Evaluating four and five-year old children's responses to interactive television programs.

Anna Hynd
Bachelor of Arts (Honours) Psychology

This thesis is presented for the degree of
Doctor of Philosophy
Murdoch University, 2006

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

....
Anna Hynd

ABSTRACT

While it is commonly believed that 'interactive' media provides benefits to young children not obtained from 'non-interactive' media, there has been little research examining this issue, or the kinds of interactivity that elicit these benefits. The present study examined the attention, comprehension, and enjoyment of young children viewing different kinds of interactive television programs compared with those of children viewing the control prototype (non-interactive) programs. Three interactive prototypes and one control prototype of *Dora the Explorer*, *Hi-5*, and *Play School* were examined on these outcome measures. The interactive prototypes allowed participants to make simple choices about program content using a television remote control. Four hundred and ninety eight children aged four (49.4%) and five (50.6%) years individually viewed one of the prototypes, and the children's attention, comprehension, and enjoyment were examined. Participants were boys (49.7%) and girls (50.3%) drawn from Government (64.9%), Catholic (27.6%) and Independent (7.4%) schools in Perth, Western Australia. Significantly higher attention, comprehension, or both were found for children interacting with two of the prototypes allowing increased viewer participation compared to children viewing the control prototype prototypes. Interactive prototypes allowing participants to repeat sections of program content also elicited significantly higher comprehension than control prototypes. However, interactive prototypes allowing participants to customise aspects of the program did not result in differences in the outcome measures compared with control prototypes. It was also found that interactive prototypes offering participants narrative choices were associated with significantly lower attention, comprehension or enjoyment for either interacting or non-interacting participants compared to the control prototypes. It is argued that interactivity, per se, does not bestow any benefits, with only specific models of interactivity resulting in higher comprehension or attention. In fact, some applications allowing young children to make choices about program narrative appears to disrupt program comprehension. It is concluded that successful interactivity builds upon the features of well-designed traditional children's television; opportunities for increased participation, and the repetition of content.

TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 4 – METHOD

CHAPTER 5 – RESULTS:

DEPENDENT VARIABLES AND SAMPLE DEMOGRAPHICS

LIST OF TABLES

CHAPTER 6 – RESULTS:

INDEPENDENT VARIABLES

LIST OF APPENDICES

ACKNOWLEDGEMENTS

First and foremost I would like to thank my supervisor and mentor, Associate Professor Pia Broderick. Thank you for your guidance, insight and helpful suggestions on all stages of the project planning, recruiting, data collection, analysis, and write-up. I know how lucky I am to have had a supervisor so organised and accessible. I am particularly grateful for your personal warmth, generosity and support.

Thanks to our research leader, Professor Duane Varan, who envisaged, obtained funding, and assembled the team for this project. Thank you for your foresight, belief and enthusiasm throughout this project, and for providing me with such a wonderful research opportunity.

Special thanks to Professor Mike Innes for his advice on statistical design and analysis.

A multi-disciplinary team contributed to this project; thanks to Chief Investigators Professor Duane Varan, Professor Mike Innes, Associate Professor Pia Broderick, Dr Libby Lee, Dr Ingrid Richardson, Dr Martin Mhando, and Dr Andrew Turk, and postgraduates Mr Hugh Baldwin and Ms Nisha Weeramanthri.

Thank you to our Industry Partners; *Nickelodeon,* the *Australian Broadcasting Corporation*, *Nine Network*, *Western Australian Department of Education and Training*, and *TVNZ*, for their intellectual and financial contributions toward the project. Special thanks to Jane Gould, Katie Cordes and Leisa Sadler from *Nickelodeon*; Gabrielle Shaw, Stephanie Carrick and Abigail Thomas from the *ABC*; and Helena Harris from *Kids Like Us* for access to their staff during our industry placements, and for allowing us to modify their programs.

Thanks to the Australian Research Council, which partially funded this project, for their support of industry-university collaborations.

Thanks to the *Western Australian Department of Education and Training*, *Catholic Education Office*, and the *Independent Schools Association* for allowing us to access their schools.

I am grateful to the staff, students, and parents from Beechboro Primary School, Cloverdale Primary School, Coolbinia Primary School, Dalkeith Primary School, Girrawheen Primary, Glengarry Primary School, Holy Rosary School, Hollywood Primary School, Kinross Primary School, Landsdale Gardens Christian School, Landsdale Primary School, Loreto Primary School, North Balga Primary, Our Lady of Fatima School, Regent College, Riverlands Montessori School, Rostrata Primary School, Sacred Heart Primary, St Joseph's School, Subiaco Primary School, and Woodbridge Primary School for their participation in the study.

I am deeply grateful to Hugh Baldwin, my fellow postgraduate working on this project. Hugh, I can't imagine how this project would have run without you. You worked tirelessly on the prototype design, scripts, filming, and editing, and were available for much-needed technical assistance during the data collection. Thank you for contributing so much to group meetings and the retreats, and for your good-humour and determination in the face of all obstacles.

Thanks to my Research Assistant extraordinaire, Karin Pegrum. You were along side me for the data collection and coding, and worked with great competence and efficiency. Only the two of us will ever know how arduous the coding was, and I will always be grateful for your help and your fantastic sandwiches.

Thanks to Associate Professor David Leach for his advice on partial-interval recording systems, and the use of his '10-second alternating tones' cassette tapes (although this stimulus does make me nauseous now).

Thanks to the School of Psychology technicians for designing and building the attention measurement computer program.

My thanks to Adrian Bollig for the technical fit-out of the research laboratory, technical support, and for 'keeping it real' on the road.

For the renovations to the research laboratory, many thanks to Vern from *Advanced Caravan Repairs*. Thanks also to Pete from *All States Towing* for transporting the research laboratory during testing, and parking it in some very tricky spots.

Thanks to Rob Forsyth for drawing the enjoyment face scale.

On a personal note, I would like to express my love and appreciation to my husband, Dale Hynd, who wrote his PhD thesis concurrent with mine. I'm sure there are more sensible ways to start married life, but your company on this lonely road brought me much comfort and laughter.

CHAPTER 1 - BACKGROUND AND PROJECT OVERVIEW

1.1 Television and Young Children

1.1.1 Concern about television

Television is part of life for young children today. A 1999 study, and several others, have reported that children aged between three and five years watch approximately 20 hours of television weekly (Huston, Wright, Marquis, & Green, 1999; Huston, Wright, Rice, Kerkman, & St. Peters, 1990; Krull, 1983). Indeed, Huston and Wright have noted that children "… spend more time watching television than in any other activity except sleep" (1996, p. 38). In response to these findings, it has been suggested that, other than the family, television is the socialising force reaching children earliest, and for the most time (Huston & Wright, 1983).

Since the introduction of television there has been concern amongst parents, educators, and policy makers about its effects on children. Lumby and Fine (2006) suggest that much of the concern about television relates to the perceived passivity of the medium. For example, Mander suggested that the television viewer has

> No cognition, no discernment, no notations upon the experience one is having such that the viewer is little more than a vessel of reception… We become fixated to the changing images, but as it is impossible to do anything about them as they enter us, we merely give ourselves over to them (1978, p. 204).

The media frequently report apprehension about the number of hours children spend watching television, with moderate to heavy viewing being linked to childhood obesity, diabetes, and poor school performance (Dennison, Russo, Burdick, & Jenkins, 2004; Landers, 2004; "Pediatric obesity", 2004; "TV-watching", 2004). There is a common concern that television makes children "lazy, obese, violent, promiscuous and even brain-damaged" (Aisbett, 2006, p. 4). The academic literature has also reported concern that television viewing in young children may contribute to later attentional problems (American Academy of Pediatrics Committee on Public Education, 1999; Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004). There are also much concern about exposing young children to television content that depicts violence, sexual activity, or that reinforces sexual and racial stereotypes (Mares, 1996). Consequently, some researchers have focussed on designing interventions to reduce young children's exposure to television (Dennison et al., 2004).

1.1.2 Educational television for children

In spite of the concerns about television's effect on children's cognitive development, there is a substantial body of literature suggesting that television viewing can produce positive effects (Anderson, 1998; Van Evra, 2004). Many studies have demonstrated that curriculum-based television programs designed specifically for young children, such as *Sesame Street* and *Blue's Clues,* benefit children's cognitive and social development (Anderson, 1998). These programs are the result of collaborations between television producers and child development researchers, and are designed to be stimulating, entertaining and comprehensible to young children (Anderson, 1998; Fisch & Truglio, 2001). Extensive research has been conducted on the influence of *Sesame Street* in particular, which has been broadcast since 1969 and is seen in over 130 countries (Cole, Richman, & McCann Brown, 2001). For example, Rice, Huston, Truglio and Wright (1990) conducted a two-year longitudinal study into the relationship between children's viewing of *Sesame Street* and their vocabulary development. The viewing behaviour of 160 three to five-year olds was recorded over the duration of the study, and vocabulary was assessed at the commencement and conclusion of the data collection period. It was found that young children who frequently viewed *Sesame Street* performed significantly better on the vocabulary assessment compared with infrequent viewers. This trend was not apparent for children's viewing of other television programs (Rice et al., 1990). Similarly, Wright, Huston, Scantlin and Kotler (2001) reported that *Sesame Street* viewers had significantly better pre-reading skills at five-years of age than children who watched little or no television. Encouragingly, many of these positive effects appear to have a long-term impact on children. A study of adolescents reported that participants who had viewed educational programs, such as *Sesame Street*, had better high school grades than participants who had not been viewers of such programs (Huston, Anderson, Wright, Linebarger, & Schmitt, 2001).

Cole and colleagues (2001) suggest that television is an ideal learning medium for young children, who learn much about the world through modelling the behaviours they observe. "It is far better to *show and tell* young children to wash their hands than merely to *tell* them, and it is one step better yet if the images that are presented are ones that take place in situations are settings that are familiar and relevant to the child" (Cole et al., 2001, p. 156, original emphasis)

1.2 Interactive Television for Young Children

1.2.1 What is interactive television?

There is no consensus in the literature about the definition of 'interactive television', the technologies involved, or its inherent characteristics (Carey, 1997). This lack of a uniform definition of the term has seen it used in describing many kinds of programming. Srivastava describes interactive television as "a TV system that allows the viewer to send information to the broadcaster, as well as receive information from the broadcaster" (2002, p. 369). By this definition, broadcast television has traditionally been a 'non-interactive' medium (Wartella, O'Keefe, & Scantlin, 2000). The flow of information has typically been in one direction; content is transmitted by the broadcaster and received by the viewer, and the viewer typically has no opportunity to respond to the broadcaster. 'Interactive' television, as it is used throughout this thesis, differs from regular broadcast television in two ways. First, as noted in Srivastava's (2002) description, the flow of information is bi-directional. Interactive television allows the viewer to participate with and alter the content of the program, or respond to the broadcaster in a way that results in content change. Second, interactive television is on-demand, meaning the communication with the broadcaster results in immediate content change. Many contemporary television programs meet the first criteria for interactive television. For example, many programs have websites allowing viewers to make comments and suggestions about the program, or formats allowing viewers to vote about aspects of the program. One of the best known examples of this kind of program is the *Big Brother* franchise, which allows viewers to vote (usually by mobile phone) on the contestant they would like to see 'evicted' from the house. These kinds of programs are not on-demand, however, as there is a time-delay between the communication (i.e. voting) and the content change (i.e. eviction of a contestant). Therefore, interactive television is distinct from traditional television in that it is both participatory and on-demand.

