30.435	13.321	2.285
	Huynh-Feldt	30.435	14.788	2.058
	Lower-bound	30.435	4.000	7.609
CATEGORY * GENDER * HS	Sphericity Assumed	9.020	5	1.804
	Greenhouse-Geisser	9.020	3.330	2.708
	Huynh-Feldt	9.020	3.697	2.440
	Lower-bound	9.020	1.000	9.020
CATEGORY * EXEMPLAR * HS	Sphericity Assumed	13.611	10	1.361
	Greenhouse-Geisser	13.611	6.660	2.044
	Huynh-Feldt	13.611	7.394	1.841
	Lower-bound	13.611	2.000	6.806
CATEGORY * GENDER * EXEMPLAR * HS	Sphericity Assumed	22.769	10	2.277
	Greenhouse-Geisser	22.769	6.660	3.418
	Huynh-Feldt	22.769	7.394	3.079
	Lower-bound	22.769	2.000	11.384

Source		Type III Sum of Squares	df	Mean Square
CATEGORY * GROUP2 * HS	Sphericity Assumed	19.101	10	1.910
	Greenhouse-Geisser	19.101	6.660	2.868
	Huynh-Feldt	19.101	7.394	2.583
	Lower-bound	19.101	2.000	9.551
CATEGORY * GENDER * GROUP2 * HS	Sphericity Assumed	13.676	10	1.368
	Greenhouse-Geisser	13.676	6.660	2.053
	Huynh-Feldt	13.676	7.394	1.850
	Lower-bound	13.676	2.000	6.838
CATEGORY * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	16.119	20	.806
	Greenhouse-Geisser	16.119	13.321	1.210
	Huynh-Feldt	16.119	14.788	1.090
	Lower-bound	16.119	4.000	4.030
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	11.153	15	.744
	Greenhouse-Geisser	11.153	9.991	1.116
	Huynh-Feldt	11.153	11.091	1.006
	Lower-bound	11.153	3.000	3.718
Error(CATEGORY)	Sphericity Assumed	2921.703	1730	1.689
	Greenhouse-Geisser	2921.703	1152.263	2.536
	Huynh-Feldt	2921.703	1279.133	2.284
	Lower-bound	2921.703	346.000	8.444

Measure: MEASURE_1

Source		F	Sig.
CATEGORY	Sphericity Assumed	167.912	.000
	Greenhouse-Geisser	167.912	.000
	Huynh-Feldt	167.912	.000
	Lower-bound	167.912	.000
CATEGORY * GENDER	Sphericity Assumed	2.117	.061
	Greenhouse-Geisser	2.117	.089
	Huynh-Feldt	2.117	.082
	Lower-bound	2.117	.147
CATEGORY * EXEMPLAR	Sphericity Assumed	24.393	.000
	Greenhouse-Geisser	24.393	.000
	Huynh-Feldt	24.393	.000
	Lower-bound	24.393	.000
CATEGORY * GROUP2	Sphericity Assumed	4.169	.000
	Greenhouse-Geisser	4.169	.000
	Huynh-Feldt	4.169	.000
	Lower-bound	4.169	.016
CATEGORY * HS	Sphericity Assumed	.576	.718
	Greenhouse-Geisser	.576	.648
	Huynh-Feldt	.576	.666
	Lower-bound	.576	.448
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	.892	.540
	Greenhouse-Geisser	.892	.508
	Huynh-Feldt	.892	.516
	Lower-bound	.892	.411
CATEGORY * GENDER * GROUP2	Sphericity Assumed	.673	.750
	Greenhouse-Geisser	.673	.687
	Huynh-Feldt	.673	.703
	Lower-bound	.673	.511
CATEGORY * EXEMPLAR * GROUP2	Sphericity Assumed	.692	.838
	Greenhouse-Geisser	.692	.777
	Huynh-Feldt	.692	.793
	Lower-bound	.692	.598
CATEGORY * GENDER * EXEMPLAR * GROUP2	Sphericity Assumed	.901	.586
	Greenhouse-Geisser	.901	.553
	Huynh-Feldt	.901	.562
	Lower-bound	.901	.463
CATEGORY * GENDER * HS	Sphericity Assumed	1.068	.376
	Greenhouse-Geisser	1.068	.365
	Huynh-Feldt	1.068	.369
	Lower-bound	1.068	.302
CATEGORY * EXEMPLAR * HS	Sphericity Assumed	.806	.623
	Greenhouse-Geisser	.806	.577
	Huynh-Feldt	.806	.588
	Lower-bound	.806	.448
CATEGORY * GENDER * EXEMPLAR * HS	Sphericity Assumed	1.348	.199
	Greenhouse-Geisser	1.348	.227
	Huynh-Feldt	1.348	.220
	Lower-bound	1.348	.261

Tests of Within-Subjects Effects

Measure: MEASURE_1

227

Source		F	Sig.
CATEGORY * GROUP2 * HS	Sphericity Assumed	1.131	.335
	Greenhouse-Geisser	1.131	.341
	Huynh-Feldt	1.131	.340
	Lower-bound	1.131	.324
CATEGORY * GENDER * GROUP2 * HS	Sphericity Assumed	.810	.619
	Greenhouse-Geisser	.810	.574
	Huynh-Feldt	.810	.585
	Lower-bound	.810	.446
CATEGORY * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	.477	.975
	Greenhouse-Geisser	.477	.941
	Huynh-Feldt	.477	.951
	Lower-bound	.477	.752
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	.440	.967
	Greenhouse-Geisser	.440	.927
	Huynh-Feldt	.440	.939
	Lower-bound	.440	.724
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	1042.700	1	1042.700	444.653	.000
	Quadratic	118.311	1	118.311	44.270	.000
	Cubic	3.191	1	3.191	2.513	.114
	Order 4	57.268	1	57.268	60.732	.000
	Order 5	196.418	1	196.418	161.779	.000
CATEGORY * GENDER	Linear	2.997E-02	1	2.997E-02	.013	.910
	Quadratic	12.182	1	12.182	4.558	.033
	Cubic	5.564	1	5.564	4.382	.037
	Order 4	7.197E-02	1	7.197E-02	.076	.783
	Order 5	3.177E-02	1	3.177E-02	.026	.872
CATEGORY * EXEMPLAR	Linear	28.549	2	14.274	6.087	.003
	Quadratic	225.837	2	112.919	42.252	.000
	Cubic	97.532	2	48.766	38.408	.000
	Order 4	25.839	2	12.919	13.701	.000
	Order 5	34.205	2	17.103	14.086	.000
CATEGORY * GROUP2	Linear	12.729	2	6.365	2.714	.068
	Quadratic	20.894	2	10.447	3.909	.021
	Cubic	6.718	2	3.359	2.646	.072
	Order 4	6.519	2	3.260	3.457	.033
	Order 5	23.552	2	11.776	9.699	.000

Tests of Within-Subjects Contrasts

228

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY * HS	Linear	.326	1	.326	.139	.709
	Quadratic	1.000	1	1.000	.374	.541
	Cubic	.459	1	.459	.361	.548
	Order 4	.710	1	.710	.753	.386
	Order 5	2.372	1	2.372	1.953	.163
CATEGORY * GENDER * EXEMPLAR	Linear	3.799	2	1.900	.810	.446
	Quadratic	5.213	2	2.607	.975	.378
	Cubic	1.076	2	.538	.424	.655
	Order 4	2.946	2	1.473	1.562	.211
	Order 5	2.027	2	1.013	.835	.435
CATEGORY * GENDER * GROUP2	Linear	.204	2	.102	.044	.957
	Quadratic	10.144	2	5.072	1.898	.151
	Cubic	8.277E-02	2	4.139E-02	.033	.968
	Order 4	.489	2	.244	.259	.772
	Order 5	.448	2	.224	.185	.831
CATEGORY * EXEMPLAR * GROUP2	Linear	8.820	4	2.205	.940	.441
	Quadratic	9.565	4	2.391	.895	.467
	Cubic	1.049	4	.262	.207	.935
	Order 4	2.172	4	.543	.576	.680
	Order 5	1.758	4	.439	.362	.836
CATEGORY * GENDER * EXEMPLAR * GROUP2	Linear	8.404	4	2.101	.896	.466
	Quadratic	9.881	4	2.470	.924	.450
	Cubic	4.417	4	1.104	.870	.482
	Order 4	1.765	4	.441	.468	.759
	Order 5	5.969	4	1.492	1.229	.298
CATEGORY * GENDER * HS	Linear	3.739	1	3.739	1.594	.208
	Quadratic	4.109	1	4.109	1.537	.216
	Cubic	.386	1	.386	.304	.582
	Order 4	.784	1	.784	.831	.363
	Order 5	3.086E-03	1	3.086E-03	.003	.960
CATEGORY * EXEMPLAR * HS	Linear	.852	2	.426	.182	.834
	Quadratic	2.293	2	1.147	.429	.652
	Cubic	5.039	2	2.519	1.984	.139
	Order 4	4.501	2	2.250	2.387	.093
	Order 5	.926	2	.463	.381	.683
CATEGORY * GENDER * EXEMPLAR * HS	Linear	2.000	2	1.000	.426	.653
	Quadratic	10.549	2	5.274	1.974	.141
	Cubic	1.716	2	.858	.676	.509
	Order 4	6.194	2	3.097	3.284	.039
	Order 5	2.311	2	1.155	.952	.387
CATEGORY * GROUP2 * HS	Linear	3.275	2	1.638	.698	.498
	Quadratic	8.650	2	4.325	1.618	.200
	Cubic	.949	2	.475	.374	.688
	Order 4	2.978	2	1.489	1.579	.208
	Order 5	3.249	2	1.624	1.338	.264

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY * GENDER * GROUP2 * HS	Linear	.487	2	.243	.104	.901
	Quadratic	8.398	2	4.199	1.571	.209
	Cubic	.501	2	.251	.197	.821
	Order 4	1.119	2	.560	.594	.553
	Order 5	3.170	2	1.585	1.305	.272
CATEGORY * EXEMPLAR * GROUP2 * HS	Linear	4.783	4	1.196	.510	.729
	Quadratic	4.782	4	1.196	.447	.774
	Cubic	1.820	4	.455	.358	.838
	Order 4	.833	4	.208	.221	.927
	Order 5	3.902	4	.975	.803	.524
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Linear	3.126	3	1.042	.444	.721
	Quadratic	1.499	3	.500	.187	.905
	Cubic	2.561	3	.854	.672	.569
	Order 4	1.906	3	.635	.674	.569
	Order 5	2.061	3	.687	.566	.638
Error(CATEGORY)	Linear	811.361	346	2.345		
	Quadratic	924.679	346	2.672		
	Cubic	439.314	346	1.270		
	Order 4	326.266	346	.943		
	Order 5	420.083	346	1.214		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	3497.997	1	3497.997	768.844	.000
GENDER	3.576	1	3.576	.786	.376
EXEMPLAR	24.039	2	12.019	2.642	.073
GROUP2	3.708E-02	2	1.854E-02	.004	.996
HS	.771	1	.771	.169	.681
GENDER * EXEMPLAR	18.596	2	9.298	2.044	.131
GENDER * GROUP2	8.959	2	4.480	.985	.375
EXEMPLAR * GROUP2	18.191	4	4.548	1.000	.408
GENDER * EXEMPLAR * GROUP2	17.382	4	4.346	.955	.432
GENDER * HS	13.020	1	13.020	2.862	.092
EXEMPLAR * HS	5.606	2	2.803	.616	.541
GENDER * EXEMPLAR * HS	11.407	2	5.704	1.254	.287
GROUP2 * HS	.478	2	.239	.052	.949
GENDER * GROUP2 * HS	10.796	2	5.398	1.186	.307
EXEMPLAR * GROUP2 * HS	28.093	4	7.023	1.544	.189
GENDER * EXEMPLAR * GROUP2 * HS	.991	3	.330	.073	.975
Error	1574.190	346	4.550		

GLM

humctpli mammctpl nmamctpl birdctpl planctpl handctpl BY gender exemplar group2 hs /WSFACTOR = category 6 Polynomial /METHOD = SSTYPE(3) /CRITERIA = ALPHA(.05) /WSDSIGN = category /DESIGN = gender exemplar group2 hs gender*exemplar gender*group2 exemplar*group2 gender*exemplar*group2 gender*hs exemplar*hs gender*exemplar*hs group2*hs gender*group2*hs exemplar*group2*hs gender*exemplar*group2*hs .

230

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMCTPLI
2	MAMMCTPL
3	NMAMCTPL
4	BIRDCTPL
5	PLANCTPL
6	HANDCTPL

Between-Subjects Factors

		Value Label	N
Child's gender	1.00	male	189
	2.00	female	192
Exemplar taught to the child (child:1, dog:2, duck:3)	1.00	child	135
	2.00	dog	128
	3.00	duck	118
GROUP2	.1		163
	2		121
	3		97
variable for defining healthy and sick children from studies 3 &5	1.00	healthy children	291
	2.00	sick children	90

Effect		Value	F	Hypothesis df
CATEGORY	Pillai's Trace	.671	139.556 ^a	5.000
	Wilks' Lambda	.329	139.556 ^a	5.000
	Hotelling's Trace	2.040	139.556 ^a	5.000
	Roy's Largest Root	2.040	139.556 ^a	5.000
CATEGORY * GENDER	Pillai's Trace	.022	1.554 ^a	5.000
	Wilks' Lambda	.978	1.554 ^a	5.000
	Hotelling's Trace	.023	1.554 ^a	5.000
	Roy's Largest Root	.023	1.554 ^a	5.000
CATEGORY * EXEMPLAR	Pillai's Trace	.295	11.877	10.000
	Wilks' Lambda	.720	12.194 ^a	10.000
	Hotelling's Trace	.367	12.510	10.000
	Roy's Largest Root	.294	20.159 ^b	5.000
CATEGORY * GROUP2	Pillai's Trace	.099	3.577	10.000
	Wilks' Lambda	.903	3.572 ^a	10.000
	Hotelling's Trace	.105	3.567	10.000
	Roy's Largest Root	.065	4.467 ^b	5.000
CATEGORY * HS	Pillai's Trace	.017	1.187 ^a	5.000
	Wilks' Lambda	.983	1.187 ^a	5.000
	Hotelling's Trace	.017	1.187 ^a	5.000
	Roy's Largest Root	.017	1.187 ^a	5.000
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	.009	.327	10.000
	Wilks' Lambda	.991	.326 ^a	10.000
	Hotelling's Trace	.010	.326	10.000
	Roy's Largest Root	.008	.576 ^b	5.000
CATEGORY * GENDER * GROUP2	Pillai's Trace	.023	.789	10.000
	Wilks' Lambda	.977	.790 ^a	10.000
	Hotelling's Trace	.023	.791	10.000
	Roy's Largest Root	.021	1.473 ^b	5.000
CATEGORY * EXEMPLAR * GROUP2	Pillai's Trace	.063	1.098	20.000
	Wilks' Lambda	.938	1.098	20.000
	Hotelling's Trace	.065	1.098	20.000
	Roy's Largest Root	.041	2.828 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * GROUP2	Pillai's Trace	.062	1.088	20.000
	Wilks' Lambda	.939	1.084	20.000
	Hotelling's Trace	.063	1.080	20.000
	Roy's Largest Root	.030	2.061 ^b	5.000
CATEGORY * GENDER * HS	Pillai's Trace	.010	.674 ^a	5.000
	Wilks' Lambda	.990	.674 ^a	5.000
	Hotelling's Trace	.010	.674 ^a	5.000
	Roy's Largest Root	.010	.674 ^a	5.000
CATEGORY * EXEMPLAR * HS	Pillai's Trace	.043	1.511	10.000
	Wilks' Lambda	.957	1.515 ^a	10.000
	Hotelling's Trace	.045	1.518	10.000
	Roy's Largest Root	.038	2.601 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * HS	Pillai's Trace	.028	.984	10.000
	Wilks' Lambda	.972	.986 ^a	10.000
	Hotelling's Trace	.029	.989	10.000
	Roy's Largest Root	.027	1.853 ^b	5.000

Effect		Value	F	Hypothesis df
CATEGORY * GROUP2 * HS	Pillai's Trace	.036	1.249	10.000
	Wilks' Lambda	.964	1.253 ^a	10.000
	Hotelling's Trace	.037	1.257	10.000
	Roy's Largest Root	.033	2.287 ^b	5.000
CATEGORY * GENDER * GROUP2 * HS	Pillai's Trace	.019	.674	10.000
	Wilks' Lambda	.981	.674 ^a	10.000
	Hotelling's Trace	.020	.675	10.000
	Roy's Largest Root	.018	1.255 ^b	5.000
CATEGORY * EXEMPLAR * GROUP2 * HS	Pillai's Trace	.046	.801	20.000
	Wilks' Lambda	.955	.798	20.000
	Hotelling's Trace	.047	.796	20.000
	Roy's Largest Root	.023	1.582 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Pillai's Trace	.033	.759	15.000
	Wilks' Lambda	.968	.758	15.000
	Hotelling's Trace	.033	.757	15.000
	Roy's Largest Root	.023	1.579 ^b	5.000

Effect		Error df	Sig.
CATEGORY	Pillai's Trace	342.000	.000
	Wilks' Lambda	342.000	.000
	Hotelling's Trace	342.000	.000
	Roy's Largest Root	342.000	.000
CATEGORY * GENDER	Pillai's Trace	342.000	.173
	Wilks' Lambda	342.000	.173
	Hotelling's Trace	342.000	.173
	Roy's Largest Root	342.000	.173
CATEGORY * EXEMPLAR	Pillai's Trace	686.000	.000
	Wilks' Lambda	684.000	.000
	Hotelling's Trace	682.000	.000
	Roy's Largest Root	343.000	.000
CATEGORY * GROUP2	Pillai's Trace	686.000	.000
	Wilks' Lambda	684.000	.000
	Hotelling's Trace	682.000	.000
	Roy's Largest Root	343.000	.001
CATEGORY * HS	Pillai's Trace	342.000	.315
	Wilks' Lambda	342.000	.315
	Hotelling's Trace	342.000	.315
	Roy's Largest Root	342.000	.315
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	686.000	.974
	Wilks' Lambda	684.000	.974
	Hotelling's Trace	682.000	.974
	Roy's Largest Root	343.000	.718
CATEGORY * GENDER * GROUP2	Pillai's Trace	686.000	.640
	Wilks' Lambda	684.000	.639
	Hotelling's Trace	682.000	.638
	Roy's Largest Root	343.000	.198
CATEGORY * EXEMPLAR * GROUP2	Pillai's Trace	1380.000	.345
	Wilks' Lambda	1135.236	.344
	Hotelling's Trace	1362.000	.344
	Roy's Largest Root	345.000	.016
CATEGORY * GENDER * EXEMPLAR * GROUP2	Pillai's Trace	1380.000	.356
	Wilks' Lambda	1135.236	.360
	Hotelling's Trace	1362.000	.364
	Roy's Largest Root	345.000	.070
CATEGORY * GENDER * HS	Pillai's Trace	342.000	.644
	Wilks' Lambda	342.000	.644
	Hotelling's Trace	342.000	.644
	Roy's Largest Root	342.000	.644
CATEGORY * EXEMPLAR * HS	Pillai's Trace	686.000	.131
	Wilks' Lambda	684.000	.130
	Hotelling's Trace	682.000	.128
	Roy's Largest Root	343.000	.025
CATEGORY * GENDER * EXEMPLAR * HS	Pillai's Trace	686.000	.456
	Wilks' Lambda	684.000	.454
	Hotelling's Trace	682.000	.452
	Roy's Largest Root	343.000	.102

Effect		Error df	Sig.
CATEGORY * GROUP2 * HS	Pillai's Trace	686.000	.256
	Wilks' Lambda	684.000	.254
	Hotelling's Trace	682.000	.252
	Roy's Largest Root	343.000	.046
CATEGORY * GENDER * GROUP2 * HS	Pillai's Trace	686.000	.749
	Wilks' Lambda	684.000	.749
	Hotelling's Trace	682.000	.749
	Roy's Largest Root	343.000	.283
CATEGORY * EXEMPLAR * GROUP2 * HS	Pillai's Trace	1380.000	.715
	Wilks' Lambda	1135.236	.718
	Hotelling's Trace	1362.000	.720
	Roy's Largest Root	345.000	.164
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Pillai's Trace	1032.000	.724
	Wilks' Lambda	944.513	.726
	Hotelling's Trace	1022.000	.727
	Roy's Largest Root	344.000	.165

- a. Exact statistic
- b. The statistic is an upper bound on F that yields a lower bound on the significance level.
- c. Design: Intercept+GENDER+EXEMPLAR+GROUP2+HS+GENDER * EXEMPLAR+GENDER * GROUP2+EXEMPLAR * GROUP2+GENDER * EXEMPLAR * GROUP2+GENDER * HS+EXEMPLAR * HS+GENDER * EXEMPLAR * HS+GROUP2 * HS+GENDER * GROUP2 * HS+EXEMPLAR * GROUP2 * HS+GENDER * EXEMPLAR * GROUP2 * HS
Within Subjects Design: CATEGORY

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Mauchly's W	Approx. Chi-Square	df	Sig.
Within Subjects Effect				
CATEGORY	.245	484.422	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Measure: MEASURE_1

	Epsilon ^a		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Within Subjects Effect			
CATEGORY	.670	.744	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b. Design: Intercept+GENDER+EXEMPLAR+GROUP2+HS+GENDER * EXEMPLAR+GENDER * GROUP2+EXEMPLAR * GROUP2+GENDER * EXEMPLAR * GROUP2+GENDER * HS+EXEMPLAR * HS+GENDER * EXEMPLAR * HS+GROUP2 * HS+GENDER * GROUP2 * HS+EXEMPLAR * GROUP2 * HS+GENDER * EXEMPLAR * GROUP2 * HS
Within Subjects Design: CATEGORY

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	1543.129	5	308.626
	Greenhouse-Geisser	1543.129	3.349	460.738
	Huynh-Feldt	1543.129	3.718	415.013
	Lower-bound	1543.129	1.000	1543.129
CATEGORY * GENDER	Sphericity Assumed	16.732	.5	3.346
	Greenhouse-Geisser	16.732	3.349	4.996
	Huynh-Feldt	16.732	3.718	4.500
	Lower-bound	16.732	1.000	16.732
CATEGORY * EXEMPLAR	Sphericity Assumed	344.101	10	34.410
	Greenhouse-Geisser	344.101	6.699	51.370
	Huynh-Feldt	344.101	7.437	46.272
	Lower-bound	344.101	2.000	172.050
CATEGORY * GROUP2	Sphericity Assumed	57.817	10	5.782
	Greenhouse-Geisser	57.817	6.699	8.631
	Huynh-Feldt	57.817	7.437	7.775
	Lower-bound	57.817	2.000	28.909
CATEGORY * HS	Sphericity Assumed	10.668	5	2.134
	Greenhouse-Geisser	10.668	3.349	3.185
	Huynh-Feldt	10.668	3.718	2.869
	Lower-bound	10.668	1.000	10.668
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	5.338	10	.534
	Greenhouse-Geisser	5.338	6.699	.797
	Huynh-Feldt	5.338	7.437	.718
	Lower-bound	5.338	2.000	2.669
CATEGORY * GENDER * GROUP2	Sphericity Assumed	12.287	10	1.229
	Greenhouse-Geisser	12.287	6.699	1.834
	Huynh-Feldt	12.287	7.437	1.652
	Lower-bound	12.287	2.000	6.143
CATEGORY * EXEMPLAR * GROUP2	Sphericity Assumed	27.366	20	1.368
	Greenhouse-Geisser	27.366	13.397	2.043
	Huynh-Feldt	27.366	14.873	1.840
	Lower-bound	27.366	4.000	6.841
CATEGORY * GENDER * EXEMPLAR * GROUP2	Sphericity Assumed	32.197	20	1.610
	Greenhouse-Geisser	32.197	13.397	2.403
	Huynh-Feldt	32.197	14.873	2.165
	Lower-bound	32.197	4.000	8.049
CATEGORY * GENDER * HS	Sphericity Assumed	8.669	5	1.734
	Greenhouse-Geisser	8.669	3.349	2.588
	Huynh-Feldt	8.669	3.718	2.332
	Lower-bound	8.669	1.000	8.669
CATEGORY * EXEMPLAR * HS	Sphericity Assumed	18.140	10	1.814
	Greenhouse-Geisser	18.140	6.699	2.708
	Huynh-Feldt	18.140	7.437	2.439
	Lower-bound	18.140	2.000	9.070
CATEGORY * GENDER * EXEMPLAR * HS	Sphericity Assumed	15.842	10	1.584
	Greenhouse-Geisser	15.842	6.699	2.365
	Huynh-Feldt	15.842	7.437	2.130
	Lower-bound	15.842	2.000	7.921

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY * GROUP2 * HS	Sphericity Assumed	11.025	10	1.102
	Greenhouse-Geisser	11.025	6.699	1.646
	Huynh-Feldt	11.025	7.437	1.483
	Lower-bound	11.025	2.000	5.512
CATEGORY * GENDER * GROUP2 * HS	Sphericity Assumed	10.333	10	1.033
	Greenhouse-Geisser	10.333	6.699	1.543
	Huynh-Feldt	10.333	7.437	1.389
	Lower-bound	10.333	2.000	5.166
CATEGORY * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	20.124	20	1.006
	Greenhouse-Geisser	20.124	13.397	1.502
	Huynh-Feldt	20.124	14.873	1.353
	Lower-bound	20.124	4.000	5.031
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	16.479	15	1.099
	Greenhouse-Geisser	16.479	10.048	1.640
	Huynh-Feldt	16.479	11.155	1.477
	Lower-bound	16.479	3.000	5.493
Error(CATEGORY)	Sphericity Assumed	2950.642	1730	1.706
	Greenhouse-Geisser	2950.642	1158.843	2.546
	Huynh-Feldt	2950.642	1286.520	2.294
	Lower-bound	2950.642	346.000	8.528

Measure: MEASURE_1

Source		F	Sig.
CATEGORY	Sphericity Assumed	180.951	.000
	Greenhouse-Geisser	180.951	.000
	Huynh-Feldt	180.951	.000
	Lower-bound	180.951	.000
CATEGORY * GENDER	Sphericity Assumed	1.962	.081
	Greenhouse-Geisser	1.962	.111
	Huynh-Feldt	1.962	.103
	Lower-bound	1.962	.162
CATEGORY * EXEMPLAR	Sphericity Assumed	20.175	.000
	Greenhouse-Geisser	20.175	.000
	Huynh-Feldt	20.175	.000
	Lower-bound	20.175	.000
CATEGORY * GROUP2	Sphericity Assumed	3.390	.000
	Greenhouse-Geisser	3.390	.002
	Huynh-Feldt	3.390	.001
	Lower-bound	3.390	.035
CATEGORY * HS	Sphericity Assumed	1.251	.283
	Greenhouse-Geisser	1.251	.290
	Huynh-Feldt	1.251	.288
	Lower-bound	1.251	.264
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	.313	.978
	Greenhouse-Geisser	.313	.944
	Huynh-Feldt	.313	.955
	Lower-bound	.313	.731
CATEGORY * GENDER * GROUP2	Sphericity Assumed	.720	.706
	Greenhouse-Geisser	.720	.649
	Huynh-Feldt	.720	.663
	Lower-bound	.720	.487
CATEGORY * EXEMPLAR * GROUP2	Sphericity Assumed	.802	.713
	Greenhouse-Geisser	.802	.662
	Huynh-Feldt	.802	.675
	Lower-bound	.802	.524
CATEGORY * GENDER * EXEMPLAR * GROUP2	Sphericity Assumed	.944	.530
	Greenhouse-Geisser	.944	.508
	Huynh-Feldt	.944	.514
	Lower-bound	.944	.439
CATEGORY * GENDER * HS	Sphericity Assumed	1.017	.406
	Greenhouse-Geisser	1.017	.390
	Huynh-Feldt	1.017	.394
	Lower-bound	1.017	.314
CATEGORY * EXEMPLAR * HS	Sphericity Assumed	1.064	.387
	Greenhouse-Geisser	1.064	.384
	Huynh-Feldt	1.064	.385
	Lower-bound	1.064	.346
CATEGORY * GENDER * EXEMPLAR * HS	Sphericity Assumed	.929	.505
	Greenhouse-Geisser	.929	.480
	Huynh-Feldt	.929	.487
	Lower-bound	.929	.396