One application of interactive television, for example, would be an interactive episode of the evening news. The newsreader might ask the viewer if they would like to see the political news or the sport news. While few interactive television applications have been launched to date, Swann (2000) suggests that interactive television content is likely to rely on the television remote control as the mechanism for the viewer to communicate with the broadcaster. In the abovementioned example, the newsreader might direct the viewer to make their content selection using particular buttons on their remote control, such as the coloured or arrow buttons. As illustrated in this example, the viewer has a finite number of available choices, which are predetermined by the broadcaster. The broadcaster produces and transmits extra content for all the available choices.

Interactive television has clear appeal for viewers given that they can choose the content of greatest interest or relevance to them (Swann, 2000). For broadcasters, however, interactive television can involve additional content production, and the cost of transmitting additional content. This expense is greatest for broadcasters using analogue transmission. Analogue transmissions take up much of the bandwidth allotted to each broadcasting network, greatly limiting the number of transmissions that can be made at one time (Swann, 2000). The alternative to the analogue system, digital transmission, requires much less bandwidth than analogue transmission, allowing networks to broadcast multiple transmissions simultaneously (Given, 2003). The ability to transmit multiple signals in the same amount of bandwidth will make the transmission of interactive programs less cost prohibitive for broadcasters. In Australia, free-to-air digital transmission commenced in January 2001, and on pay-TV in March 2004 (Loncar, Fairbrother, & Daiziel, 2005). It is estimated that approximately 22% of Australian homes currently receive digital transmissions (Loncar et al., 2005).

1.2.2 Why develop interactive television programs for young children?

To date, few interactive television programs have been developed or broadcasted globally, and only a handful have been designed for children. These programs have been aimed at older children (eight to 15 years), and have been special events rather than regular programs. For example, the United Kingdom’s *Disney Channel* broadcast an interactive awards program (informitv.com, 2004). Every few minutes throughout the broadcast program-related questions appeared on the screen. Viewers were able to answer these questions using their television remote controls, and were rewarded for correct answers by accessing 'backstage' video footage, and the chance to win prizes (informitv.com, 2004).

There are currently very few studies examining young children's responses to interactive television programs, and no experimental studies examining four and five year-old children's comprehension, attention, and enjoyment in response to them. However, there is a rich body of literature examining the design, and young children's use of, traditional television. There is also research examining the effects of television programming designed to elicit viewer participation, such as *Blue's Clues*. The findings from this body of research, and their implications for studying interactive television for young children, are discussed in Chapter 3.

1.3 Project Description

1.3.1 Project aims

This thesis forms part of a larger multi-disciplinary project entitled "Enhancing the Content and Experience of Interactive Children's Television". The project aimed to address a number of research questions around the design and development of interactive television programming for young children. The project explored the technological and platform requirements for interactive television; the nature of the instructions, interface, and navigation suitable for young children; the unique script and production issues associated with interactive content; the kinds of interactions that are appealing to young children; the effects of interactive compared with non-interactive programs in controlled settings; and the way interactive content is used and understood by young children in naturalistic settings.

1.3.2 Project structure

A multi-disciplinary team was required to address the wide range of research questions associated with the project. Seven academic staff collaborated on the project as Primary Investigators; with individual expertise in Cultural Studies, Developmental Psychology, Early Childhood Education, Media Studies, Media Production, Social Psychology, and Usability. Three postgraduates also collaborated on different aspects of the project for their doctoral research. The postgraduates were each supervised by one or more of the Primary Investigators.

Although much discussion and collaboration took place within the academic and postgraduate group, for particular aspects of the project responsibility was assigned to those with the necessary expertise. Four teams were formed within the project. The production component of the project, including the design, script, filming, and editing required for the interactive and control prototypes was managed by one of the postgraduates. This postgraduate was supervised by the Early Childhood Education and Media Production Investigators. Throughout this thesis, this postgraduate is referred to as the 'prototype designer'. Another of the postgraduates was responsible for designing the interactive instructions (the 'calls to action'), the prototype navigation and interface, and for evaluating the usability of the prototypes. This postgraduate was supervised by the Investigator with expertise in Usability. Two Investigators with expertise in Cultural Studies and Early Childhood Education, respectively, were responsible for evaluating children's uses and understandings of the interactive prototypes in home settings.

As the third postgraduate, I was supervised by the Developmental Psychologist. I was responsible for evaluating the responses of four and five-year-old children to the interactive and control prototypes in a controlled environment. The project's Social Psychologist also collaborated on aspects of the experimental design and statistical analysis. This thesis is an account of my contribution toward the project.

1.3.3 Project funding

This project was partially funded by the Australian Research Council, which provide Linkage Grants to university collaborations with industry. The three postgraduates received Australian Research Council scholarships. The remainder of the project funding was contributed by five industry partners; the Australian Broadcasting Corporation (ABC), Nickelodeon, the Nine Network, TVNZ, and the Western Australian Department for Education and Training.

1.4 Industry Collaboration

This project is unusual in the Australian context as it involves a partnership with industry. The partners provided financial support for the project and were joint recipients of all project findings. In addition to their financial support Nickelodeon, the Nine Network, and the ABC provided the programs from which the interactive and control prototypes were created. While university-industry collaborations are unusual in Australia, it is also rare for industry competitors to work collaboratively. The partners also provided access to their production resources, program talent, and program designers. It was important to the partners that the prototypes developed for the study be consistent with the style and ethos of their programs.

The Department for Education and Training was interested in the project's implications for their Early Childhood Curriculum, and their delivery of distance education services. The Department provided access to children in government schools, comprising 73% of

Western Australian primary school children (J. Harris, personal communication, June 7, 2004), for the prototype evaluations. The fifth partner, TVNZ, is New Zealand's free-to-air public broadcaster. TVNZ was interested in using the project findings to develop new interactive television programs for children.

As discussed, all partners were equal recipients of the project findings. These findings will provide the basis for partner decisions about whether to invest in the development of interactive television programs for young children. At the commencement of the project it was unclear whether interactive programming would be sufficiently interesting, comprehensible and usable for young children. The partners were also interested in knowing which models of interactivity are most effective, and for which segments of the audience. The project also offered Nickelodeon, the Nine Network, and the ABC the opportunity to see how interactivity might function within their programs.

1.4.1 Conferences

The head offices of Nickelodeon, the Nine Network, and the ABC are located in Sydney, on Australia's east coast. The academic research team are located at Murdoch University in Perth, on the west coast. The geographic distance and time difference between these cities made regular communication between the partners and researchers difficult. Therefore, biannual conferences were held in either Perth or Sydney throughout the three year project duration. These conferences provided the opportunity for the partners and researchers to meet and discuss project planning and progress. The first three conferences were primarily concerned with the nature of the interactivity to be featured in the prototypes, and other aspects of prototype design and interface. While the researchers had full control over the project's research questions and methodological design, partner approval was required for the prototypes adapted from their programs.

The conferences held in the later stages of the project focussed on reporting and discussing the emerging project findings.

1.4.2 Placements

The three postgraduates visited the head offices of Nickelodeon, the Nine Network and the ABC in the first year of the project. One week was spent with each of these organisations. The aim of these placements was to familiarise the postgraduates with the partners' values and ethos, and to gain a thorough understanding of the programs; *Dora the Explorer, Hi-5* and *Play School.* It was particularly important for the postgraduates to understand the design processes and facilities involved in producing these programs, and the methods used by the partners to evaluate them. The placements also facilitated on-going dialogue between the partners and the postgraduates.

1.5 Background to Nickelodeon and *Dora the Explorer*

Nickelodeon has broadcast in Australia since 1996, and is carried by Foxtel and Austar, pay-TV providers. At the commencement of the study, it was estimated that Nickelodeon was received in 23% of Australian homes, and 28% of children aged under four years have access to their preschool programming (Lees, 2004). Nickelodeon produce and broadcast some of the best known children's programs globally including *Rugrats, Blue's Clues*, and *Open Sesame*.

During the Nickelodeon placement the postgraduates had access to all staff and met with personnel from the research, programming, marketing, production, and online services departments. The open nature of the organisation provided a clear view of Nickelodeon's values and ethos.

Nickelodeon's primary focus for young children is the provision of a safe and friendly environment. Nickelodeon aim to provide programming that "entertains, educates and empowers children" (J. Gould, personal communication, May 26, 2003).

1.5.1 Description of *Dora the Explorer*

Dora the Explorer is an animated program produced in New York. Therefore, we were unable to meet directly with the program's designers or producers. However, a conference call was arranged with the Head Researcher for *Dora the Explorer*, Christine Ricci. *Dora the Explorer* is an adventure program for children, set in a South American jungle. *Dora the Explorer* is a narrative-based program, with one story line linking the program from beginning to end. Each episode is approximately 24 minutes in duration and features Dora, a four-year-old Latina, and Boots, a two-year-old monkey, on a journey through the jungle. At the beginning of each episode a problem is established, which Dora and Boots set out to solve. Dora and Boots always pass three landmarks, and they also solve a series of smaller problems along the way. The program is designed to appeal to four and five-year-old children (C. Ricci, personal communication, May 29, 2003). A scene from the program is shown in Figure 1.1.

Figure 1.1: A scene from *Dora the Explorer* featuring Dora, Boots, and Swiper.

1.5.2 Theoretical underpinnings for *Dora the Explorer*

Ricci was able to explain many of the underlying principles for *Dora the Explorer*, and the ways in which Nickelodeon evaluate their programming. Ricci explained that *Dora the Explorer* follows in the tradition of *Blue's Clues*, an internationally successful Nickelodeon program. *Blue's Clues* involves an animated dog, named Blue, living in an animated world with a live-action adult presenter, Joe. Together, Blue and Joe find clues and act as detectives to solve a puzzle in each episode. For example, Blue and Joe might find a wand, crown and tutu before deducing that these objects belong to a fairy. As well as piecing together three clues, Blue and Joe also solve smaller problems throughout the program. *Blue's Clues* was designed to be a highly participatory program, with the viewer encouraged to actively assist Blue and Joe with solving problems. This is achieved by having Joe look at the eye-line of the viewer and directly ask questions such as "Can you see a clue?" At this point, an off-screen child's voice responds with an answer. This prompts the viewer to also respond verbally to these questions. The program also encourages nonverbal participation, such as pointing to objects on the screen. Ricci mentioned anecdotal reports from the makers of *Blue's Clues* that once children have viewed a few episodes of the program, they understand that they can participate in this way.

Like *Blue's Clues, Dora the Explorer* encourages verbal and nonverbal participation from the viewer. The creators of *Dora the Explorer* have reported that their aim was to support children's problem solving skills and familiarise them with computers and interactive games (Gifford, Walsh, & Weiner, 2002). The program also aims to develop self-esteem and encourage active viewing (Gifford et al., 2002).

The program is based on Gardner's multiple intelligences theory (1983), and in every episode each of the intelligences is used to solve a task. For example, episodes always feature a spatial, verbal, interpersonal, and kinaesthetic (body movement and physical co-ordination) task. The viewer might be encouraged to count aloud to assist with a spatial task, or jump up and down on the spot to help Dora with a kinaesthetic task.