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		F	Sig.
CATEGORY * GROUP2 * HS	Sphericity Assumed	.646	.775
	Greenhouse-Geisser	.646	.711
	Huynh-Feldt	.646	.727
	Lower-bound	.646	.525
CATEGORY * GENDER * GROUP2 * HS	Sphericity Assumed	.606	.810
	Greenhouse-Geisser	.606	.744
	Huynh-Feldt	.606	.762
	Lower-bound	.606	.546
CATEGORY * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	.590	.922
	Greenhouse-Geisser	.590	.868
	Huynh-Feldt	.590	.883
	Lower-bound	.590	.670
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	.644	.840
	Greenhouse-Geisser	.644	.777
	Huynh-Feldt	.644	.794
	Lower-bound	.644	.587
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	1128.537	1	1128.537	450.636	.000
	Quadratic	200.097	1	200.097	77.467	.000
	Cubic	2.916	1	2.916	2.291	.131
	Order 4	61.557	1	61.557	59.072	.000
	Order 5	150.022	1	150.022	133.227	.000
CATEGORY * GENDER	Linear	8.405E-04	1	8.405E-04	.000	.985
	Quadratic	6.712	1	6.712	2.598	.108
	Cubic	7.516	1	7.516	5.907	.016
	Order 4	9.305E-05	1	9.305E-05	.000	.992
	Order 5	2.503	1	2.503	2.223	.137
CATEGORY * EXEMPLAR	Linear	14.929	2	7.465	2.981	.052
	Quadratic	224.304	2	112.152	43.419	.000
	Cubic	64.678	2	32.339	25.416	.000
	Order 4	16.241	2	8.120	7.793	.000
	Order 5	23.948	2	11.974	10.634	.000
CATEGORY * GROUP2	Linear	12.997	2	6.499	2.595	.076
	Quadratic	11.629	2	5.815	2.251	.107
	Cubic	8.264	2	4.132	3.247	.040
	Order 4	7.853	2	3.926	3.768	.024
	Order 5	17.074	2	8.537	7.581	.001

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY * HS	Linear	2.986	1	2.986	1.192	.276
	Quadratic	1.024	1	1.024	.396	.529
	Cubic	.835	1	.835	.656	.419
	Order 4	.251	1	.251	.240	.624
	Order 5	5.573	1	5.573	4.949	.027
CATEGORY * GENDER * EXEMPLAR	Linear	.989	2	.494	.197	.821
	Quadratic	1.705	2	.852	.330	.719
	Cubic	.225	2	.113	.089	.915
	Order 4	1.538	2	.769	.738	.479
	Order 5	.881	2	.441	.391	.677
CATEGORY * GENDER * GROUP2	Linear	3.131	2	1.565	.625	.536
	Quadratic	6.137	2	3.069	1.188	.306
	Cubic	.147	2	7.334E-02	.058	.944
	Order 4	.418	2	.209	.201	.818
	Order 5	2.454	2	1.227	1.090	.337
CATEGORY * EXEMPLAR * GROUP2	Linear	8.676	4	2.169	.866	.484
	Quadratic	11.907	4	2.977	1.152	.332
	Cubic	.712	4	.178	.140	.967
	Order 4	5.008	4	1.252	1.201	.310
	Order 5	1.062	4	.266	.236	.918
CATEGORY * GENDER * EXEMPLAR * GROUP2	Linear	4.695	4	1.174	.469	.759
	Quadratic	15.032	4	3.758	1.455	.216
	Cubic	3.713	4	.928	.729	.572
	Order 4	5.114	4	1.278	1.227	.299
	Order 5	3.643	4	.911	.809	.520
CATEGORY * GENDER * HS	Linear	5.137	1	5.137	2.051	.153
	Quadratic	1.159	1	1.159	.449	.503
	Cubic	.986	1	.986	.775	.379
	Order 4	.410	1	.410	.394	.531
	Order 5	.977	1	.977	.868	.352
CATEGORY * EXEMPLAR * HS	Linear	.522	2	.261	.104	.901
	Quadratic	3.743	2	1.872	.725	.485
	Cubic	5.087	2	2.543	1.999	.137
	Order 4	5.317	2	2.658	2.551	.079
	Order 5	3.472	2	1.736	1.542	.215
CATEGORY * GENDER * EXEMPLAR * HS	Linear	.221	2	.111	.044	.957
	Quadratic	6.907	2	3.454	1.337	.264
	Cubic	1.042	2	.521	.409	.664
	Order 4	4.364	2	2.182	2.094	.125
	Order 5	3.308	2	1.654	1.469	.232
CATEGORY * GROUP2 * HS	Linear	3.353	2	1.676	.669	.513
	Quadratic	1.366	2	.683	.264	.768
	Cubic	1.117	2	.558	.439	.645
	Order 4	3.308	2	1.654	1.587	.206
	Order 5	1.881	2	.941	.835	.435

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY * GENDER * GROUP2 * HS	Linear	3.190	2	1.595	.637	.530
	Quadratic	4.403	2	2.202	.852	.427
	Cubic	.256	2	.128	.100	.904
	Order 4	1.543	2	.771	.740	.478
	Order 5	.941	2	.470	.418	.659
CATEGORY * EXEMPLAR * GROUP2 * HS	Linear	3.575	4	.894	.357	.839
	Quadratic	8.689	4	2.172	.841	.500
	Cubic	3.181	4	.795	.625	.645
	Order 4	.610	4	.153	.146	.965
	Order 5	4.069	4	1.017	.903	.462
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Linear	6.466	3	2.155	.861	.462
	Quadratic	2.377	3	.792	.307	.821
	Cubic	4.044	3	1.348	1.059	.366
	Order 4	2.186	3	.729	.699	.553
	Order 5	1.406	3	.469	.416	.741
Error(CATEGORY)	Linear	866.495	346	2.504		
	Quadratic	893.719	346	2.583		
	Cubic	440.254	346	1.272		
	Order 4	360.557	346	1.042		
	Order 5	389.617	346	1.126		

Tests of Between-Subjects Effects

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	6478.902	1	6478.902	1330.955	.000
GENDER	.696	1	.696	.143	.705
EXEMPLAR	35.475	2	17.737	3.644	.027
GROUP2	.584	2	.292	.060	.942
HS	.336	1	.336	.069	.793
GENDER * EXEMPLAR	33.846	2	16.923	3.476	.032
GENDER * GROUP2	28.491	2	14.246	2.926	.055
EXEMPLAR * GROUP2	34.860	4	8.715	1.790	.130
GENDER * EXEMPLAR * GROUP2	5.724	4	1.431	.294	.882
GENDER * HS	11.917	1	11.917	2.448	.119
EXEMPLAR * HS	3.195	2	1.597	.328	.720
GENDER * EXEMPLAR * HS	15.481	2	7.740	1.590	.205
GROUP2 * HS	3.850	2	1.925	.395	.674
GENDER * GROUP2 * HS	15.319	2	7.659	1.573	.209
EXEMPLAR * GROUP2 * HS	22.453	4	5.613	1.153	.331
GENDER * EXEMPLAR * GROUP2 * HS	1.984	3	.661	.136	.939
Error	1684.279	346	4.868		