The creators of *Dora the Explorer* have explained that the active participation encouraged in the program is its most important feature:

> One of the things I love most about the show, and something that makes it unique, is that viewers are asked to be active participants - not only by answering questions, but by getting off the couch and moving their bodies. Parents tell us they know when *Dora* is on because they'll see and hear their kids playing along with the show: counting, speaking Spanish, jumping, rowing, clapping, etc. (Gifford et al., 2002, ¶ 3).

1.5.3 Nickelodeon evaluations of *Dora the Explorer*

Ricci discussed the evaluation process conducted for each episode of *Dora the Explorer* (C. Ricci, personal communication, May 29, 2003). When one of the program's writers first develops a concept for an episode, they write an outline stating how each of the intelligences will be incorporated into the episode. This outline is then given to the in-house artist who draws up a storybook for the episode. The outline and storybook are then taken to primary schools, where the researchers read the story to four and five-year old children, show them the pictures, and explain the participative components (tasks designed to elicit responses from viewers). This process allows the researchers to establish whether the story and tasks are appropriate for the age group. At this session, appeal testing is also conducted. This involves asking the children how they felt after the story using a face scale with expressions ranging from 'very happy' to 'angry'.

Comprehension testing is also conducted to determine which parts of the episode are well understood and which are too difficult. Individual children are also tested on the tasks contained in the program. For example, if there is a counting task in the episode, a researcher will evaluate the counting ability of individual children to ensure that the task in the episode is developmentally appropriate. The researchers have noted that some tasks are too difficult for four-year olds to accomplish on their own, but are manageable for the five-year olds. However, they believe that both age groups enjoy the tasks and the story. Any sections of the episode that were too difficult or elicited negative feelings during this initial evaluation are removed or rewritten.

When the writer completes the final script, artists create black-and-white storyboards and an audio recording is made. The audio and storyboards are recorded onto video, and this video is shown to a class of four and five-year olds from a different school. The purpose of this phase of evaluations is to collect attention data. The researchers are interested in which sections of the episode elicit children's attention and which participatory tasks the children respond to. During these evaluations, children view in a class-sized group and are provided with toys. The toys are provided as distracters in order to avoid artificially high attention (see Anderson & Lorch, 1983). Ricci was not specific about the method used to measure attention, or whether children were assessed individually or in groups. However, Ricci stated that the researchers aim to have the children attending to 90% or more of the episode. Any scenes associated with low attention are removed or altered. For example, a 'travel song' which featured in every episode of season one became associated with decreased visual attention. In later seasons, the song was shortened and individualised for each episode to reduce the audience's familiarity with the song. Consequently, attention during the travel song increased. Ricci explained that attention was important to measure because decreases in attention can indicate decreased viewer comprehension and enjoyment.

This evaluation process is repeated once the episode has been fully animated in colour. If any portions of the episode are demonstrated to be confusing, or elicit low levels of attention, the episode is modified. This process takes approximately one year, and each episode is evaluated by more than 70 children before it is broadcast.

1.5.4 Nickelodeon perspectives on the interactive prototypes

Some of the Nickelodeon staff had suggestions about the kinds of interactivity which might appeal to four and five-year-old children. Online Manager, Katie Cordes, noted that the young children she had observed with computers seemed to enjoy seeing movement or change on the screen more than anything else in the experience. This lead to the development of a 'zap' button on Nickelodeon's set top box remote controls. The zap button can be pushed at any time during a broadcast, and causes the image on the television screen to temporarily wobble. Although older children found this function uninteresting, it was very appealing to young children.

In discussion of the types of interactions that might be examined in this study, Cordes expressed concern about the appropriateness of giving young children narrative choices, such as determining the path Dora travels on her journey (K. Cordes, personal communication, May 27, 2003). She suggested that perhaps it was not meaningful or necessary for children to influence the narrative structure of the program, and that perhaps much simpler choices, such as choosing the colour of Dora's dress, would be more suitable. General Manager, Catherine Nebauer, noted that participatory viewing is a characteristic of many Nickelodeon programs. She argued that any interactivity developed for *Dora the Explorer* should further facilitate participation and active viewing (C. Nebauer, personal communication, May 27, 2003).

1.6 Background to the Nine Network, Kids Like Us, and *Hi-5*

Hi-5 is broadcast by the Nine Network, a national free-to-air commercial broadcaster, and is designed and produced by production company Kids Like Us. A series of conversations with program creator Helena Harris, and Early Childhood Advisor and Script Editor, Helen Martin, provided information about the focus and design of *Hi-5*.

1.6.1 Description of *Hi-5*

Hi-5 is an Australian program, first broadcast in 1999, and has been exported to 59 countries (Kids Like Us, 1999; 2004). *Hi-5* is aimed at a two to eight-year old audience (H. Harris, personal communication, June 17, 2003; H. Martin, personal communication, June 16, 2003) and is broadcast each weekday. *Hi-5* is a live-action, segment-based (magazine-style) program. Each episode is approximately 24 minutes in duration. Five adult presenters appear in every episode of *Hi-5*; Charli, Kathleen, Kellie, Nathan, and Tim. Each presenter has their own segment that is reflective of a particular learning style (H. Harris, personal communication, June 17, 2003). While presenters in live-action programs often relate to the viewer as adults, the *Hi-5* presenters interact as older siblings or friends (H. Martin, personal communication, June 16, 2003). A scene from the program is shown in Figure 1.2.

Figure 1.2: A scene from *Hi-5* featuring Charli.

The key priority for *Hi-5* is fun, and the promotion of viewer fantasy and exploration. Martin explained that the writers assume viewers are safe and grounded in their home environments, and ready for a television experience that stimulates fantasy. In contrast to *Dora the Explorer*, *Hi-5* does not encourage viewer participation. Harris and Martin explained that participation is rarely requested of the viewer, as this is seen as didactic and patronising. Instead, Harris aims for viewer engagement and imagination.

<u>1.6.2 Theoretical underpinnings for *Hi-5*</u>

The five learning styles featured on *Hi-5* are loosely analogous to Gardner's multiple intelligences (Gardner, 1983). Gardner's multiple intelligences theory argues that individuals have different learning styles and preferences, and that they learn best through their dominant learning mode (1983). *Hi-5* features presenters utilising a verbal, mathematical, spatial, musical and kinaesthetic style. Harris has observed that most viewers have a favourite *Hi-5* presenter, and she believes that children prefer the presenter who models their preferred learning style (H. Harris, personal communication, June 17, 2003).

Of all the learning styles, the kinaesthetic style is most heavily emphasised in the program (H. Martin, personal communication, June 16, 2003). This emphasis on kinaesthetics has resulted in a particularly fast-paced program. Harris said that she believed today's children are living in a faster-paced world than did previous generations, and that a high level of activity is required to engage them. Harris explained that she designed the program to replicate the style and energy of a music video. She had observed that her own young children enjoyed the colour, pace and dancing featured in the music videos of groups such as *Aqua, Spice Girls*, and the *Backstreet Boys*. Although these music videos were not developed for a preschool audience, she observed that many young children enjoyed them. Consequently, the *Hi-5* presenters are dressed in fashionable and colourful clothing, and perform choreographed songs and dances in each episode.

Harris also referred to the *Brain Gym*™ Program as an inspiration for the kinaesthetic focus of *Hi-5*. *Brain Gym* was designed to help children with learning disabilities, such as dyslexia (Brain Gym International, 2006). *Brain Gym* involves a series of exercises that are thought to improve hand-eye co-ordination, balance, and focus by crossing the midline to involve left-right brain coordination (Brain Gym International, 2006). Harris's dyslexic son found the program very helpful, and Harris incorporates many of the exercises into *Hi-5*'s dance routines.

1.6.3 Kids Like Us evaluations of *Hi-5*

Kids Like Us do not formally evaluate individual episodes of *Hi-5*. Harris explained that the original pilot episode of *Hi-5* was shown to a test audience. She observed that individual children in the audience responded quite differently to the episode. "Some jumped up and joined in right away, while others watched very attentively. But all of them were engaged”. No modifications to the program format were made after this test screening. Harris does not believe there is any value in formally testing individual episodes of the program, because “using kids you know really well can provide a good basis for research and can tell you more than observing a large group of kids you don’t know” (H. Harris, personal communication, June 17, 2003). For example, she commented that some children will always stare blankly at the television screen, and this does not mean they are less engaged or interested than the child who always jumps around and sings.

1.6.4 Kids Like Us perspectives on the interactive prototypes

None of the Kids Like Us staff had any specific suggestions or comments about the interactive prototypes for the present study. However, they placed no restrictions on the modifications we could make to their program.

1.7 Background to the Australian Broadcasting Corporation and *Play School*

The ABC is Australia’s free-to-air public broadcaster, and has been broadcasting since 1956 (Australian Broadcasting Corporation, 2006). The ABC is a non-commercial broadcaster and aims to deliver content that will “inform and entertain, and reflect the cultural diversity of, the Australian community” (Australian Broadcasting Corporation, 2002, p. 4).

The postgraduates spent the ABC placement divided between several departments; Children’s Television (where *Play School* is produced), New Media, and ABC Management. Brief meetings were conducted with *Play School*’s Series Producer, Deborah Bourne; Executive Producer, Virginia Lumsden; and Early Childhood Advisor, June Buckingham. The *Play School* team were particularly busy during the placement, and the postgraduates had very limited access to them.

1.7.1 Description of *Play School*

Play School has been on air since 1966 and is Australia's second longest-running television program (Bundell, 2006). *Play School* is aimed at a two to five-year old audience (D. Bourne, personal communication, June 2, 2003). Given the length of time *Play School* has been on air, it is a widely known and deeply respected part of the children's television landscape in Australia. Many parents of today's preschool children in Australia themselves watched *Play School* as a child (Bundell, 2006).

Play School is a live-action, segment-based program, with each episode being approximately 24-minutes in duration. *Play School* is broadcast each weekday, morning and afternoon. The program is hosted by two adult presenters, usually a male and a female. Different episodes are presented by different combinations of the approximately 20 actors who feature on *Play School*. Each episode of *Play School* features a story, craft activity, a segment about time showing the *Play School* clock, and a look through the *Play School* windows. There are three *Play School* window shapes (an arch, circle, and square), and in each episode a presenter chooses one window to look through. After selecting a window, a brief animation or live-action video is shown. The five episodes broadcast each morning or afternoon in a given week are linked by a theme, such as frogs. The stories, craft activity, animation or video, and the songs featured in each episode relate to this theme. The presenters in *Play School* sing songs familiar to children, and seldom have any musical accompaniment other than an off-screen piano. The pace of *Play School* is quiet and relaxed, and contains a combination of quiet and more active segments. A scene from the program is shown in Figure 1.3.