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humdtpli mammdtpl nmamdtpl birddtpl plandtpl handdtpl BY gender exemplar
group2 hs
/WSFACTOR = category 6 Polynomial
/METHOD = SSTYPE(3)
/CRITERIA = ALPHA(.05)
/WSDESIGN = category
/DESIGN = gender exemplar group2 hs gender*exemplar gender*group2 exemplar
*group2 gender*exemplar*group2 gender*hs exemplar*hs gender*exemplar*hs
group2*hs gender*group2*hs exemplar*group2*hs gender*exemplar*group2*hs .
```

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMDTPLI
2	MAMMDTPL
3	NMAMDTPL
4	BIRDDTPL
5	PLANDTPL
6	HANDDTPL

Between-Subjects Factors

		Value Label	N
Child's gender	1.00	male	189
	2.00	female	192
Exemplar taught to the child (child:1, dog:2, duck:3)	1.00	child	135
	2.00	dog	128
	3.00	duck	118
GROUP2	1		163
	2		121
	3		97
variable for defining healthy and sick children from studies 3 &5	1.00	healthy children	291
	2.00	sick children	90

Effect		Value	F	Hypothesis df
CATEGORY	Pillai's Trace	.103	7.881 ^a	5.000
	Wilks' Lambda	.897	7.881 ^a	5.000
	Hotelling's Trace	.115	7.881 ^a	5.000
	Roy's Largest Root	.115	7.881 ^a	5.000
CATEGORY * GENDER	Pillai's Trace	.027	1.902 ^a	5.000
	Wilks' Lambda	.973	1.902 ^a	5.000
	Hotelling's Trace	.028	1.902 ^a	5.000
	Roy's Largest Root	.028	1.902 ^a	5.000
CATEGORY * EXEMPLAR	Pillai's Trace	.062	2.201	10.000
	Wilks' Lambda	.938	2.206 ^a	10.000
	Hotelling's Trace	.065	2.211	10.000
	Roy's Largest Root	.051	3.487 ^b	5.000
CATEGORY * GROUP2	Pillai's Trace	.022	.776	10.000
	Wilks' Lambda	.978	.774 ^a	10.000
	Hotelling's Trace	.023	.773	10.000
	Roy's Largest Root	.017	1.155 ^b	5.000
CATEGORY * HS	Pillai's Trace	.034	2.418 ^a	5.000
	Wilks' Lambda	.966	2.418 ^a	5.000
	Hotelling's Trace	.035	2.418 ^a	5.000
	Roy's Largest Root	.035	2.418 ^a	5.000
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	.029	1.017	10.000
	Wilks' Lambda	.971	1.015 ^a	10.000
	Hotelling's Trace	.030	1.013	10.000
	Roy's Largest Root	.020	1.376 ^b	5.000
CATEGORY * GENDER * GROUP2	Pillai's Trace	.031	1.064	10.000
	Wilks' Lambda	.970	1.061 ^a	10.000
	Hotelling's Trace	.031	1.059	10.000
	Roy's Largest Root	.019	1.335 ^b	5.000
CATEGORY * EXEMPLAR * GROUP2	Pillai's Trace	.109	1.932	20.000
	Wilks' Lambda	.894	1.951	20.000
	Hotelling's Trace	.115	1.964	20.000
	Roy's Largest Root	.079	5.446 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * GROUP2	Pillai's Trace	.111	1.978	20.000
	Wilks' Lambda	.893	1.978	20.000
	Hotelling's Trace	.116	1.971	20.000
	Roy's Largest Root	.052	3.569 ^b	5.000
CATEGORY * GENDER * HS	Pillai's Trace	.016	1.144 ^a	5.000
	Wilks' Lambda	.984	1.144 ^a	5.000
	Hotelling's Trace	.017	1.144 ^a	5.000
	Roy's Largest Root	.017	1.144 ^a	5.000
CATEGORY * EXEMPLAR * HS	Pillai's Trace	.024	.829	10.000
	Wilks' Lambda	.976	.828 ^a	10.000
	Hotelling's Trace	.024	.828	10.000
	Roy's Largest Root	.020	1.368 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * HS	Pillai's Trace	.027	.951	10.000
	Wilks' Lambda	.973	.950 ^a	10.000
	Hotelling's Trace	.028	.949	10.000
	Roy's Largest Root	.021	1.426 ^b	5.000

Effect		Value	F	Hypothesis df
CATEGORY * GROUP2 * HS	Pillai's Trace	.037	1.284	10.000
	Wilks' Lambda	.964	1.282 ^a	10.000
	Hotelling's Trace	.038	1.281	10.000
	Roy's Largest Root	.027	1.862 ^b	5.000
CATEGORY * GENDER * GROUP2 * HS	Pillai's Trace	.041	1.418	10.000
	Wilks' Lambda	.960	1.416 ^a	10.000
	Hotelling's Trace	.041	1.413	10.000
	Roy's Largest Root	.028	1.887 ^b	5.000
CATEGORY * EXEMPLAR * GROUP2 * HS	Pillai's Trace	.100	1.766	20.000
	Wilks' Lambda	.902	1.792	20.000
	Hotelling's Trace	.106	1.813	20.000
	Roy's Largest Root	.081	5.612 ^b	5.000
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Pillai's Trace	.033	.771	15.000
	Wilks' Lambda	.967	.771	15.000
	Hotelling's Trace	.034	.772	15.000
	Roy's Largest Root	.027	1.826 ^b	5.000

Effect		Error df	Sig.
CATEGORY	Pillai's Trace	342.000	.000
	Wilks' Lambda	342.000	.000
	Hotelling's Trace	342.000	.000
	Roy's Largest Root	342.000	.000
CATEGORY * GENDER	Pillai's Trace	342.000	.093
	Wilks' Lambda	342.000	.093
	Hotelling's Trace	342.000	.093
	Roy's Largest Root	342.000	.093
CATEGORY * EXEMPLAR	Pillai's Trace	686.000	.016
	Wilks' Lambda	684.000	.016
	Hotelling's Trace	682.000	.016
	Roy's Largest Root	343.000	.004
CATEGORY * GROUP2	Pillai's Trace	686.000	.652
	Wilks' Lambda	684.000	.654
	Hotelling's Trace	682.000	.655
	Roy's Largest Root	343.000	.331
CATEGORY * HS	Pillai's Trace	342.000	.036
	Wilks' Lambda	342.000	.036
	Hotelling's Trace	342.000	.036
	Roy's Largest Root	342.000	.036
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	686.000	.427
	Wilks' Lambda	684.000	.429
	Hotelling's Trace	682.000	.431
	Roy's Largest Root	343.000	.233
CATEGORY * GENDER * GROUP2	Pillai's Trace	686.000	.388
	Wilks' Lambda	684.000	.390
	Hotelling's Trace	682.000	.392
	Roy's Largest Root	343.000	.249
CATEGORY * EXEMPLAR * GROUP2	Pillai's Trace	1380.000	.008
	Wilks' Lambda	1135.236	.007
	Hotelling's Trace	1362.000	.007
	Roy's Largest Root	345.000	.000
CATEGORY * GENDER * EXEMPLAR * GROUP2	Pillai's Trace	1380.000	.006
	Wilks' Lambda	1135.236	.006
	Hotelling's Trace	1362.000	.006
	Roy's Largest Root	345.000	.004
CATEGORY * GENDER * HS	Pillai's Trace	342.000	.337
	Wilks' Lambda	342.000	.337
	Hotelling's Trace	342.000	.337
	Roy's Largest Root	342.000	.337
CATEGORY * EXEMPLAR * HS	Pillai's Trace	686.000	.601
	Wilks' Lambda	684.000	.601
	Hotelling's Trace	682.000	.602
	Roy's Largest Root	343.000	.236
CATEGORY * GENDER * EXEMPLAR * HS	Pillai's Trace	686.000	.485
	Wilks' Lambda	684.000	.486
	Hotelling's Trace	682.000	.488
	Roy's Largest Root	343.000	.214

Effect		Error df	Sig.
CATEGORY * GROUP2 * HS	Pillai's Trace	686.000	.235
	Wilks' Lambda	684.000	.236
	Hotelling's Trace	682.000	.237
	Roy's Largest Root	343.000	.100
CATEGORY * GENDER * GROUP2 * HS	Pillai's Trace	686.000	.168
	Wilks' Lambda	684.000	.169
	Hotelling's Trace	682.000	.170
	Roy's Largest Root	343.000	.096
CATEGORY * EXEMPLAR * GROUP2 * HS	Pillai's Trace	1380.000	.020
	Wilks' Lambda	1135.236	.017
	Hotelling's Trace	1362.000	.015
	Roy's Largest Root	345.000	.000
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Pillai's Trace	1032.000	.711
	Wilks' Lambda	944.513	.711
	Hotelling's Trace	1022.000	.710
	Roy's Largest Root	344.000	.107

- a. Exact statistic
- b. The statistic is an upper bound on F that yields a lower bound on the significance level.
- c. Design: Intercept+GENDER+EXEMPLAR+GROUP2+HS+GENDER * EXEMPLAR+GENDER * GROUP2+EXEMPLAR * GROUP2+GENDER * EXEMPLAR * GROUP2+GENDER * HS+EXEMPLAR * HS+GENDER * EXEMPLAR * HS+GROUP2 * HS+GENDER * GROUP2 * HS+EXEMPLAR * GROUP2 * HS+GENDER * EXEMPLAR * GROUP2 * HS
Within Subjects Design: CATEGORY

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Mauchly's W	Approx. Chi-Square	df	Sig.
Within Subjects Effect				
CATEGORY	.457	269.292	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Measure: MEASURE_1

	Epsilon ^a		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Within Subjects Effect			
CATEGORY	.785	.873	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b. Design: Intercept+GENDER+EXEMPLAR+GROUP2+HS+GENDER * EXEMPLAR+GENDER * GROUP2+EXEMPLAR * GROUP2+GENDER * EXEMPLAR * GROUP2+GENDER * HS+EXEMPLAR * HS+GENDER * EXEMPLAR * HS+GROUP2 * HS+GENDER * GROUP2 * HS+EXEMPLAR * GROUP2 * HS+GENDER * EXEMPLAR * GROUP2 * HS
Within Subjects Design: CATEGORY

Tests of Within-Subjects Effects

248

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	15.260	5	3.052
	Greenhouse-Geisser	15.260	3.924	3.889
	Huynh-Feldt	15.260	4.365	3.496
	Lower-bound	15.260	1.000	15.260
CATEGORY * GENDER	Sphericity Assumed	3.288	5	.658
	Greenhouse-Geisser	3.288	3.924	.838
	Huynh-Feldt	3.288	4.365	.753
	Lower-bound	3.288	1.000	3.288
CATEGORY * EXEMPLAR	Sphericity Assumed	8.218	10	.822
	Greenhouse-Geisser	8.218	7.848	1.047
	Huynh-Feldt	8.218	8.729	.941
	Lower-bound	8.218	2.000	4.109
CATEGORY * GROUP2	Sphericity Assumed	3.297	10	.330
	Greenhouse-Geisser	3.297	7.848	.420
	Huynh-Feldt	3.297	8.729	.378
	Lower-bound	3.297	2.000	1.648
CATEGORY * HS	Sphericity Assumed	7.857	5	1.571
	Greenhouse-Geisser	7.857	3.924	2.002
	Huynh-Feldt	7.857	4.365	1.800
	Lower-bound	7.857	1.000	7.857
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	4.458	10	.446
	Greenhouse-Geisser	4.458	7.848	.568
	Huynh-Feldt	4.458	8.729	.511
	Lower-bound	4.458	2.000	2.229
CATEGORY * GENDER * GROUP2	Sphericity Assumed	6.018	10	.602
	Greenhouse-Geisser	6.018	7.848	.767
	Huynh-Feldt	6.018	8.729	.689
	Lower-bound	6.018	2.000	3.009
CATEGORY * EXEMPLAR * GROUP2	Sphericity Assumed	16.575	20	.829
	Greenhouse-Geisser	16.575	15.695	1.056
	Huynh-Feldt	16.575	17.458	.949
	Lower-bound	16.575	4.000	4.144
CATEGORY * GENDER * EXEMPLAR * GROUP2	Sphericity Assumed	21.607	20	1.080
	Greenhouse-Geisser	21.607	15.695	1.377
	Huynh-Feldt	21.607	17.458	1.238
	Lower-bound	21.607	4.000	5.402
CATEGORY * GENDER * HS	Sphericity Assumed	1.957	5	.391
	Greenhouse-Geisser	1.957	3.924	.499
	Huynh-Feldt	1.957	4.365	.448
	Lower-bound	1.957	1.000	1.957
CATEGORY * EXEMPLAR * HS	Sphericity Assumed	3.560	10	.356
	Greenhouse-Geisser	3.560	7.848	.454
	Huynh-Feldt	3.560	8.729	.408
	Lower-bound	3.560	2.000	1.780
CATEGORY * GENDER * EXEMPLAR * HS	Sphericity Assumed	4.468	10	.447
	Greenhouse-Geisser	4.468	7.848	.569
	Huynh-Feldt	4.468	8.729	.512
	Lower-bound	4.468	2.000	2.234

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY * GROUP2 * HS	Sphericity Assumed	6.281	10	.628
	Greenhouse-Geisser	6.281	7.848	.800
	Huynh-Feldt	6.281	8.729	.720
	Lower-bound	6.281	2.000	3.141
CATEGORY * GENDER * GROUP2 * HS	Sphericity Assumed	6.599	10	.660
	Greenhouse-Geisser	6.599	7.848	.841
	Huynh-Feldt	6.599	8.729	.756
	Lower-bound	6.599	2.000	3.300
CATEGORY * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	19.310	20	.965
	Greenhouse-Geisser	19.310	15.695	1.230
	Huynh-Feldt	19.310	17.458	1.106
	Lower-bound	19.310	4.000	4.827
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	5.676	15	.378
	Greenhouse-Geisser	5.676	11.772	.482
	Huynh-Feldt	5.676	13.094	.434
	Lower-bound	5.676	3.000	1.892
Error(CATEGORY)	Sphericity Assumed	915.520	1730	.529
	Greenhouse-Geisser	915.520	1357.658	.674
	Huynh-Feldt	915.520	1510.119	.606
	Lower-bound	915.520	346.000	2.646

Measure: MEASURE_1

Source		F	Sig.
CATEGORY	Sphericity Assumed	5.767	.000
	Greenhouse-Geisser	5.767	.000
	Huynh-Feldt	5.767	.000
	Lower-bound	5.767	.017
CATEGORY * GENDER	Sphericity Assumed	1.242	.287
	Greenhouse-Geisser	1.242	.291
	Huynh-Feldt	1.242	.290
	Lower-bound	1.242	.266
CATEGORY * EXEMPLAR	Sphericity Assumed	1.553	.115
	Greenhouse-Geisser	1.553	.136
	Huynh-Feldt	1.553	.127
	Lower-bound	1.553	.213
CATEGORY * GROUP2	Sphericity Assumed	.623	.795
	Greenhouse-Geisser	.623	.756
	Huynh-Feldt	.623	.773
	Lower-bound	.623	.537
CATEGORY * HS	Sphericity Assumed	2.969	.011
	Greenhouse-Geisser	2.969	.019
	Huynh-Feldt	2.969	.015
	Lower-bound	2.969	.086
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	.842	.588
	Greenhouse-Geisser	.842	.563
	Huynh-Feldt	.842	.574
	Lower-bound	.842	.432
CATEGORY * GENDER * GROUP2	Sphericity Assumed	1.137	.330
	Greenhouse-Geisser	1.137	.335
	Huynh-Feldt	1.137	.333
	Lower-bound	1.137	.322
CATEGORY * EXEMPLAR * GROUP2	Sphericity Assumed	1.566	.053
	Greenhouse-Geisser	1.566	.072