Figure 1.3: A scene from *Play School.*

Play School was originally developed in conjunction with the New South Wales Department of Education, and until this association ended in the 1980's, *Play School* had a heavy educational focus and a set curriculum (D. Bourne, personal communication, June 2, 2003). Since then, the makers of *Play School* have considered it to be an entertainment program, rather than an educational one (V. Lumsden, personal communication, June 5, 2003). Lumsden and Bourne rate learning as a low priority compared to enjoyment and engagement. Bourne explained that having the viewer participate during the program is less important to her than having them experience particular activities after the program. Lumsden commented that an episode eliciting low attention and engagement from viewers was not considered undesirable to *Play School's* creators. Instead, she hoped that the program fostered creativity and imagination. Buckingham added that 'getting it wrong' (meaning creating an episode that elicits low viewer interest and attention) is a good outcome because "the kids will turn the TV off and go and play outside. I'd rather they didn't watch television" (J. Buckingham, personal communication, June 2, 2003).

1.7.2 Theoretical underpinnings of *Play School*

Buckingham explained that *Play School* is based on Piagetian and Vgotskian concepts of child development. For example, the two adult presenters often provide 'peer scaffolds' for each other during the demonstration of activities (Vgotsky, 1978). The program draws on Piaget's concepts of assimilation and accommodation to present the viewer with challenging but comprehensible experiences (Ginsberg & Opper, 1988). Buckingham noted that *Play School* is heavily reality-based, presenting children with images, ideas and information that they are likely to encounter in their everyday lives. The presenters in *Play School* relate to the viewers as adults, and avoid behaving like children or adolescents (J. Buckingham, personal communication, June 2, 2003).

1.7.3 ABC evaluations of *Play School*

As with *Hi-5*, there is no formal evaluation process for individual episodes of *Play School.* Lumsden noted that each episode of *Play School* was 'tested' on children prior to broadcast, either in a day-care centre or home setting. However, no systematic evaluation process is used, and no alterations to episodes are made as a result of these evaluations. Instead, Bourne noted that they received feedback on episodes of *Play School* through letters from children and parents.

1.7.4 ABC perspectives on the interactive prototypes

Lumsden had several concerns about the creation of interactive *Play School* prototypes. She explained that interactivity which provided children with choices might actually serve to reduce choice. For example, she said that *Play School* often demonstrates activities, such as a presenter counting trucks. An interactive prototype that allowed the viewer to choose between counting trucks and counting dolls may lead the child to believe that only trucks or dolls could be counted, and that other objects could not.

Lumsden also explained that she did not want the interactive prototypes to utilise the windows motif. In *Play School*, looking through the windows always represents an experience of the 'outside world' and she did not wish to see any interactivity interfering with this (V. Lumsden, personal communication, June 5, 2003).

1.8 Conclusion

The current project involves the development of interactive and control prototypes for *Dora the Explorer, Hi-5* and *Play School*. As discussed, the program makers have differing values and aims which need to be reflected in the prototypes. My role in the project is to evaluate the responses of four and five-year old children viewing the interactive and control prototypes. The aim of these evaluations is to determine the effect of interactive prototypes on children's viewing responses compared to the control prototypes. The evaluations also aim to determine whether particular kinds of interactivity elicit different effects.

CHAPTER 2 – YOUNG CHILDREN AND LINEAR TELEVISION

2.1 Introduction

Interactive television is a relatively recent concept that has been the subject of little research. However, the influence of traditional television on young children has been examined extensively. Perhaps because young children are perceived as the most impressionable and vulnerable members of the community, a great deal of television research has focussed on children under five years of age.

The literature has focussed on the long-term impact of television viewing on factors such as creativity, altruism, school readiness and language development (MacBeth, 1996; Van Evra, 2004). Laboratory studies have typically focussed on television's more immediate effects on attention, comprehension, engagement, and enjoyment (Van Evra, 2004). This chapter will examine the ways these outcomes have been measured in the literature, and the characteristics of television that have been found to influence these outcomes for young children. This chapter will also examine the influence of individual factors, such as gender and age, on children's attention, comprehension, engagement, and enjoyment of television.

2.2 Measuring Children's Responses to Television

2.2.1 Attention

While attention to television can be visual or auditory, the majority of attention research has focussed on visual attention, which can be directly observed. Visual attention can be operationalised as visual orientation or visual fixation (Anderson & Lorch, 1983). Visual orientation literally refers to the proportion of program time when the viewer's eyes are oriented toward the television screen (Anderson & Lorch, 1983). Visual orientation is also referred to as 'eyes-on-screen' (Cole et al., 2001) or 'looking'

(Crawley et al., 2002; Crawley, Anderson, Wilder, Williams, & Santomero, 1999). Anderson and Levin (1976) used a real-time data-recording device to assess attention as a continuous measure. The percentage of program time the viewer spent looking at the television was calculated by having an observer depress a button when the viewer looked toward the screen and release the button when they looked away. The continuous method of measuring attention has been used in many other studies of children's television viewing (Alwitt, Anderson, Lorch, & Levin, 1980; Anderson, Choi, & Lorch, 1987; Calvert, Huston, Watkins, & Wright, 1982; Field & Anderson, 1985; Geiger & Reeves, 1993; Hawkins, Tapper, Bruce, & Pingree, 1995; Lorch & Castle, 1997; Rolandelli, Wright, Huston, & Eakins, 1991; Wright et al., 1984). Using this method, visual orientation has high inter-rater reliability (reported as .95 and above by Alvarez, Huston, Wright, & Kerkman, 1988; Anderson & Levin, 1976; Campbell, Wright, & Huston, 1987; Crawley et al., 2002).

Cole and colleagues report that two other methods are used to measure visual orientation in evaluations of *Sesame Street* episodes; interval sampling and global ratings (2001). The interval sampling method involves observing children at fixed time intervals, such as every 10 seconds, while they view television. The mean number of children attending at different intervals throughout the program is then compared. Alternatively, the global method involves having multiple observers rate whether each child appeared to be highly, moderately, or minimally attentive throughout the program. Anderson and Lorch (1983) note that the advantage of using an observational measure, such as visual orientation, with young children, is that it is non-obtrusive, and allows them to sit, move, and behave in a natural manner during testing.

The alternative to measuring visual orientation is to assess visual fixation, which involves determining the precise location of the viewer's gaze on the television screen (Anderson & Lorch, 1983). This measure provides detailed information about the exact location of a viewer's gaze, which is important in usability testing or during software design and development (Glenstrup, 1995). However, there are difficulties in measuring visual fixation in young children (Anderson & Lorch, 1983). Gaze tracking software requires the viewer to keep their head and eyes still for a calibration period, and then to keep the head still for the duration of viewing (Glenstrup, 1995). While many adults find this task difficult, it is extremely challenging for young children (Read, Kelly, & Birkett, 2006). Given these difficulties, and the observation that young children rarely remain motionless while viewing television, Anderson and Lorch (1983) argue that visual fixation is a more ecologically relevant, and more easily employed, measure than visual fixation for young children. It is noted, however, that neither visual orientation nor visual fixation are pure measures of actual cognitive attention (Cole et al., 2001). A child may be visually oriented toward the television while thinking about something unrelated to the program (Lull, 1980), or may be looking away from the screen while thinking about the content they have seen (Van Evra, 2004).

There are few studies measuring auditory attention in children, and most measure it indirectly through recall of aurally presented information (Field & Anderson, 1985). A direct measure of auditory attention was used by Rolandelli and colleagues (1991). In this study, young children viewed a television program with gradually degrading sound. Participants were told that the television was not working properly, but could be 'fixed' by depressing a lever on the side of the television. The period between when the sound began to degrade and when the sound was fixed was used as a measure of auditory attention.

2.2.2 Comprehension

Comprehension is frequently measured in children's television studies to determine how much of the program content was understood by the child, and is usually assessed by interviewing children individually after viewing (Cole et al., 2001) Three dimensions of comprehension have been reported in the literature; recognition, recall, and skill acquisition, and many studies report using a combination of these approaches. Recognition measures generally involve showing children props or photographic stills of characters, objects and events from the program they viewed, with children being asked to identify the images they had seen (Cole et al., 2001). Given that recognition measures are often nonverbal, Fisch and Bernstein (2001) note that they are useful in dealing with particularly shy children, or those with limited verbal skills. Recall measures involve asking the child questions about specific program content and may be free recall (such as "What did you just see?") (Crawley et al., 1999) or cued recall (such as "Where does Steve keep his notebook?) (Crawley et al., 2002), and is generally assessed in terms of the child's ability to describe specific program content (e.g. characters, events and objects in the program).

Skill acquisition measures assess the generic abilities that the program aims to improve, such as vocabulary (eg. Rice et al., 1990; Salomon, 1979), or children's ability to complete tasks requiring skills or strategies demonstrated in the program. For example, Crawley and colleagues (1999) showed four and five-year old children an episode of *Blue's Clues* containing a matching game. Joe solved the matching game by holding item next to each comparison item to see if they matched. During comprehension testing, the researchers gave children a matching task, and observed whether they used the strategy modelled in the program.

It is noted that all comprehension measures are limited by the extent to which the child is comfortable and willing to communicate with the researcher. Fisch and Bernstein (2001) note that children often understand more than they articulate, and that young children may be particularly unwilling to communicate with an unfamiliar adult researcher. They argue that behavioural observation measures of children's responses to television should be used in addition to verbal measures (Fisch & Bernstein, 2001).

2.2.3 Engagement

Engagement is an observational measure of children's viewing responses designed to assess the extent to which the viewer is interested and absorbed in the content they are watching. Engagement is likely to be a more conservative measure of program interest and absorption than visual attention. For example, a child visually attending to a television program may not necessarily be thinking about the program (Lull, 1980). However, interest and absorption are more likely for a child who is pointing to the television screen or imitating the actions of a program character.

Measures equivalent to engagement have been reported in several children's viewing studies. However, several different terms are used throughout the literature, with different combinations of behaviours observed. For example, Anderson, Lorch, Smith, Bradford and Levin (1981) used the term 'involvement' to refer to all observable behaviours exhibited in response to the program except visual attention, such as laughing and talking about the program. An episode of *Sesame Street* was viewed by 299 three and five-year old children, with their involvement behaviours recorded continuously (in the same way as continuous attention recording). For each child, the percentage of the program where involvement behaviours were present was calculated.

The authors reported that involvement behaviours occurred infrequently (for less than 3 percent of the program duration), however the measure was sensitive enough for significant differences to be found between the age groups (Anderson et al., 1981).

In assessing children's responses to *Sesame Street*, a combination of attention and other observational data is used to assess engagement. For example, Cole and colleagues (2001) report that engagement is sometimes measured by "capturing a sense of children's actions and verbalizations as they watch" (p. 164). At other times, engagement has been operationalised as a combination of visual attention, talking and laughter data (Fisch & Bernstein, 2001).

The term 'interaction' was used by Crawley and colleagues (2002, 1999) in two studies of three to five-year old children viewing *Blue's Clues*. *Blue's Clues* was designed to encourage audience participation, and the study aimed to determine whether children demonstrated more overt interactions when watching *Blue's Clues* compared to other preschool children's programs. Crawley and colleagues (2002; 1999) defined an interaction as either a verbal or nonverbal overt behaviour directed toward the program, or in response to the program. Four categories of verbal interaction were recorded; verbal answers in response to a character's question, verbal imitations of character verbalisations, verbalisations about the program (i.e. "Steve fell over"), and other verbalisations including singing and laughter. Three categories of nonverbal interaction were also recorded; nonverbal answers in response to a character's question, nonverbal imitations of character gestures or actions, and other nonverbal behaviours (primarily dancing) (Crawley et al., 2002). Interactions were recorded continuously, and a percentage of program time spent interacting was calculated for each child.