	Huynh-Feldt	1.566	.063
	Lower-bound	1.566	.183
CATEGORY * GENDER * EXEMPLAR * GROUP2	Sphericity Assumed	2.041	.004
	Greenhouse-Geisser	2.041	.009
	Huynh-Feldt	2.041	.007
	Lower-bound	2.041	.088
CATEGORY * GENDER * HS	Sphericity Assumed	.740	.594
	Greenhouse-Geisser	.740	.563
	Huynh-Feldt	.740	.576
	Lower-bound	.740	.390
CATEGORY * EXEMPLAR * HS	Sphericity Assumed	.673	.751
	Greenhouse-Geisser	.673	.713
	Huynh-Feldt	.673	.729
	Lower-bound	.673	.511
CATEGORY * GENDER * EXEMPLAR * HS	Sphericity Assumed	.844	.586
	Greenhouse-Geisser	.844	.562
	Huynh-Feldt	.844	.572
	Lower-bound	.844	.431

Tests of Within-Subjects Effects

Measure: MEASURE_1

251

Source		F	Sig.
CATEGORY * GROUP2 * HS	Sphericity Assumed	1.187	.295
	Greenhouse-Geisser	1.187	.304
	Huynh-Feldt	1.187	.300
	Lower-bound	1.187	.306
CATEGORY * GENDER * GROUP2 * HS	Sphericity Assumed	1.247	.256
	Greenhouse-Geisser	1.247	.269
	Huynh-Feldt	1.247	.263
	Lower-bound	1.247	.289
CATEGORY * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	1.824	.014
	Greenhouse-Geisser	1.824	.025
	Huynh-Feldt	1.824	.020
	Lower-bound	1.824	.124
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Sphericity Assumed	.715	.771
	Greenhouse-Geisser	.715	.735
	Huynh-Feldt	.715	.751
	Lower-bound	.715	.544
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	1.747	1	1.747	2.701	.101
	Quadratic	10.540	1	10.540	13.653	.000
	Cubic	2.324E-03	1	2.324E-03	.006	.938
	Order 4	6.928E-02	1	6.928E-02	.151	.698
	Order 5	2.902	1	2.902	7.491	.007
CATEGORY * GENDER	Linear	5.946E-02	1	5.946E-02	.092	.762
	Quadratic	.877	1	.877	1.136	.287
	Cubic	.149	1	.149	.393	.531
	Order 4	9.290E-02	1	9.290E-02	.202	.653
	Order 5	2.109	1	2.109	5.445	.020
CATEGORY * EXEMPLAR	Linear	2.374	2	1.187	1.835	.161
	Quadratic	7.298E-03	2	3.649E-03	.005	.995
	Cubic	3.465	2	1.732	4.561	.011
	Order 4	1.160	2	.580	1.261	.285
	Order 5	1.212	2	.606	1.565	.211
CATEGORY * GROUP2	Linear	.379	2	.189	.293	.746
	Quadratic	1.925	2	.962	1.247	.289
	Cubic	.136	2	6.794E-02	.179	.836
	Order 4	.210	2	.105	.229	.796
	Order 5	.647	2	.323	.835	.435

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY * HS	Linear	5.215	1	5.215	8.062	.005
	Quadratic	1.847E-05	1	1.847E-05	.000	.996
	Cubic	5.428E-02	1	5.428E-02	.143	.706
	Order 4	1.864	1	1.864	4.053	.045
	Order 5	.724	1	.724	1.868	.173
CATEGORY * GENDER * EXEMPLAR	Linear	1.497	2	.749	1.157	.316
	Quadratic	.920	2	.460	.596	.552
	Cubic	.309	2	.155	.407	.666
	Order 4	1.365	2	.682	1.483	.228
	Order 5	.367	2	.183	.473	.623
CATEGORY * GENDER * GROUP2	Linear	2.172	2	1.086	1.679	.188
	Quadratic	2.550	2	1.275	1.652	.193
	Cubic	6.210E-02	2	3.105E-02	.082	.922
	Order 4	.308	2	.154	.335	.716
	Order 5	.926	2	.463	1.195	.304
CATEGORY * EXEMPLAR * GROUP2	Linear	6.388	4	1.597	2.469	.045
	Quadratic	5.619	4	1.405	1.820	.124
	Cubic	.565	4	.141	.372	.829
	Order 4	1.782	4	.445	.968	.425
	Order 5	2.221	4	.555	1.433	.222
CATEGORY * GENDER * EXEMPLAR * GROUP2	Linear	7.935	4	1.984	3.067	.017
	Quadratic	6.718	4	1.679	2.175	.071
	Cubic	1.255	4	.314	.826	.509
	Order 4	1.086	4	.271	.590	.670
	Order 5	4.613	4	1.153	2.977	.019
CATEGORY * GENDER * HS	Linear	.107	1	.107	.165	.685
	Quadratic	.772	1	.772	1.000	.318
	Cubic	.192	1	.192	.504	.478
	Order 4	7.395E-02	1	7.395E-02	.161	.689
	Order 5	.812	1	.812	2.097	.148
CATEGORY * EXEMPLAR * HS	Linear	7.625E-02	2	3.812E-02	.059	.943
	Quadratic	1.985	2	.992	1.285	.278
	Cubic	.321	2	.160	.422	.656
	Order 4	4.753E-02	2	2.377E-02	.052	.950
	Order 5	1.131	2	.566	1.460	.234
CATEGORY * GENDER * EXEMPLAR * HS	Linear	2.722	2	1.361	2.104	.124
	Quadratic	.618	2	.309	.401	.670
	Cubic	8.899E-02	2	4.449E-02	.117	.890
	Order 4	.765	2	.382	.832	.436
	Order 5	.274	2	.137	.354	.702
CATEGORY * GROUP2 * HS	Linear	.436	2	.218	.337	.714
	Quadratic	3.578	2	1.789	2.317	.100
	Cubic	2.259E-02	2	1.129E-02	.030	.971
	Order 4	.803	2	.402	.873	.419
	Order 5	1.442	2	.721	1.861	.157

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY * GENDER * GROUP2 * HS	Linear	3.186	2	1.593	2.463	.087
	Quadratic	1.583	2	.792	1.026	.360
	Cubic	.401	2	.200	.527	.591
	Order 4	.628	2	.314	.683	.506
	Order 5	.800	2	.400	1.033	.357
CATEGORY * EXEMPLAR * GROUP2 * HS	Linear	7.147	4	1.787	2.763	.028
	Quadratic	10.419	4	2.605	3.374	.010
	Cubic	.528	4	.132	.347	.846
	Order 4	.453	4	.113	.246	.912
	Order 5	.762	4	.190	.492	.742
CATEGORY * GENDER * EXEMPLAR * GROUP2 * HS	Linear	1.674	3	.558	.862	.461
	Quadratic	2.578	3	.859	1.113	.344
	Cubic	.203	3	6.780E-02	.178	.911
	Order 4	5.563E-02	3	1.854E-02	.040	.989
	Order 5	1.165	3	.388	1.003	.392
Error(CATEGORY)	Linear	223.800	346	.647		
	Quadratic	267.101	346	.772		
	Cubic	131.440	346	.380		
	Order 4	159.151	346	.460		
	Order 5	134.028	346	.387		

Tests of Between-Subjects Effects

Measure: MEASURE 1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	114.745	1	114.745	73.309	.000
GENDER	1.069	1	1.069	.683	.409
EXEMPLAR	2.888	2	1.444	.923	.398
GROUP2	.431	2	.216	.138	.871
HS	5.877E-02	1	5.877E-02	.038	.846
GENDER * EXEMPLAR	3.965	2	1.982	1.266	.283
GENDER * GROUP2	5.577	2	2.789	1.782	.170
EXEMPLAR * GROUP2	11.109	4	2.777	1.774	.133
GENDER * EXEMPLAR * GROUP2	13.523	4	3.381	2.160	.073
GENDER * HS	1.267E-02	1	1.267E-02	.008	.928
EXEMPLAR * HS	1.924	2	.962	.615	.541
GENDER * EXEMPLAR * HS	.905	2	.453	.289	.749
GROUP2 * HS	3.912	2	1.956	1.250	.288
GENDER * GROUP2 * HS	.417	2	.208	.133	.875
EXEMPLAR * GROUP2 * HS	2.432	4	.608	.388	.817
GENDER * EXEMPLAR * GROUP2 * HS	3.763	3	1.254	.801	.494
Error	541.571	346	1.565		

Appendix 5**Chapter 6**

Parental Health Attitudes Questionnaire

Please give:

Your child’s full name

Your child’s date of birth

Your relationship to the child (please circle): mother/father/other

Section A

Below is a series of statements. You will agree with some and disagree with others. Sometimes you may agree strongly and sometimes you may disagree strongly and sometimes you may neither agree nor disagree. Please respond to each statement by putting a ring around the number which is right for you. For example, if you strongly agree with a statement, put a ring around the number 5. If you neither agree nor disagree, put a ring around number 3, and so on.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
1. I think people should stop counting calories and just eat what they want	1	2	3	4	5
2. I find reports about BSE in humans very disturbing	1	2	3	4	5

3. I believe it is very important to take care over my diet	1	2	3	4	5
4. I do not worry about catching germs from other people	1	2	3	4	5
5. I think the importance of taking regular exercise is overrated	1	2	3	4	5
6. I am concerned that sunbathing can trigger skin cancer	1	2	3	4	5
7. I think it is very important to take notice of government health campaigns	1	2	3	4	5
8. I never worry about the effects of drinking alcohol	1	2	3	4	5
9. I am very concerned about breathing in the smoke from other people's cigarettes	1	2	3	4	5

10. I think it is very	1	2	3	4	5
important to be well-					
informed about health					
matters					

11. I never worry about	1	2	3	4	5
eating fatty foods					

Section B
Health-related objects Questionnaire

Do you or your children have any of the following items in your home?

1. Medical book/encyclopedia	Yes [☐]	No [☐]
2. Children’s book about the human body	Yes [☐]	No [☐]
3. Plastic toy human skeleton	Yes [☐]	No [☐]
4. Computer programs about health or the body for children	Yes [☐]	No [☐]
5. Medical box/cabinet/cupboard	Yes [☐]	No [☐]
6. Medical thermometer (or other way of measuring body temperature)	Yes [☐]	No [☐]
7. Bathroom scales	Yes [☐]	No [☐]
8. Exercise bike/step/other exercise equipment	Yes [☐]	No [☐]

Appendix 6
Chapter 6

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/VARIABLES pha1 pha2 pha3 pha4 pha5 pha6 pha7 pha8 pha9 pha10 pha11
/MISSING LISTWISE /ANALYSIS pha1 pha2 pha3 pha4 pha5 pha6 pha7 pha8 pha9
pha10 pha11
/PRINT INITIAL CORRELATION DET KMO EXTRACTION ROTATION
/FORMAT SORT BLANK(0.3)
/CRITERIA FACTORS(2) ITERATE(250)
/EXTRACTION PC
/CRITERIA ITERATE(250) DELTA(0)
/ROTATION OBLIMIN
/METHOD=CORRELATION .

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Factor Analysis

Correlation Matrix^a

	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)
Correlation	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)
	1.000	.033	.191	.236	.125
	.033	1.000	.268	.114	.072
	.191	.268	1.000	.047	.276
	.236	.114	.047	1.000	.152
	.125	.072	.276	.152	1.000
	.066	.344	.362	.013	.100
	.183	.254	.264	.303	.266
	.142	.197	.214	.172	.284
	.044	.112	.166	.170	.215
	.040	.196	.294	.177	.160
	.227	.231	.302	.147	.230

	Initial	Extraction
parental health attitudes questionnaire (study 4)	1.000	.398
parental health attitudes questionnaire (study 4)	1.000	.400
parental health attitudes questionnaire (study 4)	1.000	.429
parental health attitudes questionnaire (study 4)	1.000	.459
parental health attitudes questionnaire (study 4)	1.000	.320
parental health attitudes questionnaire (study 4)	1.000	.587
parental health attitudes questionnaire (study 4)	1.000	.396
parental health attitudes questionnaire (study 4)	1.000	.352
parental health attitudes questionnaire (study 4)	1.000	.252
parental health attitudes questionnaire (study 4)	1.000	.383
parental health attitudes questionnaire (study 4)	1.000	.312

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Sums of Total
1	3.030	27.546	27.546	3.030	27.546	27.546	2.605
2	1.258	11.435	38.980	1.258	11.435	38.980	2.200
3	1.066	9.695	48.675				
4	.984	8.949	57.624				
5	.843	7.668	65.292				
6	.799	7.263	72.555				
7	.725	6.591	79.146				
8	.683	6.211	85.357				
9	.577	5.243	90.600				
10	.527	4.792	95.393				
11	.507	4.607	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

	Component	
	1	2
parental health attitudes questionnaire (study 4)	.621	
parental health attitudes questionnaire (study 4)	.616	
parental health attitudes questionnaire (study 4)	.590	
parental health attitudes questionnaire (study 4)	.584	
parental health attitudes questionnaire (study 4)	.520	
parental health attitudes questionnaire (study 4)	.501	
parental health attitudes questionnaire (study 4)	.500	
parental health attitudes questionnaire (study 4)	.496	-.393
parental health attitudes questionnaire (study 4)	.395	.550
parental health attitudes questionnaire (study 4)	.537	-.546
parental health attitudes questionnaire (study 4)	.338	.532

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Pattern Matrix^a

	Component	
	1	2
parental health attitudes questionnaire (study 4)	.803	
parental health attitudes questionnaire (study 4)	.656	
parental health attitudes questionnaire (study 4)	.613	
parental health attitudes questionnaire (study 4)	.576	
parental health attitudes questionnaire (study 4)	.370	.366
parental health attitudes questionnaire (study 4)	.345	
parental health attitudes questionnaire (study 4)		.706
parental health attitudes questionnaire (study 4)		.660
parental health attitudes questionnaire (study 4)		.499
parental health attitudes questionnaire (study 4)		.453
parental health attitudes questionnaire (study 4)	.372	.408

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 14 iterations.

	Component	
	1	2
parental health attitudes questionnaire (study 4)	.736	
parental health attitudes questionnaire (study 4)	.647	
parental health attitudes questionnaire (study 4)	.625	
parental health attitudes questionnaire (study 4)	.610	
parental health attitudes questionnaire (study 4)	.480	.477
parental health attitudes questionnaire (study 4)	.428	.379
parental health attitudes questionnaire (study 4)		.665
parental health attitudes questionnaire (study 4)		.611
parental health attitudes questionnaire (study 4)	.306	.546
parental health attitudes questionnaire (study 4)	.494	.519
parental health attitudes questionnaire (study 4)	.354	.518

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Component Correlation Matrix

Component	1	2
1	1.000	.301
2	.301	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Appendix 7

Chapter 6

15

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		parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)
Correlation	parental health attitudes questionnaire (study 4)	.066	.183	.142	.044
	parental health attitudes questionnaire (study 4)	.344	.254	.197	.112
	parental health attitudes questionnaire (study 4)	.362	.264	.214	.166
	parental health attitudes questionnaire (study 4)	.013	.303	.172	.170
	parental health attitudes questionnaire (study 4)	.100	.266	.284	.215
	parental health attitudes questionnaire (study 4)	1.000	.289	.209	.188
	parental health attitudes questionnaire (study 4)	.289	1.000	.220	.268
	parental health attitudes questionnaire (study 4)	.209	.220	1.000	.257
	parental health attitudes questionnaire (study 4)	.188	.268	.257	1.000
	parental health attitudes questionnaire (study 4)	.291	.247	.332	.292
	parental health attitudes questionnaire (study 4)	.100	.183	.265	.156
	parental health attitudes questionnaire (study 4)				

Correlation Matrix^a

267

		parental health attitudes questionnaire (study 4)	parental health attitudes questionnaire (study 4)
Correlation	parental health attitudes questionnaire (study 4)	.040	.227
	parental health attitudes questionnaire (study 4)	.196	.231
	parental health attitudes questionnaire (study 4)	.294	.302
	parental health attitudes questionnaire (study 4)	.177	.147
	parental health attitudes questionnaire (study 4)	.160	.230
	parental health attitudes questionnaire (study 4)	.291	.100
	parental health attitudes questionnaire (study 4)	.247	.183
	parental health attitudes questionnaire (study 4)	.332	.265
	parental health attitudes questionnaire (study 4)	.292	.156
	parental health attitudes questionnaire (study 4)	1.000	.177
	parental health attitudes questionnaire (study 4)	.177	1.000

a. Determinant = .206

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.778
Bartlett's Test of Sphericity	Approx. Chi-Square	396.019
	df	55
	Sig.	.000

	Initial	Extraction
parental health attitudes questionnaire (study 4)	1.000	.625
parental health attitudes questionnaire (study 4)	1.000	.468
parental health attitudes questionnaire (study 4)	1.000	.554
parental health attitudes questionnaire (study 4)	1.000	.492
parental health attitudes questionnaire (study 4)	1.000	.329
parental health attitudes questionnaire (study 4)	1.000	.598
parental health attitudes questionnaire (study 4)	1.000	.404
parental health attitudes questionnaire (study 4)	1.000	.391
parental health attitudes questionnaire (study 4)	1.000	.548
parental health attitudes questionnaire (study 4)	1.000	.495
parental health attitudes questionnaire (study 4)	1.000	.450

Extraction Method: Principal Component Analysis.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Sums of Total
1	3.030	27.546	27.546	3.030	27.546	27.546	2.443
2	1.258	11.435	38.980	1.258	11.435	38.980	2.054
3	1.066	9.695	48.675	1.066	9.695	48.675	1.616
4	.984	8.949	57.624				
5	.843	7.668	65.292				
6	.799	7.263	72.555				
7	.725	6.591	79.146				
8	.683	6.211	85.357				
9	.577	5.243	90.600				
10	.527	4.792	95.393				
11	.507	4.607	100.000				

Extraction Method: Principal Component Analysis.

- a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Component Matrix^a

	Component		
	1	2	3
parental health attitudes questionnaire (study 4)	.621		
parental health attitudes questionnaire (study 4)	.616		.353
parental health attitudes questionnaire (study 4)	.590		
parental health attitudes questionnaire (study 4)	.584		-.335
parental health attitudes questionnaire (study 4)	.520		.372
parental health attitudes questionnaire (study 4)	.500		
parental health attitudes questionnaire (study 4)	.496	-.393	
parental health attitudes questionnaire (study 4)	.395	.550	
parental health attitudes questionnaire (study 4)	.537	-.546	
parental health attitudes questionnaire (study 4)	.338	.532	.476
parental health attitudes questionnaire (study 4)	.501		-.544

Extraction Method: Principal Component Analysis.

a. 3 components extracted.

Pattern Matrix^a

	Component		
	1	2	3
parental health attitudes questionnaire (study 4)	.771		
parental health attitudes questionnaire (study 4)	.598		
parental health attitudes questionnaire (study 4)	.553		
parental health attitudes questionnaire (study 4)	.529	.325	.358
parental health attitudes questionnaire (study 4)	.492		
parental health attitudes questionnaire (study 4)	.456		
parental health attitudes questionnaire (study 4)		-.735	
parental health attitudes questionnaire (study 4)		-.673	
parental health attitudes questionnaire (study 4)		-.647	
parental health attitudes questionnaire (study 4)			.802
parental health attitudes questionnaire (study 4)			.558

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 13 iterations.

Structure Matrix

270

	Component		
	1	2	3
parental health attitudes questionnaire (study 4)	.704		
parental health attitudes questionnaire (study 4)	.623	-.418	
parental health attitudes questionnaire (study 4)	.607		
parental health attitudes questionnaire (study 4)	.584	-.329	.316
parental health attitudes questionnaire (study 4)	.527		.458
parental health attitudes questionnaire (study 4)	.515		.368
parental health attitudes questionnaire (study 4)		-.757	
parental health attitudes questionnaire (study 4)		-.683	.349
parental health attitudes questionnaire (study 4)		-.681	
parental health attitudes questionnaire (study 4)			.788
parental health attitudes questionnaire (study 4)		-.346	.598

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Component Correlation Matrix

Component	1	2	3
1	1.000	-.272	.240
2	-.272	1.000	-8.430E-02
3	.240	-8.430E-02	1.000

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

Appendix 8**Chapter 7**

GLM

humcplin mammcpli nmamcpli birdcpli plancpli handcpli BY gender group
exemplar
/WSFACTOR = category 6 Polynomial
/METHOD = SSTYPE(3)
/CRITERIA = ALPHA(.05)
/WSDSIGN = category
/DESIGN = gender group exemplar gender*group gender*exemplar group*exemplar
gender*group*exemplar .

272

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMCPLIN
2	MAMMCPLI
3	NMAMCPLI
4	BIRDCPLI
5	PLANCPLI
6	HANDCPLI

Between-Subjects Factors

		Value Label	N
Child's gender	1.00	male	143
	2.00	female	137
Child's age group (1,2,3)	1.00	Youngest group	120
	2.00	Middle group	80
	3.00	Oldest group	80
Exemplar taught to the child (child:1, dog:2, duck:3)	1.00	child	70
	2.00	dog	70
	3.00	duck	70
	4.00	rose bush	70

Effect		Value	F	Hypothesis df
CATEGORY	Pillai's Trace	.778	176.760 ^a	5.000
	Wilks' Lambda	.222	176.760 ^a	5.000
	Hotelling's Trace	3.507	176.760 ^a	5.000
	Roy's Largest Root	3.507	176.760 ^a	5.000
CATEGORY * GENDER	Pillai's Trace	.005	.277 ^a	5.000
	Wilks' Lambda	.995	.277 ^a	5.000
	Hotelling's Trace	.005	.277 ^a	5.000
	Roy's Largest Root	.005	.277 ^a	5.000
CATEGORY * GROUP	Pillai's Trace	.118	3.160	10.000
	Wilks' Lambda	.883	3.234 ^a	10.000
	Hotelling's Trace	.132	3.307	10.000
	Roy's Largest Root	.126	6.395 ^b	5.000
CATEGORY * EXEMPLAR	Pillai's Trace	1.149	31.555	15.000
	Wilks' Lambda	.201	36.508	15.000
	Hotelling's Trace	2.428	40.575	15.000
	Roy's Largest Root	1.727	87.739 ^b	5.000
CATEGORY * GENDER * GROUP	Pillai's Trace	.027	.705	10.000
	Wilks' Lambda	.973	.704 ^a	10.000
	Hotelling's Trace	.028	.703	10.000
	Roy's Largest Root	.022	1.107 ^b	5.000
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	.076	1.323	15.000
	Wilks' Lambda	.925	1.325	15.000
	Hotelling's Trace	.079	1.326	15.000
	Roy's Largest Root	.052	2.630 ^b	5.000
CATEGORY * GROUP * EXEMPLAR	Pillai's Trace	.236	2.109	30.000
	Wilks' Lambda	.782	2.135	30.000
	Hotelling's Trace	.257	2.146	30.000
	Roy's Largest Root	.131	5.568 ^b	6.000
CATEGORY * GENDER * GROUP * EXEMPLAR	Pillai's Trace	.170	1.498	30.000
	Wilks' Lambda	.840	1.501	30.000
	Hotelling's Trace	.180	1.499	30.000
	Roy's Largest Root	.081	3.477 ^b	6.000

Effect		Error df	Sig.
CATEGORY	Pillai's Trace	252.000	.000
	Wilks' Lambda	252.000	.000
	Hotelling's Trace	252.000	.000
	Roy's Largest Root	252.000	.000
CATEGORY * GENDER	Pillai's Trace	252.000	.926
	Wilks' Lambda	252.000	.926
	Hotelling's Trace	252.000	.926
	Roy's Largest Root	252.000	.926
CATEGORY * GROUP	Pillai's Trace	506.000	.001
	Wilks' Lambda	504.000	.000
	Hotelling's Trace	502.000	.000
	Roy's Largest Root	253.000	.000
CATEGORY * EXEMPLAR	Pillai's Trace	762.000	.000
	Wilks' Lambda	696.062	.000
	Hotelling's Trace	752.000	.000
	Roy's Largest Root	254.000	.000
CATEGORY * GENDER * GROUP	Pillai's Trace	506.000	.720
	Wilks' Lambda	504.000	.721
	Hotelling's Trace	502.000	.722
	Roy's Largest Root	253.000	.357
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	762.000	.181
	Wilks' Lambda	696.062	.180
	Hotelling's Trace	752.000	.179
	Roy's Largest Root	254.000	.024
CATEGORY * GROUP * EXEMPLAR	Pillai's Trace	1280.000	.000
	Wilks' Lambda	1010.000	.000
	Hotelling's Trace	1252.000	.000
	Roy's Largest Root	256.000	.000
CATEGORY * GENDER * GROUP * EXEMPLAR	Pillai's Trace	1280.000	.042
	Wilks' Lambda	1010.000	.042
	Hotelling's Trace	1252.000	.041
	Roy's Largest Root	256.000	.003

- a. Exact statistic
- b. The statistic is an upper bound on F that yields a lower bound on the significance level.
- c. Design: Intercept+GENDER+GROUP+EXEMPLAR+GENDER * GROUP+GENDER * EXEMPLAR+GROUP * EXEMPLAR+GENDER * GROUP * EXEMPLAR
Within Subjects Design: CATEGORY

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

		—		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
CATEGORY	.343	271.767	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Measure: MEASURE_1

	Epsilon ^a		
	Greenhous e-Geisser	Huynh-Fel dt	Lower-bou nd
Within Subjects Effect			
CATEGORY	.702	.777	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept+GENDER+GROUP+EXEMPLAR+GENDER * GROUP+GENDER * EXEMPLAR+GROUP * EXEMPLAR+GENDER * GROUP * EXEMPLAR
Within Subjects Design: CATEGORY

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	1443.373	5	288.675
	Greenhouse-Geisser	1443.373	3.512	411.002
	Huynh-Feldt	1443.373	3.887	371.374
	Lower-bound	1443.373	1.000	1443.373
CATEGORY * GENDER	Sphericity Assumed	2.565	5	.513
	Greenhouse-Geisser	2.565	3.512	.730
	Huynh-Feldt	2.565	3.887	.660
	Lower-bound	2.565	1.000	2.565
CATEGORY * GROUP	Sphericity Assumed	47.386	10	4.739
	Greenhouse-Geisser	47.386	7.024	6.747
	Huynh-Feldt	47.386	7.773	6.096
	Lower-bound	47.386	2.000	23.693
CATEGORY * EXEMPLAR	Sphericity Assumed	1101.117	15	73.408
	Greenhouse-Geisser	1101.117	10.536	104.515
	Huynh-Feldt	1101.117	11.660	94.438