As with the Anderson and colleagues study (1981), Crawley and colleagues' 1999 study found that interactions occurred infrequently. This study was designed to examine the effect of multiple viewings of *Blue's Clues* and consequently much of the interaction data reported relates to repeated-viewing trends. However, the mean number of combined verbal and nonverbal interactions exhibited during children's first viewing of the program was reported. It was found that four and five-year old children exhibited between 0.33 and 0.57 interactions per minute, depending on whether they were viewing program content classified as 'entertainment' or 'educational' (Crawley et al., 1999). In their 2002 study, Crawley and colleagues reported a mean number of 0.5 verbal interactions and 0.29 nonverbal interactions per minute.

2.2.4 Enjoyment

Enjoyment is a desirable outcome for most media, and the makers of *Dora the Explorer* (Gifford et al., 2002), *Hi-5* (H. Harris, personal communication, June 17, 2003) and *Play School* (V. Lumsden, personal communication, June 5, 2003) list enjoyment as a key priority for their programs. Read and colleagues (2006) note that an individual's enjoyment of media is commonly assessed using self-report, and that this can present difficulties even in adult studies. Self-report measures of enjoyment are particularly challenging with children because of their tendency to respond in what they think is the 'correct' way (Read et al., 2006) or in the way they believe the researcher would like (Airey, Plowman, Connolly, & Luckin, 2002). For example, in a study designed to evaluate children's enjoyment of different computer programs, Read and colleagues report that many young children rated all the programs as ten out of ten (2006).

Airey and colleagues (2002) argue that many of the scales used in assessment of adults' enjoyment are unsuitable for children because they contain unfamiliar words and number-based scales. Most of the studies examining children's enjoyment have used a self-report picture scale, which does not reply on numbers or complex concepts such as 'satisfaction'. For example, Salomon (1977) used a three-point face scale in assessing the enjoyment of two to five-year old children watching *Sesame Street*. The scale featured a happy, neutral, and sad face, and participants were asked to point to the face indicating how much they liked the episode they had watched (Salomon, 1977). This three-point scale was sensitive enough to detect significant differences between children whose mothers encouraged them to view *Sesame Street*, and those whose mothers did not.

Face scales have also been used in assessing children's enjoyment of *Sesame Street* episodes (Cole et al., 2001). Cole and colleagues note that face scales are used in *Sesame Street's* formative research because young children find picture scales simpler to use that verbal scales (Cole et al., 2001). These scales have been sensitive enough to detect significant differences in children's enjoyment. For example, an unpublished study conducted for the Children's Television Workshop, Kiriwil (1996, as cited in Cole et al., 2001) reported significant differences in children's enjoyment of *Sesame Street* characters using a five-point face scale. Face scales were also used by Lewis, Maras and Simonds (2000) to assess preschool children's attitudes to prosocial behaviour. A five-point scale was used, and the authors used several verification questions to ascertain the validity of the scale when used with young children. For example, participants were asked to demonstrate which face showed how much they liked their favourite food, and how much they liked their favourite and least favourite colours. The authors determined that preschool aged children were able to understand the purpose of the scale and use it to communicate their preferences.

Face scales have also been used to assist young children in reporting their pain in medical settings (Wong & Baker, 1998). These researchers created a scale comprising a series of simple faces with expressions ranging from sad to happy. The scale has been used to assess pain in children with different medical conditions and of different ages. Wong and Baker (2001) note that the scale is particularly useful for pain assessment in young children who find it difficult to articulate their pain verbally. A further advantage of the smiley-face scale is that it avoids references to age, gender or race, making it universally administrable.

While researchers such as Lewis and colleagues (2000) and Wong and Baker (2001) report that face scales are well understood and easily used by young children, others have questioned their utility. It has been suggested that young children may have difficulty distinguishing between degrees of happiness or sadness in face scales (Busching, 2000). Read and colleagues discuss some other self-report measures for assessing children's enjoyment (2002). The "again-again" method involves asking participants whether they would like to view the program (or play with the toy) they had just experienced again. This method assumes that children will want to repeat an enjoyable activity, and will not want to repeat an activity they found uninteresting (Read et al., 2002). The 'Funometer', developed by Hanna, Risden and Alexander (1997), is a vertical scale with a moveable face attached. The face can be moved to a position along the scale to represent the enjoyment experienced during the activity. In a study of five to ten year-old children, Read and colleagues (2002) reported little difference between enjoyment ratings provided on the Funometer and a five-point face scale. They note, however, that the Funometer was more readily understood by the older children in the study.

The alternative to measuring enjoyment by self-report is to observe behaviours indicative of enjoyment. Read and MacFarlane (2001) used observational measures to assess the enjoyment of six to ten-year old children playing with a series of toys. The children were observed for behaviours including smiling, laughter, signs of concentrations (such as placing fingers in their mouths), and positive vocalisations (Read & MacFarlane, 2001). However, Read, MacFarlane and Casey warn that observational studies such as this are difficult and time-intensive (2002).

2.3 Factors affecting Attention

Much of the early television research assumed that children's attention to television was initiated and maintained by television's perceptual features, such as rapid scene changes and sound effects. These perceptual, or formal, features are independent of program content (Anderson & Lorch, 1983). A body of literature has since emerged demonstrating that children's attention toward television is dependent upon a number of factors (Van Evra, 2004). It has been found that the comprehensibility of program content, the presence of particular formal features, availability of alternative activities, and whether the viewer is alone or coviewing are important influences on children's attention toward television (Van Evra, 2004).

2.3.1 Comprehensibility of content

The literature suggests that children direct their attention to television based on the moment-to-moment comprehensibility of its content (Van Evra, 2004). Children are most attentive to material that is optimally comprehensible, and show reduced attention when viewing material that is too difficult or that is familiar, repetitive or easily comprehended (Anderson & Lorch, 1983; Crawley et al., 1999; Huston et al., 1990).

Lorch, Anderson and Levin (1979) investigated the relationship between attention and comprehension in a study of five-year old children viewing *Sesame Street*. The amount of visual attention children directed toward the program was manipulated by providing toys to one group of viewers, and no toys to the other. The children's comprehension of the episode was then compared. As anticipated, the children with access to toys were significantly less attentive to the television that the group without toys. The children viewing with toys were attentive for 44% of the program compared with 87% for the children viewing without toys. Lorch and colleagues argued that if attention was the mechanism underlying comprehension (rather than comprehension underlying attention), lower comprehension would be observed for the children with toys. However, no difference in the comprehension of the two groups was found. The authors suggest that this occurred because the children viewing with toys selectively attended to those parts of the program that were optimally comprehensible and interesting (Lorch et al., 1979). That is, these children visually attended to only those portions of the program that required their attention in order to comprehend the content. Conversely, the portions of the program that were too difficult, or that were simple enough to comprehend without visually attending to the television, were spent playing with the toys. Lorch and colleagues suggest the children viewing without toys were able to comprehend the same portions of the program as the children viewing with toys (1979). However, because these children had no activities available to them other than the television, they were highly attentive. Anderson and Lorch subsequently argued that it was the viewers' moment-to-moment comprehension of program content which determined whether they attended to the television or their toys (1983).

Lorch and colleagues (1979) theorised that children monitor television programs aurally, and direct their attention to the content judged to be optimally comprehensible.

This theory was supported by the investigations of Rollandelli and colleagues (1991), who compared five-year old children's comprehension and attention to two types of content. Participants viewed either a program with audio and video content, or a program with only video content (no sound). In both program versions, all relevant content information was presented solely in the video content. It was found that children viewing the audio and video program achieved higher comprehension scores and exhibited greater attention than children viewing the video only program. The researchers concluded that the addition of the audio information assisted the children in comprehending the content, and in directing their attention to comprehensible portions of the program (Rolandelli et al., 1991).

Anderson and Lorch (1983) further tested the theory that the comprehensibility of program content influences attention in a study of two to five-year old children. An episode of *Sesame Street* was created in which half the segments were presented normally, one quarter of the segments were dubbed in Greek, and the remaining quarter were dubbed so the dialogue played backwards. Consequently, the audio of the Greek and backwards-dialogue segments were incomprehensible to the English-speaking participants. Children's attention was found to be significantly higher for the regular segments than for the Greek or backwards-dialogue segments, supporting the theory that comprehensibility guides attention (Anderson & Lorch, 1983). The authors argue that young children are efficient and active processors of television content, directing their attention strategically depending on the comprehensibility of the content. Anderson and Lorch concluded that children direct high attention to material that is optimally comprehensible to them (1983). Conversely, they argue that children direct minimal attention to content which is too difficult for them to understand, or that that is simple or familiar enough for them to comprehend without sustained visual attention

(Anderson & Lorch, 1983). Since this work was done, numerous studies have obtained results supporting the relationship between children's attention to and comprehension of television content (for example Comstock & Paik, 1991; Hawkins, Kim, & Pingree, 1991; Pingree, 1986; Ward & Wackman, 1973; Wright, St. Peters, & Huston, 1990).

2.3.2 Formal features

As discussed, Lorch and colleagues (1979) suggest that children use audio cues to monitor the comprehensibility of program content when they are not attending visually. Many studies have subsequently examined the audio and visual features of programs that are associated with changes in attention. Huston and colleagues have used the term 'formal features' in reference to television's visual and audio attributes (Huston et al., 1981). Formal features are defined as "attributes that arise from production and editing techniques… applicable to many types of content" (Huston & Wright, 1983, p. 36).

Alwitt and colleagues (1980) observed the relationship between particular formal features and visual attention in three, four, and five year olds viewing a range of children's programs. They reported that children's attention was initiated and maintained by the presence of women, women's voices, children, children's voices, auditory changes, peculiar voices, movement, cuts, sound effects, laughter and applause. An earlier study also reported increased attention in the presence of lively music, rhyming, repetition, alliteration, puppets and nonhuman characters, movement, and animation (Anderson & Levin, 1976). Conversely, attention was discontinued (or inattention maintained) in the presence of men's voices, extended zooms and pans, animals, eye-contact, and stills (Alwitt et al., 1980) as well as individual singing, slow music, inactivity, and drawings (Anderson & Levin, 1976). Similar results have been reported by Schmitt, Anderson and Collins (1999).

The finding that formal features, which are by definition independent of program content, are associated with changes in attention appears to contradict the theory that attention is guided by comprehension. While it is acknowledged that certain formal features can initiate attention through their perceptual salience, they also serve to signal particular content features (Huston & Wright, 1983). Alwitt and colleagues (1980) propose that formal features are associated with attention to the extent that they predict content comprehensible to children. For example, they suggest that the presence of children's voices in a program would be predictive of content aimed at, and comprehensible to, children (Alwitt et al., 1980). A formal feature such as a male voice, however, is associated with decreased attention in children because it is suggestive of complex content aimed at adults, such as the evening news (Alwitt et al., 1980). Of course, this explanation suggests that children learn which formal features are associated with comprehensible and incomprehensible content. Alwitt and colleagues propose that children do learn these associations after many hours of television exposure (1980). Therefore, older children and those who have had more exposure to television would be expected to use their attention more strategically in response to formal features than younger children, and those who had had less television exposure. Huston and Wright also suggest that as children become older and more experienced with television's conventions, they are better able to use formal features as a guide to content comprehensibility (1983).

While children learn which formal features are associated with comprehensible content, program makers also use formal features strategically to mark important content (Anderson & Lorch, 1983; Lorch et al., 1979).

2.3.3 Availability of alternative activities

Despite the popular view of children staring at the television screen like zombies (Lesser, 1977; Mander, 1978; Singer, 1980; Winn, 1977), Anderson and Lorch argue that children are rarely observed attending to television at the exclusion of all other activities, in either a laboratory or natural setting (1983). They note that while some children do watch the television with their full attention for long periods of time, it is more common for children to divide their attention between the television and other tasks. They report that children will commonly talk to their parents and siblings, play with toys, leave the room in which the television is located and then re-enter, and have periods of ignoring the television completely (Anderson & Lorch, 1983). Similar viewing behaviours have been observed in other studies (Anderson, Lorch, Field, Collins, & Nathan, 1986; Anderson et al., 1981; Calvert et al., 1982; Gunter, Furnam, & Lineton, 1995; Schmitt et al., 1999).

As discussed, children will attend to alternative activities concurrent with television viewing, if they are available (Lorch et al., 1979). Consequently, 'distracter' materials have been used in many studies of children's television viewing, to avoid the artificially high attention levels than can occur in the absence of other activities (Alvarez et al., 1988; Anderson et al., 1987; Crawley et al., 2002; Crawley et al., 1999; Schmitt et al., 1999).

2.3.4 Individual and group viewing

Children's attention to television is also influenced by the presence of other viewers, who represent an alternative stimulus to the television. St. Peters, Fitch, Huston, Wright and Eakins (1991) note that children commonly view with parents and siblings in home settings. Anderson and colleagues examined attention to episodes of *Sesame Street* for three to five-year old children viewing alone, or in peer groups of two and three (Anderson et al., 1981). It was found that children viewing in groups were significantly less attentive that lone viewers. It was also reported that children influenced the viewing behaviour of other viewers. When one child attended to the television, or looked away from the television, the other children tended to do the same (Anderson et al., 1981). Because children influence each others viewing behaviour in this way, individual viewing is commonly used in attention studies (Fisch & Bernstein, 2001).

2.4 Factors affecting Comprehension

As with attention, many individual factors influence a child's comprehension of television content. These individual factors are discussed in section 2.5. It has been suggested that young children are better able to process information presented visually, rather than aurally (Hayes & Birnbaum, 1980; Hayes, Kelly, & Mandel, 1986). For example, in a study of preschool children, Hayes and Birnbaum found that children recalled more visually presented television content compared with audio content (1980). The authors conclude that young children are better equipped to process visual information (Hayes & Birnbaum, 1980). However, Field and Anderson (1985) reported better recall for auditory than visual information for a television study with five-year olds.

Rollandelli and colleagues suggest that the 'superiority' of visual information may occur because character actions and important aspects of program narrative are often presented visually (1991). In contrast, much of the information that is incidental to the narrative is presented in dialogue or other auditory forms. Hayes and colleagues (1986) also concluded that video is more important in conveying central plot information, while audio is often used to convey information that is not essential to the narrative.

2.5 Individual Differences in Television Viewing

2.5.1 Gender

As Maccoby has noted, gender is a "beautifully binary factor" easily compared in studies of individual differences (1990, p. 513). Huston and colleagues have noted that gender differences in television viewing would be expected given that even young children have sex-typed interests and motivations (1990). Several studies have examined gender differences in young children's attention to television (Bianchi & Robinson, 1997; Campbell et al., 1987; Rolandelli et al., 1991; Truglio, Murphy, Oppenheimer, Huston, & Wright, 1996; Wright et al., 1990). Alvaraz and colleagues (1988) conducted a meta-analysis of nine studies exploring gender differences in attention. This analysis included data from 981 participants aged three to 11; 599 of whom were aged three to five-years. Among the studies examined were a combination of laboratory and home-viewing observations, animated and live-action programs, and programs with male and female characters. Gender differences in attention were reported in five of the studies. In each case, significantly higher attention was reported for boys. In a separate study, Alvaraz and colleagues (1988) also examined the visual attention of five-year olds viewing animations with high or low action content and high or low violence. They study found that boys were significantly more attentive than girls for all program versions. Similar findings were also reported by Rollendelli and colleagues (1991).

The authors concluded that there was strong evidence for gender differences in attention across viewing environments, programs types, and program character gender (Alvarez et al., 1988). However, the authors acknowledged that the basis for the differences between boys and girls was not clear. They suggested that boys might direct more attention toward television than girls because of different preferences for visual and verbal information. It has been argued that boys prefer visually presented information, while girls prefer verbal information (Halpern, 1986). This argument is supported by the findings of Rolandelli and colleagues, who found that girls were more attentive to auditory stimulus while boys attended more to visual stimulus (1991). It was theorised that girls may spend more time monitoring the audio content of television programs than boys, allowing them to comprehend the content while being less visually attentive (Rolandelli et al., 1991). In discussing the results of their meta-analysis, Alvarez and colleagues noted that gender differences in attention did not correspond to any differences in comprehension.

However, Field and Anderson (1985) found that five-year old girls had significantly higher recall of television content than boys. It has been suggested that the differences in comprehension might be expected due to girls' superior verbal abilities (Halpern, 1986). Theoretically, superior language skills would allow girls to comprehend more program dialogue, and better articulate their responses to comprehension questions. It has been widely reported that girls have more developed language skills than boys, and that this is evident from the preschool years (Anastasi, 1958; Gambell & Hunter, 1999; Hallman, 2000; Maccoby, 1966; Maccoby & Jacklin, 1974; Maccoby & Jacklin, 1987). It has also been found that boys have a higher incidence of language difficulties and delays than girls (Prior, Smart, Sanson, & Oberklaid, 1993). However, a meta-analysis has found that the effect sizes in verbal ability separating girls and boys are small enough to be considered negligible (Hyde & Linn, 1988).

Another possible, though unlikely, explanation for girls demonstrating higher comprehension than boys in Field and Anderson's (Field & Anderson, 1985) study is that girls have greater general intelligence. The authors reported a weak but significant positive correlation between attention and IQ, and it is reasonable to expect that comprehension would also be related to intelligence[1]. However, there is no evidence in the literature to support the suggestion that there are gender differences in children's IQ (Anastasi, 1958; Gambell & Hunter, 1999; Maccoby, 1966; Prior et al., 1993).

2.5.2 Age

There is a developmental trend in children's attention to, and comprehension of, television content (Huston & Wright, 1996; Van Evra, 2004; Wartella, 1979). From observations of one to four–year olds viewing behaviour, Levin and Anderson reported that attention increased with age, and that rapid increases occurred after 2.5 years (1976). Anderson and Lorch suggest that this increase in attention at about 2.5 years is consistent with children's cognitive development occurring at that time (1983). Piaget's theory of cognitive development posits that children change from sensorimotor to preoperational representations at approximately two years of age (Ginsberg & Opper, 1988), and Anderson and Lorch suggest this shift would allow children to apply television related schema to their viewing (1983). Consequently, higher attention and comprehension would be expected. Huston and colleagues (1990) have also argued that children comprehend more television content as they become older and their understanding of television conventions and formal features increases.

Empirical studies have confirmed that children's comprehension of television content increases with age. In studies of children aged between three and five years, comprehension has been found to be significantly higher for older children (Crawley et al., 2002; Crawley et al., 1999; Huston et al., 1990). Studies of children aged between five and 11 years have also reported significantly higher comprehension for older

[1] It is noted that Field and Anderson (1985) did not suggest IQ accounted for gender differences in attention.

children (Calvert et al., 1982; Collins, 1979; Field & Anderson, 1985; Rolandelli et al., 1991; Wright et al., 1984)

In a study of 60 three and five-year olds viewing *Sesame Street,* Anderson and colleagues also reported significantly higher overt involvement (engagement) for five-year olds than for three-year olds (1981).

2.5.3 Socio-economic status

It is widely held that socio-economic status is related to television use (Condry, 1989; Pinon, Huston, & Wright, 1989; Truglio et al., 1996). Socio-economic status appears to be related to television viewing in two important ways; access to alternative activities, and attitudes. For example, an ethnographic study of television use in Brazil found that television acts as the primary leisure activity for many working class people, while middle- and upper-class families viewed television as a less-preferred alternative to a wide selection of recreational activates (Leal, 1990). Similar findings have been reported in many studies conducted in the United States and Britain. Fetler (1984) suggests that television is less stimulating than the many other recreational activities available to children in affluent homes. Similarly, Brunsdon (1997) argues that television is viewed by the middle- and upper-classes as a “bad cultural object” (p. 114). According to Brunsdon, these groups approve of television only when the programming is considered culturally or educationally worthwhile. Truglio and colleagues (1996) report that there is a significant inverse correlation between the amount of television viewed by children and the income and education of their parents. Similar findings have been reported by Bianchi and Robinson (1997), Huston and colleagues (1990) and Pinon and colleagues (1989).

In a United States study, Burdette and Whitaker (2005) report another explanation for why children from lower socio-economic backgrounds view more television compared to their higher socio-economic counterparts. The authors suggest that children living in dangerous neighbourhoods would spend less time playing outdoors, and would therefore be likely to spend more of their recreation time viewing television. The mothers of 3141 three-year old children rated the perceived safety of their neighbourhoods, noting the presence of threats such as loitering adults, drunks, and gang activity. Burdette and Whitaker note that neighbourhoods perceived as unsafe were low socio-economic areas and were associated with lower maternal education and income than safer neighbourhoods (2005). It was found that the children of mothers who lived in unsafe neighbourhoods did watch significantly more television on a weekly basis than the children of mothers in safer areas.

2.5.4 Experience with television

There is reason to expect that the amount of television a child has viewed will influence the way they attend to and comprehend television programs. Anderson and colleagues note it is a "reasonable assumption that percent attention to TV might be negatively or positively correlated with time spent with TV. A negative correlation would be expected if, for example, lighter viewers find TV more novel, and therefore, of greater attention value" (1986, p. 1030). It has been suggested that children with more experience of television have more developed comprehensional schema for understanding television (Huston & Wright, 1983; Huston et al., 1990), and are therefore better positioned to comprehend content than children with less television viewing experience. Adults and older children are familiar with the television conventions that need to be learnt by young children. For example, a young child may not understand that audio of a character's voice presented concurrent with video of the character without her mouth moving indicates what she is thinking, rather than what she is saying. Therefore, children with greater television experience are more likely to comprehend television programming compared with less experienced children.

Anderson and Lorch argue that children's attention to television depends on "his or her experience with the medium, familiarity with the specific program, level of cognitive development, and general world knowledge" (1983, p. 9). Therefore, it is reasonable to assume that children who spend more hours watching television (more experienced viewers) would have greater comprehension of television content than children who spend less time watching television (less experienced viewers). Conversely, it would be reasonable to expect that experienced viewers would require less visual attention to comprehend the same content as less experienced viewers.