	Lower-bound	1101.117	3.000	367.039
CATEGORY * GENDER * GROUP	Sphericity Assumed	12.186	10	1.219
	Greenhouse-Geisser	12.186	7.024	1.735
	Huynh-Feldt	12.186	7.773	1.568
	Lower-bound	12.186	2.000	6.093
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	35.282	15	2.352
	Greenhouse-Geisser	35.282	10.536	3.349
	Huynh-Feldt	35.282	11.660	3.026
	Lower-bound	35.282	3.000	11.761
CATEGORY * GROUP * EXEMPLAR	Sphericity Assumed	90.618	30	3.021
	Greenhouse-Geisser	90.618	21.071	4.301
	Huynh-Feldt	90.618	23.319	3.886
	Lower-bound	90.618	6.000	15.103
CATEGORY * GENDER * GROUP * EXEMPLAR	Sphericity Assumed	79.321	30	2.644
	Greenhouse-Geisser	79.321	21.071	3.764
	Huynh-Feldt	79.321	23.319	3.401
	Lower-bound	79.321	6.000	13.220
Error(CATEGORY)	Sphericity Assumed	2312.639	1280	1.807
	Greenhouse-Geisser	2312.639	899.031	2.572
	Huynh-Feldt	2312.639	994.964	2.324
	Lower-bound	2312.639	256.000	9.034

Measure: MEASURE_1

Source		F	Sig.
CATEGORY	Sphericity Assumed	159.776	.000
	Greenhouse-Geisser	159.776	.000
	Huynh-Feldt	159.776	.000
	Lower-bound	159.776	.000
CATEGORY * GENDER	Sphericity Assumed	.284	.922
	Greenhouse-Geisser	.284	.866
	Huynh-Feldt	.284	.884
	Lower-bound	.284	.595
CATEGORY * GROUP	Sphericity Assumed	2.623	.004
	Greenhouse-Geisser	2.623	.011
	Huynh-Feldt	2.623	.008
	Lower-bound	2.623	.075
CATEGORY * EXEMPLAR	Sphericity Assumed	40.630	.000
	Greenhouse-Geisser	40.630	.000
	Huynh-Feldt	40.630	.000
	Lower-bound	40.630	.000
CATEGORY * GENDER * GROUP	Sphericity Assumed	.674	.749
	Greenhouse-Geisser	.674	.694
	Huynh-Feldt	.674	.710
	Lower-bound	.674	.510
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	1.302	.193
	Greenhouse-Geisser	1.302	.221
	Huynh-Feldt	1.302	.213
	Lower-bound	1.302	.274
CATEGORY * GROUP * EXEMPLAR	Sphericity Assumed	1.672	.013
	Greenhouse-Geisser	1.672	.029
	Huynh-Feldt	1.672	.024
	Lower-bound	1.672	.128
CATEGORY * GENDER * GROUP * EXEMPLAR	Sphericity Assumed	1.463	.051
	Greenhouse-Geisser	1.463	.081
	Huynh-Feldt	1.463	.072
	Lower-bound	1.463	.191
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	1067.761	1	1067.761	406.492	.000
	Quadratic	195.288	1	195.288	72.434	.000
	Cubic	73.968	1	73.968	48.949	.000
	Order 4	.218	1	.218	.223	.637
	Order 5	106.138	1	106.138	86.914	.000
CATEGORY * GENDER	Linear	.161	1	.161	.061	.805
	Quadratic	2.110	1	2.110	.782	.377
	Cubic	.142	1	.142	.094	.759
	Order 4	.149	1	.149	.152	.697
	Order 5	3.913E-03	1	3.913E-03	.003	.955
CATEGORY * GROUP	Linear	3.510	2	1.755	.668	.514
	Quadratic	8.357	2	4.179	1.550	.214
	Cubic	.901	2	.451	.298	.742
	Order 4	.445	2	.223	.228	.797
	Order 5	34.172	2	17.086	13.991	.000
CATEGORY * EXEMPLAR	Linear	233.595	3	77.865	29.643	.000
	Quadratic	256.547	3	85.516	31.718	.000
	Cubic	217.261	3	72.420	47.925	.000
	Order 4	222.686	3	74.229	75.853	.000
	Order 5	171.028	3	57.009	46.684	.000
CATEGORY * GENDER * GROUP	Linear	3.248	2	1.624	.618	.540
	Quadratic	2.203	2	1.101	.408	.665
	Cubic	2.051	2	1.025	.679	.508
	Order 4	.165	2	8.242E-02	.084	.919
	Order 5	4.520	2	2.260	1.851	.159
CATEGORY * GENDER * EXEMPLAR	Linear	4.956	3	1.652	.629	.597
	Quadratic	4.401	3	1.467	.544	.653
	Cubic	13.944	3	4.648	3.076	.028
	Order 4	8.539	3	2.846	2.909	.035
	Order 5	3.443	3	1.148	.940	.422
CATEGORY * GROUP * EXEMPLAR	Linear	13.920	6	2.320	.883	.508
	Quadratic	19.940	6	3.323	1.233	.290
	Cubic	16.907	6	2.818	1.865	.087
	Order 4	28.986	6	4.831	4.937	.000
	Order 5	10.865	6	1.811	1.483	.184
CATEGORY * GENDER * GROUP * EXEMPLAR	Linear	25.979	6	4.330	1.648	.134
	Quadratic	33.048	6	5.508	2.043	.061
	Cubic	5.544	6	.924	.611	.721
	Order 4	5.899	6	.983	1.005	.423
	Order 5	8.852	6	1.475	1.208	.302
Error(CATEGORY)	Linear	672.452	256	2.627		
	Quadratic	690.196	256	2.696		
	Cubic	386.848	256	1.511		
	Order 4	250.520	256	.979		
	Order 5	312.622	256	1.221		

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	5841.726	1	5841.726	987.468	.000
GENDER	23.535	1	23.535	3.978	.047
GROUP	10.816	2	5.408	.914	.402
EXEMPLAR	32.030	3	10.677	1.805	.147
GENDER * GROUP	12.466	2	6.233	1.054	.350
GENDER * EXEMPLAR	12.463	3	4.154	.702	.551
GROUP * EXEMPLAR	14.083	6	2.347	.397	.881
GENDER * GROUP * EXEMPLAR	54.512	6	9.085	1.536	.167
Error	1514.461	256	5.916		

GLM

humctpli mammctpl nmamctpl birdctpl planctpl handctpl BY gender group
exemplar
/WSFACTOR = category 6 Polynomial
/METHOD = SSTYPE(3)
/CRITERIA = ALPHA(.05)
/WSDESIGN = category
/DESIGN = gender group exemplar gender*group gender*exemplar group*exemplar
gender*group*exemplar .

280

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMCTPLI
2	MAMMCTP L
3	NMAMCTP L
4	BIRDCTPL
5	PLANCTPL
6	HANDCTPL

Between-Subjects Factors

		Value Label	N
Child's gender	1.00	male	143
	2.00	female	137
Child's age group (1,2,3)	1.00	Youngest group	120
	2.00	Middle group	80
	3.00	Oldest group	80
Exemplar taught to the child (child:1, dog:2, duck:3)	1.00	child	70
	2.00	dog	70
	3.00	duck	70
	4.00	rose bush	70

Effect		Value	F	Hypothesis df
CATEGORY	Pillai's Trace	.810	214.529 ^a	5.000
	Wilks' Lambda	.190	214.529 ^a	5.000
	Hotelling's Trace	4.257	214.529 ^a	5.000
	Roy's Largest Root	4.257	214.529 ^a	5.000
CATEGORY * GENDER	Pillai's Trace	.013	.649 ^a	5.000
	Wilks' Lambda	.987	.649 ^a	5.000
	Hotelling's Trace	.013	.649 ^a	5.000
	Roy's Largest Root	.013	.649 ^a	5.000
CATEGORY * GROUP	Pillai's Trace	.149	4.068	10.000
	Wilks' Lambda	.853	4.184 ^a	10.000
	Hotelling's Trace	.171	4.298	10.000
	Roy's Largest Root	.161	8.141 ^b	5.000
CATEGORY * EXEMPLAR	Pillai's Trace	1.020	26.185	15.000
	Wilks' Lambda	.248	30.545	15.000
	Hotelling's Trace	2.059	34.406	15.000
	Roy's Largest Root	1.526	77.539 ^b	5.000
CATEGORY * GENDER * GROUP	Pillai's Trace	.048	1.233	10.000
	Wilks' Lambda	.953	1.232 ^a	10.000
	Hotelling's Trace	.049	1.231	10.000
	Roy's Largest Root	.038	1.914 ^b	5.000
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	.048	.825	15.000
	Wilks' Lambda	.953	.824	15.000
	Hotelling's Trace	.049	.824	15.000
	Roy's Largest Root	.035	1.772 ^b	5.000
CATEGORY * GROUP * EXEMPLAR	Pillai's Trace	.190	1.682	30.000
	Wilks' Lambda	.822	1.688	30.000
	Hotelling's Trace	.202	1.685	30.000
	Roy's Largest Root	.093	3.975 ^b	6.000
CATEGORY * GENDER * GROUP * EXEMPLAR	Pillai's Trace	.118	1.029	30.000
	Wilks' Lambda	.887	1.028	30.000
	Hotelling's Trace	.123	1.027	30.000
	Roy's Largest Root	.065	2.757 ^b	6.000

Effect		Error df	Sig.
CATEGORY	Pillai's Trace	252.000	.000
	Wilks' Lambda	252.000	.000
	Hotelling's Trace	252.000	.000
	Roy's Largest Root	252.000	.000
CATEGORY * GENDER	Pillai's Trace	252.000	.663
	Wilks' Lambda	252.000	.663
	Hotelling's Trace	252.000	.663
	Roy's Largest Root	252.000	.663
CATEGORY * GROUP	Pillai's Trace	506.000	.000
	Wilks' Lambda	504.000	.000
	Hotelling's Trace	502.000	.000
	Roy's Largest Root	253.000	.000
CATEGORY * EXEMPLAR	Pillai's Trace	762.000	.000
	Wilks' Lambda	696.062	.000
	Hotelling's Trace	752.000	.000
	Roy's Largest Root	254.000	.000
CATEGORY * GENDER * GROUP	Pillai's Trace	506.000	.267
	Wilks' Lambda	504.000	.267
	Hotelling's Trace	502.000	.268
	Roy's Largest Root	253.000	.092
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	762.000	.650
	Wilks' Lambda	696.062	.651
	Hotelling's Trace	752.000	.652
	Roy's Largest Root	254.000	.119
CATEGORY * GROUP * EXEMPLAR	Pillai's Trace	1280.000	.012
	Wilks' Lambda	1010.000	.012
	Hotelling's Trace	1252.000	.012
	Roy's Largest Root	256.000	.001
CATEGORY * GENDER * GROUP * EXEMPLAR	Pillai's Trace	1280.000	.424
	Wilks' Lambda	1010.000	.425
	Hotelling's Trace	1252.000	.427
	Roy's Largest Root	256.000	.013

- a. Exact statistic
- b. The statistic is an upper bound on F that yields a lower bound on the significance level.
- c. Design: Intercept+GENDER+GROUP+EXEMPLAR+GENDER * GROUP+GENDER * EXEMPLAR+GROUP * EXEMPLAR+GENDER * GROUP * EXEMPLAR
Within Subjects Design: CATEGORY

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Mauchly's W	Approx. Chi-Square	df	Sig.
Within Subjects Effect				
CATEGORY	.408	227.792	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Measure: MEASURE_1

	Epsilon ^a		
	Greenhous e-Geisser	Huynh-Fel dt	Lower-bou nd
Within Subjects Effect			
CATEGORY	.736	.816	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b. Design: Intercept+GENDER+GROUP+EXEMPLAR+GENDER * GROUP+GENDER * EXEMPLAR+GROUP * EXEMPLAR+GENDER * GROUP * EXEMPLAR
Within Subjects Design: CATEGORY

Tests of Within-Subjects Effects

284

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	1919.242	5	383.848
	Greenhouse-Geisser	1919.242	3.682	521.288
	Huynh-Feldt	1919.242	4.078	470.665
	Lower-bound	1919.242	1.000	1919.242
CATEGORY * GENDER	Sphericity Assumed	6.508	5	1.302
	Greenhouse-Geisser	6.508	3.682	1.768
	Huynh-Feldt	6.508	4.078	1.596
	Lower-bound	6.508	1.000	6.508
CATEGORY * GROUP	Sphericity Assumed	67.698	10	6.770
	Greenhouse-Geisser	67.698	7.363	9.194
	Huynh-Feldt	67.698	8.155	8.301
	Lower-bound	67.698	2.000	33.849
CATEGORY * EXEMPLAR	Sphericity Assumed	967.678	15	64.512
	Greenhouse-Geisser	967.678	11.045	87.611
	Huynh-Feldt	967.678	12.233	79.103
	Lower-bound	967.678	3.000	322.559
CATEGORY * GENDER * GROUP	Sphericity Assumed	28.099	10	2.810
	Greenhouse-Geisser	28.099	7.363	3.816
	Huynh-Feldt	28.099	8.155	3.445
	Lower-bound	28.099	2.000	14.049
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	22.363	15	1.491
	Greenhouse-Geisser	22.363	11.045	2.025
	Huynh-Feldt	22.363	12.233	1.828
	Lower-bound	22.363	3.000	7.454
CATEGORY * GROUP * EXEMPLAR	Sphericity Assumed	85.698	30	2.857
	Greenhouse-Geisser	85.698	22.090	3.879
	Huynh-Feldt	85.698	24.466	3.503
	Lower-bound	85.698	6.000	14.283
CATEGORY * GENDER * GROUP * EXEMPLAR	Sphericity Assumed	50.743	30	1.691
	Greenhouse-Geisser	50.743	22.090	2.297
	Huynh-Feldt	50.743	24.466	2.074
	Lower-bound	50.743	6.000	8.457
Error(CATEGORY)	Sphericity Assumed	2342.566	1280	1.830
	Greenhouse-Geisser	2342.566	942.523	2.485
	Huynh-Feldt	2342.566	1043.897	2.244
	Lower-bound	2342.566	256.000	9.151

Tests of Within-Subjects Effects

285

Measure: MEASURE_1

Source		F	Sig.
CATEGORY	Sphericity Assumed	209.738	.000
	Greenhouse-Geisser	209.738	.000
	Huynh-Feldt	209.738	.000
	Lower-bound	209.738	.000
CATEGORY * GENDER	Sphericity Assumed	.711	.615
	Greenhouse-Geisser	.711	.573
	Huynh-Feldt	.711	.587
	Lower-bound	.711	.400
CATEGORY * GROUP	Sphericity Assumed	3.699	.000
	Greenhouse-Geisser	3.699	.000
	Huynh-Feldt	3.699	.000
	Lower-bound	3.699	.026
CATEGORY * EXEMPLAR	Sphericity Assumed	35.250	.000
	Greenhouse-Geisser	35.250	.000
	Huynh-Feldt	35.250	.000
	Lower-bound	35.250	.000
CATEGORY * GENDER * GROUP	Sphericity Assumed	1.535	.121
	Greenhouse-Geisser	1.535	.148
	Huynh-Feldt	1.535	.139
	Lower-bound	1.535	.217
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	.815	.662
	Greenhouse-Geisser	.815	.626
	Huynh-Feldt	.815	.638
	Lower-bound	.815	.487
CATEGORY * GROUP * EXEMPLAR	Sphericity Assumed	1.561	.028
	Greenhouse-Geisser	1.561	.048
	Huynh-Feldt	1.561	.041
	Lower-bound	1.561	.159
CATEGORY * GENDER * GROUP * EXEMPLAR	Sphericity Assumed	.924	.585
	Greenhouse-Geisser	.924	.563
	Huynh-Feldt	.924	.570
	Lower-bound	.924	.478
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Tests of Within-Subjects Contrasts

286

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	1322.210	1	1322.210	507.218	.000