Crawley and colleagues (2002) examined the viewing behaviour of children who were regular watchers of *Blue's Clues* (experienced viewers), and children who had not viewed the program (inexperienced viewers). Children aged between three and five-years were assessed for their attention and comprehension of the program. It was found that experienced *Blue's Clues* viewers had similar comprehension to inexperienced viewers, but that they directed significantly less attention to the television (Crawley et al., 2002). This finding suggests that experience with the program made children more efficient in dividing their attention between the program and other stimuli. Interestingly, the experienced viewers also directed significantly less attention and obtained similar comprehension scores than inexperienced *Blue's Clues* viewers when both groups watched another program (*Big Bag*) which neither group had seen before. This finding lead the authors to conclude that experience with one program plausibly affects the way they view other programs (Crawley et al., 2002). Therefore, it is reasonable to expect that children familiar with a range of television programs, or that view a great deal of television, would respond in a manner similar to experienced viewers in Crawley and colleagues' study.

CHAPTER 3 – YOUNG CHILDREN AND INTERACTIVE TELEVISION

3.1 Assessing Children's Responses to Interactivity

As discussed in Chapter 1, there have been few interactive television programs designed for young children globally, and no published studies examining children's responses to them. Consequently, there is a gap in current understandings of how interactivity might be applied in children's television programs, and the kinds of interactive applications that children comprehend and enjoy. Given the paucity of research in this area, there is little empirical basis to form hypotheses about children's responses to interactive television. However, there are theoretical reasons to expect that interactivity might benefit children's television. This literature, and the implications for interactive television, are discussed below.

The terms 'interactive' and 'interactivity' have been used to refer to a broad range of technological characteristics and capabilities (Wartella et al., 2000). Carey notes that there is no consensus on what 'interactive' means and, consequently, the term is used by marketers to describe almost any media technology development (Carey, 1996). Wartella and colleagues (2000) suggest that this lack of a unitary definition has made it difficult to assess the effect of 'interactive' versus 'non-interactive' media in a cumulative way.

Interactive media refers to a range of technologies such as computer games, video games, the internet, and computer software such as CD-ROMs, which allow users to enact influence over the media experience (Heeter, 2000). Wartella and colleagues (2000) point out that interactive media differ in the extent to which they allow users to contribute to the media experience, and how responsive they are to these contributions. For example, an internet chat room, where users can post messages and reply to other users' messages, provides a substantially different interactive experience to a CD-ROM allowing users to try out different hairstyles on pictures of themselves.

There is a common assumption that interactive media provide benefits for young children that are not provided by traditional media (Wartella et al., 2000). However, Wartella and colleagues have pointed out that there are few systematic and developmentally-grounded explanations for how and why interactivity would elicit these positive effects. They question whether interactive media "influence processing of the information, even as increased comprehension and retention, or does it influence perceptions of the task, such as increased motivation for sustained engagement?" (Wartella et al., 2000, p. 56)

The notion that children are passive when viewing television (Mander, 1978; Winn, 1977) has been contested (Anderson & Lorch, 1983). However, it is possible that some media formats require more active processing from viewers than others. Wartella and colleagues (2000) point out that developmental theorists including Piaget and Vgotsky emphasise the importance of active learning. Piaget theorised that children learn best when they are actively engaged, rather than passively observing (Ginsberg & Opper, 1988). Therefore, it is possible that interactive television may stimulate greater attention and comprehension in young children because it requires a form of activity that traditional television does not.

Salomon's theory of invested mental effort also provides theoretical support for the benefits of interactive television (1983; 1984). Salomon proposes that children invest more or less effort in understanding media depending on the effort they perceive that media requires, and the payoff they perceive will be received for their efforts (1984).

Cohen and Salomon (1979) suggest that children comprehend and retain more television content when they invest greater effort in their viewing.

Crawley and colleagues conducted two studies on the impact of *Blue's Clues* on young children's attention and comprehension (2002; 1999). As discussed in Chapter 1, *Blue's Clues* encourages overt participation from viewers. The viewer is encouraged to call out answers, point to areas on the screen and perform physical actions during the program (Crawley et al., 1999). When compared to another animated preschool children's program that was not designed to encourage overt participation, it was found that three to five-year old children watching *Blue's Clues* had significantly higher attention and comprehension than viewers of *The Busy World of Richard Scarry.* The authors suggest that *Blue's Clues* may elicit high attention and comprehension from viewers because of it's focus on overt participation (Crawley et al., 1999). They also argue that "based on Salomon's (1983) theory of invested mental effort… traditional educational television programs that do not invite active participation may not be perceived by young viewers as requiring sustained mental effort" (Crawley et al., 1999, p. 636). A logical conclusion from this suggestion is that interactive television programs, which encourage action and participation from viewers in a way traditional television does not, would be perceived by children as necessitating increased sustained effort. Higher attention and comprehension would be the expected consequences of such a perception.

Another explanation for why interactivity might enhance children's television is that the provision of choice in itself may increase interest and intrinsic motivation. Calvert, Strong and Gallagher (2005) observed 53 four and five-year old children viewing a computer-based *Blue's Clues* story book. Children co-viewed the story with an adult, and in the three program conditions children had varying control over the computer mouse; no control, shared control, or total control. Children's attention to the story was observed, and after viewing the story on two occasions, children were asked a series of comprehension questions. It was found that children who had total control over the mouse directed more attention to the story than children who had no control. However, no differences in story comprehension were found between the groups. Calvert and colleagues conclude that control is an 'engagement feature' which functions to increase children's interest and attention in media content (Calvert et al., 2005). These findings suggest that interactive television programs might also increase children's interest and attention by providing a sense of control.

Finally, interactivity may enhance children's television because viewers are able to select content that is personally appealing to them, thereby increasing their interest in the content. Cordova and Lepper (1996) examined the effects of personalisation and choice on primary school-aged children's learning from, and enjoyment of, a maths-based computer game. In the personalisation condition, the child's name, birthday, favourite foods, and friend's names were incorporated into the game narrative. In the choice condition, participants were able to choose the name of the spaceship featured in the game, and choose the icon that represented them on the computer screen. The control version of the game was not embellished in either of these ways. It was found children in both the personalisation and choice conditions demonstrated significantly greater learning from the game (as evidenced by pre and post-test math skills comparisons) and enjoyment of the game. Cordova and Lepper (1996) concluded that personalisation and choice increased the self-relevance of the game to children, thereby increasing their intrinsic motivation to play the game. Given these findings, it is reasonable to expect that interactive television programs offering choice and personalisation might provide more relevant content to viewers. This might in turn increase young children's motivation to attend to and learn from television programs.

3.2 Developing Interactive Prototypes for the Present Study

A number of limitations were placed on the nature of the interactive prototypes tested in this study. The prototype designer developed the prototypes according to his creative and aesthetic preferences but was constrained by particular partner and investigator requirements. These constraints are discussed below.

3.2.1 Number of prototypes

At the commencement of the study, it was determined that three interactive and one non-interactive (control) prototype would be developed for each of the partners' programs; *Dora the Explorer, Hi-5* and *Play School.* This resulted in the development of nine distinct interactive applications. This would provide each of the partners with three potential interactive applications for their program, and data about children's responses to them.

3.2.2 Number of interactions in each prototype

The academic team determined that each prototype would feature one interactive application. Of course, more interactive applications could have been evaluated if multiple interactions were contained in each prototype. However, multiple interactive applications in each prototype would have made it difficult to determine which applications (or combinations of applications) were eliciting which effects. Similarly, it was decided that interactivity would only occur once within each prototype. The only exception to this was one of the *Hi-5* prototypes, which is discussed in section 3.3.6.

3.2.3 Length of prototypes

It was decided that the prototypes would be shorter in duration that a regular broadcast program. Each episode of *Dora the Explorer, Hi-5* and *Play School* is approximately 24 minutes in duration. Given that only one instance of interactivity was to occur in each prototype, it was decided that a reduced program duration would be appropriate. All of the prototypes were between 12 and 15 minutes in duration. Because there were 12 prototypes developed for this study, reducing the prototype length by almost half afforded a considerable time saving for both the prototype designer and the Researcher.

3.2.4 Target age for prototypes

The target age group for the prototypes was fixed at four and five-year olds. The rationale for this decision was two-fold. Firstly, these ages were common to the three partner's programs. The target age of each of the programs is four and five years for *Dora the Explorer* (C. Ricci, personal communication, May 29, 2003), two to eight years for *Hi-5* (H. Harris, personal communication, June 17, 2003), and two to five years for *Play School* (H. Martin, personal communication, June 16, 2003). Children younger than four-years old are difficult to access for data collection. Only a subset of children aged under four years attend day-care centers or play groups, and there was concern that recruiting from such places might result in a non-representative sample. In Western Australia children begin attending pre-primary classes (which are attached to primary schools) at age four.

3.2.5 Interactive interface[2]

Just as the mouse and keyboard are the devices used to respond to computer content, it has been predicted that the remote control will be the primary device used to respond to

[2] The rationale and supporting literature for these interface decisions is beyond the scope of this thesis, and is addressed by another postgraduate student contributing to the larger project.

interactive television content (Srivastava, 2002; Swann, 2000). To replicate what is anticipated to be future ‘real world’ conditions, and to provide participants with a sense that they were viewing television content (rather than computer content, for example) it was decided that the interactive prototypes would be operated by remote control. Participants were directed to interact with the prototypes using the coloured buttons on the remote control. The interface was designed to be clear and comprehensible to young children. Coloured buttons were represented on the television alongside symbols depicting an aspect of the available content. This interface in demonstrated in Figure 3.1.

Figure 3.1: Screenshot depicting screen layout and use of icons

In this prototype, the viewer is able to choose a pathway for Dora. The viewer can select the path to the flowers by pressing the blue button, or the path to the dragon by pressing the yellow button. As illustrated in Figure 3.1, a portion on the left and bottom of the screen was reserved for the interactive elements.

A final feature of the interface was the use of ‘confirmatory’ features. Each time participants interacted with a prototype, the coloured button icon on the screen would flash or wiggle before the selected content commenced. This confirmed to the viewer that their button press had ‘worked’ and that their action had brought about the subsequent content.

3.2.6 Calls to action

The term ‘call to action’ is used in reference to an instruction or notification that an interaction is possible. Interactive applications designed for adults typically employ text-based calls to action (Srivastava, 2002). For example, the message “Press the red button for tomorrow’s weather forecast” may appear at the bottom of the screen during an interactive news broadcast. Obviously, text-based calls to action are unsuitable for young children, and so it was decided that the calls to action in the present study would involve a combination of verbal instructions and accompanying symbols (represented in Figure 3.1).

The prototype designer decided that the calls to action should be as imbedded as possible within the context of the original programs, and that this would be best achieved by having a program character or presenter provide the calls to action. It was thought that this would provide a more cohesive experience than if an unfamiliar or unrelated character gave the call to action. Nickelodeon arranged for the actress providing the voice of Dora to record the calls to action for the *Dora the Explorer* prototypes. These were edited together with suitable video footage to create the calls to action. The producers of *Play School* provided an audiovisual recording of one of their regular presenters, Andrew, providing the calls to action. These were edited into existing episode segments of *Play School* featuring Andrew. In this way, the calls to action were provided by a presenter featuring in the prototypes. Ideally, the calls to action for *Hi-5* would have been made by one of the *Hi-5* presenters. Unfortunately, *Hi-5*’s busy filming and touring schedule made it impossible to obtain the calls to action using the *Hi-5* presenters or set. In place of this, a puppet was used to provide the *Hi-5* calls to action. The puppet, named Bingo, was filmed in the production studios at Murdoch University. A picture of Bingo is shown in Figure 3.2. Bingo's calls to action were edited into the *Hi-5* prototypes.