	Quadratic	400.440	1	400.440	153.803	.000
	Cubic	78.091	1	78.091	50.838	.000
	Order 4	2.210	1	2.210	1.895	.170
	Order 5	116.291	1	116.291	93.945	.000
CATEGORY * GENDER	Linear	.777	1	.777	.298	.586
	Quadratic	2.280	1	2.280	.876	.350
	Cubic	1.684	1	1.684	1.097	.296
	Order 4	.824	1	.824	.706	.401
	Order 5	.943	1	.943	.762	.384
CATEGORY * GROUP	Linear	15.337	2	7.668	2.942	.055
	Quadratic	3.809	2	1.904	.731	.482
	Cubic	.202	2	.101	.066	.936
	Order 4	1.351	2	.675	.579	.561
	Order 5	47.000	2	23.500	18.984	.000
CATEGORY * EXEMPLAR	Linear	185.641	3	61.880	23.738	.000
	Quadratic	189.118	3	63.039	24.213	.000
	Cubic	216.754	3	72.251	47.037	.000
	Order 4	202.061	3	67.354	57.747	.000
	Order 5	174.104	3	58.035	46.883	.000
CATEGORY * GENDER * GROUP	Linear	5.197	2	2.598	.997	.370
	Quadratic	15.572	2	7.786	2.991	.052
	Cubic	1.112	2	.556	.362	.697
	Order 4	3.313	2	1.656	1.420	.244
	Order 5	2.905	2	1.453	1.174	.311
CATEGORY * GENDER * EXEMPLAR	Linear	2.627	3	.876	.336	.799
	Quadratic	2.085	3	.695	.267	.849
	Cubic	5.968	3	1.989	1.295	.277
	Order 4	2.943	3	.981	.841	.472
	Order 5	8.739	3	2.913	2.353	.073
CATEGORY * GROUP * EXEMPLAR	Linear	17.163	6	2.860	1.097	.364
	Quadratic	21.511	6	3.585	1.377	.224
	Cubic	16.366	6	2.728	1.776	.104
	Order 4	22.377	6	3.729	3.198	.005
	Order 5	8.281	6	1.380	1.115	.354
CATEGORY * GENDER * GROUP * EXEMPLAR	Linear	16.713	6	2.785	1.069	.382
	Quadratic	17.391	6	2.899	1.113	.355
	Cubic	5.322	6	.887	.577	.748
	Order 4	6.986	6	1.164	.998	.427
	Order 5	4.332	6	.722	.583	.744
Error(CATEGORY)	Linear	667.337	256	2.607		
	Quadratic	666.518	256	2.604		
	Cubic	393.232	256	1.536		
	Order 4	298.586	256	1.166		
	Order 5	316.892	256	1.238		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	10363.752	1	10363.752	1800.946	.000
GENDER	3.911	1	3.911	.680	.411
GROUP	4.169	2	2.085	.362	.696
EXEMPLAR	46.738	3	15.579	2.707	.046
GENDER * GROUP	8.877	2	4.439	.771	.463
GENDER * EXEMPLAR	1.536	3	.512	.089	.966
GROUP * EXEMPLAR	22.247	6	3.708	.644	.695
GENDER * GROUP * EXEMPLAR	40.083	6	6.681	1.161	.328
Error	1473.182	256	5.755		

GLM

humdtpli mammdtpl nmamdtpl birddtpl plandtpl handdtpl BY gender group
exemplar
/WSFACTOR = category 6 Polynomial
/METHOD = SSTYPE(3)
/CRITERIA = ALPHA(.05)
/WSDESIGN = category
/DESIGN = gender group exemplar gender*group gender*exemplar group*exemplar
gender*group*exemplar .

288

General Linear Model

Within-Subjects Factors

Measure: MEASURE_1

CATEGORY	Dependent Variable
1	HUMDTPLI
2	MAMMDTPL
3	NMAMDTPL
4	BIRDDTPL
5	PLANDTPL
6	HANDDTPL

Between-Subjects Factors

		Value Label	N
Child's gender	1.00	male	143
	2.00	female	137
Child's age group (1,2,3)	1.00	Youngest group	120
	2.00	Middle group	80
	3.00	Oldest group	80
Exemplar taught to the child (child:1, dog:2, duck:3)	1.00	child	70
	2.00	dog	70
	3.00	duck	70
	4.00	rose bush	70

Effect		Value	F	Hypothesis df
CATEGORY	Pillai's Trace	.248	16.589 ^a	5.000
	Wilks' Lambda	.752	16.589 ^a	5.000
	Hotelling's Trace	.329	16.589 ^a	5.000
	Roy's Largest Root	.329	16.589 ^a	5.000
CATEGORY * GENDER	Pillai's Trace	.027	1.408 ^a	5.000
	Wilks' Lambda	.973	1.408 ^a	5.000
	Hotelling's Trace	.028	1.408 ^a	5.000
	Roy's Largest Root	.028	1.408 ^a	5.000
CATEGORY * GROUP	Pillai's Trace	.075	1.962	10.000
	Wilks' Lambda	.926	1.964 ^a	10.000
	Hotelling's Trace	.078	1.966	10.000
	Roy's Largest Root	.059	2.998 ^b	5.000
CATEGORY * EXEMPLAR	Pillai's Trace	.070	1.222	15.000
	Wilks' Lambda	.931	1.223	15.000
	Hotelling's Trace	.073	1.223	15.000
	Roy's Largest Root	.047	2.399 ^b	5.000
CATEGORY * GENDER * GROUP	Pillai's Trace	.058	1.509	10.000
	Wilks' Lambda	.943	1.508 ^a	10.000
	Hotelling's Trace	.060	1.507	10.000
	Roy's Largest Root	.045	2.267 ^b	5.000
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	.089	1.547	15.000
	Wilks' Lambda	.914	1.543	15.000
	Hotelling's Trace	.092	1.537	15.000
	Roy's Largest Root	.051	2.609 ^b	5.000
CATEGORY * GROUP * EXEMPLAR	Pillai's Trace	.078	.677	30.000
	Wilks' Lambda	.924	.675	30.000
	Hotelling's Trace	.081	.674	30.000
	Roy's Largest Root	.046	1.980 ^b	6.000
CATEGORY * GENDER * GROUP * EXEMPLAR	Pillai's Trace	.105	.912	30.000
	Wilks' Lambda	.898	.913	30.000
	Hotelling's Trace	.110	.915	30.000
	Roy's Largest Root	.066	2.809 ^b	6.000

Multivariate Tests^c

290

Effect		Error df	Sig.
CATEGORY	Pillai's Trace	252.000	.000
	Wilks' Lambda	252.000	.000
	Hotelling's Trace	252.000	.000
	Roy's Largest Root	252.000	.000
CATEGORY * GENDER	Pillai's Trace	252.000	.222
	Wilks' Lambda	252.000	.222
	Hotelling's Trace	252.000	.222
	Roy's Largest Root	252.000	.222
CATEGORY * GROUP	Pillai's Trace	506.000	.035
	Wilks' Lambda	504.000	.035
	Hotelling's Trace	502.000	.035
	Roy's Largest Root	253.000	.012
CATEGORY * EXEMPLAR	Pillai's Trace	762.000	.249
	Wilks' Lambda	696.062	.248
	Hotelling's Trace	752.000	.248
	Roy's Largest Root	254.000	.038
CATEGORY * GENDER * GROUP	Pillai's Trace	506.000	.133
	Wilks' Lambda	504.000	.133
	Hotelling's Trace	502.000	.133
	Roy's Largest Root	253.000	.048
CATEGORY * GENDER * EXEMPLAR	Pillai's Trace	762.000	.083
	Wilks' Lambda	696.062	.085
	Hotelling's Trace	752.000	.086
	Roy's Largest Root	254.000	.025
CATEGORY * GROUP * EXEMPLAR	Pillai's Trace	1280.000	.906
	Wilks' Lambda	1010.000	.908
	Hotelling's Trace	1252.000	.909
	Roy's Largest Root	256.000	.069
CATEGORY * GENDER * GROUP * EXEMPLAR	Pillai's Trace	1280.000	.604
	Wilks' Lambda	1010.000	.602
	Hotelling's Trace	1252.000	.600
	Roy's Largest Root	256.000	.012

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept+GENDER+GROUP+EXEMPLAR+GENDER * GROUP+GENDER * EXEMPLAR+GROUP * EXEMPLAR+GENDER * GROUP * EXEMPLAR
Within Subjects Design: CATEGORY

Mauchly's Test of Sphericity^b

Measure: MEASURE_1

	Mauchly's W	Approx. Chi-Square	df	Sig.
Within Subjects Effect				
CATEGORY	.509	171.466	14	.000

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

Measure: MEASURE_1

	Epsilon ^a		
	Greenhous e-Geisser	Huynh-Fel dt	Lower-bou nd
Within Subjects Effect			
CATEGORY	.780	.865	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

- a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
- b. Design: Intercept+GENDER+GROUP+EXEMPLAR+GENDER * GROUP+GENDER * EXEMPLAR+GROUP * EXEMPLAR+GENDER * GROUP * EXEMPLAR
Within Subjects Design: CATEGORY

Tests of Within-Subjects Effects

292

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
CATEGORY	Sphericity Assumed	53.466	5	10.693
	Greenhouse-Geisser	53.466	3.901	13.705
	Huynh-Feldt	53.466	4.325	12.362
	Lower-bound	53.466	1.000	53.466
CATEGORY * GENDER	Sphericity Assumed	3.653	5	.731
	Greenhouse-Geisser	3.653	3.901	.936
	Huynh-Feldt	3.653	4.325	.845
	Lower-bound	3.653	1.000	3.653
CATEGORY * GROUP	Sphericity Assumed	11.669	10	1.167
	Greenhouse-Geisser	11.669	7.802	1.496
	Huynh-Feldt	11.669	8.650	1.349
	Lower-bound	11.669	2.000	5.834
CATEGORY * EXEMPLAR	Sphericity Assumed	15.572	15	1.038
	Greenhouse-Geisser	15.572	11.704	1.331
	Huynh-Feldt	15.572	12.975	1.200
	Lower-bound	15.572	3.000	5.191
CATEGORY * GENDER * GROUP	Sphericity Assumed	11.070	10	1.107
	Greenhouse-Geisser	11.070	7.802	1.419
	Huynh-Feldt	11.070	8.650	1.280
	Lower-bound	11.070	2.000	5.535
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	15.946	15	1.063
	Greenhouse-Geisser	15.946	11.704	1.363
	Huynh-Feldt	15.946	12.975	1.229
	Lower-bound	15.946	3.000	5.315
CATEGORY * GROUP * EXEMPLAR	Sphericity Assumed	10.345	30	.345
	Greenhouse-Geisser	10.345	23.407	.442
	Huynh-Feldt	10.345	25.950	.399
	Lower-bound	10.345	6.000	1.724
CATEGORY * GENDER * GROUP * EXEMPLAR	Sphericity Assumed	15.323	30	.511
	Greenhouse-Geisser	15.323	23.407	.655
	Huynh-Feldt	15.323	25.950	.590
	Lower-bound	15.323	6.000	2.554
Error(CATEGORY)	Sphericity Assumed	783.415	1280	.612
	Greenhouse-Geisser	783.415	998.717	.784
	Huynh-Feldt	783.415	1107.220	.708
	Lower-bound	783.415	256.000	3.060

Tests of Within-Subjects Effects

Measure: MEASURE_1

293

Source		F	Sig.
CATEGORY	Sphericity Assumed	17.471	.000
	Greenhouse-Geisser	17.471	.000
	Huynh-Feldt	17.471	.000
	Lower-bound	17.471	.000
CATEGORY * GENDER	Sphericity Assumed	1.194	.310
	Greenhouse-Geisser	1.194	.312
	Huynh-Feldt	1.194	.311
	Lower-bound	1.194	.276
CATEGORY * GROUP	Sphericity Assumed	1.907	.040
	Greenhouse-Geisser	1.907	.057
	Huynh-Feldt	1.907	.050
	Lower-bound	1.907	.151
CATEGORY * EXEMPLAR	Sphericity Assumed	1.696	.046
	Greenhouse-Geisser	1.696	.064
	Huynh-Feldt	1.696	.056
	Lower-bound	1.696	.168
CATEGORY * GENDER * GROUP	Sphericity Assumed	1.809	.055
	Greenhouse-Geisser	1.809	.074
	Huynh-Feldt	1.809	.066
	Lower-bound	1.809	.166
CATEGORY * GENDER * EXEMPLAR	Sphericity Assumed	1.737	.039
	Greenhouse-Geisser	1.737	.056
	Huynh-Feldt	1.737	.049
	Lower-bound	1.737	.160
CATEGORY * GROUP * EXEMPLAR	Sphericity Assumed	.563	.973
	Greenhouse-Geisser	.563	.953
	Huynh-Feldt	.563	.962
	Lower-bound	.563	.759
CATEGORY * GENDER * GROUP * EXEMPLAR	Sphericity Assumed	.835	.722
	Greenhouse-Geisser	.835	.691
	Huynh-Feldt	.835	.704
	Lower-bound	.835	.544
Error(CATEGORY)	Sphericity Assumed		
	Greenhouse-Geisser		
	Huynh-Feldt		
	Lower-bound		

Measure: MEASURE_1

Source	CATEGORY	Type III Sum of Squares	df	Mean Square	F	Sig.
CATEGORY	Linear	13.673	1	13.673	23.669	.000
	Quadratic	35.906	1	35.906	38.592	.000
	Cubic	4.250E-02	1	4.250E-02	.071	.791
	Order 4	3.670	1	3.670	8.715	.003
	Order 5	.174	1	.174	.329	.567
CATEGORY * GENDER	Linear	1.676	1	1.676	2.902	.090
	Quadratic	1.037E-02	1	1.037E-02	.011	.916
	Cubic	.793	1	.793	1.319	.252
	Order 4	.234	1	.234	.556	.457
	Order 5	.940	1	.940	1.774	.184
CATEGORY * GROUP	Linear	5.274	2	2.637	4.565	.011
	Quadratic	1.760	2	.880	.946	.390
	Cubic	.375	2	.187	.312	.732
	Order 4	1.228	2	.614	1.458	.235
	Order 5	3.032	2	1.516	2.860	.059
CATEGORY * EXEMPLAR	Linear	2.967	3	.989	1.712	.165
	Quadratic	7.232	3	2.411	2.591	.053
	Cubic	1.967	3	.656	1.091	.354
	Order 4	2.194	3	.731	1.737	.160
	Order 5	1.213	3	.404	.763	.516
CATEGORY * GENDER * GROUP	Linear	.341	2	.171	.295	.745
	Quadratic	7.838	2	3.919	4.212	.016
	Cubic	.751	2	.376	.625	.536
	Order 4	2.002	2	1.001	2.377	.095
	Order 5	.137	2	6.864E-02	.130	.879
CATEGORY * GENDER * EXEMPLAR	Linear	2.193	3	.731	1.265	.287
	Quadratic	4.455	3	1.485	1.596	.191
	Cubic	4.808	3	1.603	2.666	.048
	Order 4	1.525	3	.508	1.207	.308
	Order 5	2.967	3	.989	1.866	.136
CATEGORY * GROUP * EXEMPLAR	Linear	3.461	6	.577	.999	.427
	Quadratic	2.077	6	.346	.372	.896
	Cubic	.440	6	7.330E-02	.122	.994
	Order 4	2.997	6	.499	1.186	.314
	Order 5	1.370	6	.228	.431	.858
CATEGORY * GENDER * GROUP * EXEMPLAR	Linear	6.123	6	1.021	1.767	.106
	Quadratic	4.392	6	.732	.787	.581
	Cubic	.526	6	8.766E-02	.146	.990
	Order 4	1.596	6	.266	.632	.705
	Order 5	2.686	6	.448	.845	.536
Error(CATEGORY)	Linear	147.888	256	.578		
	Quadratic	238.182	256	.930		
	Cubic	153.869	256	.601		
	Order 4	107.810	256	.421		
	Order 5	135.667	256	.530		

Measure: MEASURE_1

Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	243.155	1	243.155	122.209	.000
GENDER	8.022	1	8.022	4.032	.046
GROUP	2.425	2	1.213	.609	.544
EXEMPLAR	5.615	3	1.872	.941	.422
GENDER * GROUP	1.911	2	.956	.480	.619
GENDER * EXEMPLAR	6.366	3	2.122	1.067	.364
GROUP * EXEMPLAR	7.791	6	1.298	.653	.688
GENDER * GROUP * EXEMPLAR	13.549	6	2.258	1.135	.342
Error	509.353	256	1.990		

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