Figure 3.2: Bingo the Puppet

Clearly, Bingo's calls to action were not as well integrated in the *Hi-5* prototypes as Dora and Andrew's were in *Dora the Explorer* and *Play School,* respectively.

3.2.7 Prototype introductions

The postgraduate responsible for evaluating usability designed a series of audiovisual introductions for each of the prototypes. The introductions were shown to participants prior to the commencement of the prototypes. All introductions featured Bingo, and were between ten and 60 seconds in duration. Essentially, the interactive prototype introductions informed participants that they could use the remote during the prototype, and the control prototype introductions informed participants that they would be watching a special television program. Detailed discussion about the rationale for these introductions, and children's responses to them, are included in the abovementioned postgraduate's thesis and are therefore not included in this work.

3.2.8 Constraints from the program makers

The partners were concerned that the interactive prototypes be consistent with the ethos and stylistic conventions of their programs (see Chapter 1). This placed certain restrictions on the interactive applications that could be used. For example, the producers of *Play School* requested that the iconic *Play School* windows not be used for the interactive components of the prototypes. Similarly, no modifications were to be made to the appearance of Dora or Boots in *Dora the Explorer*, as these characters are dressed identically in every episode.

3.2.9 Technological constraints

There were technical limitations on the kinds of interactivity that could be applied to the prototypes. The prototypes had to be producible given the technical capacity of the Institute and the production resources available from the partners. Given that participants were to be tested individually and asynchronously, interactive prototypes that required live collaborations between viewers were not viable. Technical limitations of testing in a portable facility also precluded the use of cable or fixed-line applications.

3.3 Prototype Concepts and Executions

After consideration of all these constraints the prototype designer, in collaboration with the industry partners, designed three interactive prototypes and one control prototype for each program. The concept, rationale, and execution of each of these prototypes are discussed below. The prototype designer named each of the interactive prototypes. The prototype names were reflective of the designer's rationale for the concepts underlying each application. As part of the comprehension testing participants were asked to explain what they had done during the prototypes. For some prototypes, participants' interpretations of the interactivity differed from the prototype designer's perspective.

(Participants' understandings of the prototypes are discussed in Chapter 5). As a result of these findings, the prototypes were renamed for the purposes of this thesis. This was done to avoid the tendency, discussed by Wartella and colleagues (2000), for researchers to frame interactive content in terms of adult perceptions.

3.3.1 *Dora the Explorer* Control

The four *Dora the Explorer* prototypes were adapted from episode #304 "Benny the Potato", provided by Nickelodeon. In this episode, Dora and Boots meet their friend Benny, a bull, walking in the jungle. Benny finds a magic wand, and while attempting a magic trick, accidentally turns himself into a potato. Dora and Boots decide to help Benny by taking him and the magic wand to the wand's owner, the Wizard. The trio pass a number of obstacles on their way to the Wizard's Castle.

3.3.2 *Dora the Explorer* Character Assistance

All of the programs being studied in this project can be considered 'interactive' in the sense that they directly address the viewer and encourage participation with the program. In *Dora the Explorer*, the viewer is also directly encouraged to verbally and nonverbally answer questions or perform actions to assist Dora. This could be considered a non-technological form of interaction. The same answers or actions could be provided using the remote control, making the interaction technological. This prototype was developed to determine how using the remote control in place of a non-technological interaction influences children's viewing behaviour. This is a relatively simple and cost effective way to add interactivity to a program, as no additional content is required.

Each episode of *Dora the Explorer* features Swiper the Fox, a villain-type character who tries to 'swipe' things from Dora and Boots. In its traditional format, the viewer is encouraged to participate with the program by verbally warning Dora when Swiper is approaching. In *Dora the Explorer* Character Assistance the viewer is able to warn Dora that Swiper is approaching by using the remote control.

The prototype designer deemed that this application was well suited to *Dora the Explorer* because the program's CD-ROM influenced presentation style is consistent with technological participation, and because the program gives the most explicit encouragement to participate of all the programs in this study.

Figure 3.3: Screenshots illustrating aspects of the interactivity in *Dora the Explorer* Character Assistance.

Figure 3.3 demonstrates portions of the interactivity in this prototype. The screenshot on the top right of Figure 3.3 shows Dora providing the call to action, telling viewers that they can warn her if they see Swiper coming by pressing the red button on the remote control. Concurrent with the verbal call to action, a red button and Swiper appear at the bottom of the screen. The screenshots on the left and bottom right of Figure 3.3 show portions of the interactive segment where Swiper is approaching. As shown, the red button and Swiper icon are present throughout the interactive segment and the participant is able to press the red button at any time during Swiper's approach. The icon seen on the upper left corner of the screen in both of these screenshots depicts Swiper holding an alarm bell. This icon appears every time the red button is pressed, to confirm to the participant that their button press was registered.

3.3.3 *Dora the Explorer* Minor Narrative Choice

Interactive television can be used to provide viewers with choices about aspects of a program narrative. Conceptually, this application is similar to the children's book series "Choose Your Own Adventure". These books allowed readers to choose between a limited number of alternatives at fixed points in the story. However, allowing narrative choices within a television program is problematic because of the expensive involved in producing content that will only be viewed by a subset of the audience. This prototype was designed to determine whether giving children the ability to make minor choices that require little additional production is as salient to children as the ability to make major choices requiring more production.

In this episode of *Dora the Explorer,* Benny the bull accidentally turns himself into a potato using a magic wand he found. Dora and Boots decide to return the wand to its owner, the Young Wizard, and ask him to turn Benny back into a bull. In the control prototype, Benny is transported to the wizard's castle in a wagon because he is unable to walk. The wagon happens to be coloured red, a minor detail in the episode narrative. In Minor Narrative Choice, the viewer is able to choose the colour of Benny's wagon. Using the coloured buttons on the remote control the viewer can select a blue or yellow wagon for Benny. The selected wagon is then featured for the remainder of the episode.

Figure 3.4: Screenshots illustrating aspects of the interactivity in *Dora the Explorer* Minor Narrative Choice.

Figure 3.4 demonstrates aspects of the interactivity from this prototype. The screenshot on the left of Figure 3.4 shows Dora providing the call to action, inviting the participant to select one of the coloured wagons for Benny. This screenshot shows the blue button and an icon with the blue wagon, along with the yellow button and an icon with the yellow wagon. The screenshot in the top right of Figure 3.4 depicts the outcome occurring if the yellow wagon is selected. The icon of the yellow wagon briefly moves from side to side to indicate that the button press was registered, and Benny is placed in the yellow wagon. The screenshot in the bottom right side of Figure 3.4 shows the outcome occurring if the blue wagon is selected. The icon of the blue wagon moves briefly, and Benny is then placed in the blue wagon.

3.3.4 *Dora the Explorer* Major Narrative Choice

As with Minor Narrative Choice, this prototype explores the issue of interactive narrative. This prototype explores children's responses when presented with the opportunity to make major choices in a program narrative. Applications exploring aspects of narrative are suited to *Dora the Explorer*, which is the only narrative-based program examined in this study. In the control version of this episode, Dora and Boots pass three landmarks; the magic garden, the golden gate, and the Wizard's castle. In Major Narrative Choice, the viewer can chose between two pathways leading to the magic garden; past the giant flowers or past a sleeping dragon. The choice is made using the coloured buttons on the remote control. The viewer is told to push the blue button for Dora to pass the giant flowers, or the yellow button for Dora to go pass the sleeping dragon. After the program moves on to either the flowers or dragon segment, the prototype resumes outside the magic garden and the prototype continues as in the control prototype.

Figure 3.5: Screenshots illustrating aspects of the interactivity in *Dora the Explorer* Major Narrative Choice.

Figure 3.5 demonstrates aspects of the interactivity in this prototype. The screenshot on the left of Figure 3.5 shows Dora providing the call to action, asking the viewer to choose the path to the giant flowers or the sleeping dragon. This screenshot shows the blue button and the icon of a flower, and the yellow button with an icon of a dragon. The screenshot at the top right of Figure 3.5 shows the outcome occurring if the viewer selects the flowers path. The icon of the flowers appears throughout the subsequent segment to confirm the participant's choice. The screenshot at the bottom right of Figure 3.5 shows the outcome occurring if the viewer selects the dragon. The icon of the dragon also appears throughout the subsequent dragon segment to confirm the participant's choice.

3.3.5 *Hi-5* Control

The four *Hi-5* prototypes were adapted from several episodes in season #4. *Hi-5* is a segment-based program and each episode contains several segments featuring each of the five presenters. The control prototype contained one segment from each of the five presenters in addition to the opening and closing songs featuring all five presenters.

3.3.6 *Hi-5* Segment Repetition

Interactivity can be used to provide the opportunity to repeat portions of program content. This application was designed to allow children to repeat a program segment if they wish to re-view it. There are five segments in the control version of this episode, each featuring one of the five *Hi-5* presenters. Charli's segment involves her singing a lullaby to put her teddy bear to sleep. Once the bear is put to bed, Charli sings a 'rock and roll' version of the lullaby, which wakes the bear. In *Hi-5* Segment Repetition the participants is able to view the segment again. The viewer is directed to press the red button if they would like to hear Charli sing the song again. Those viewers who chose to repeat the song re-view the segment. Those viewers who do not opt to see the song again view the remainder of the episode as usual. This application does not require the production of any additional content and would therefore be inexpensive to implement.

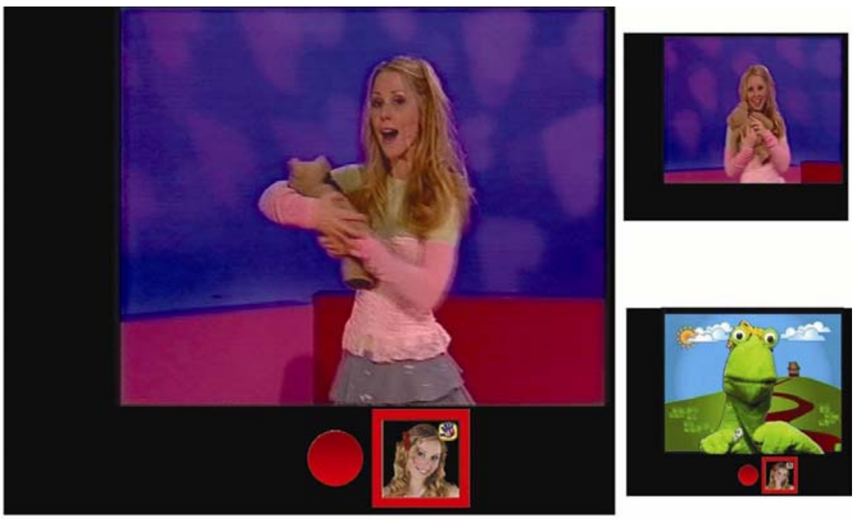


Figure 3.6: Screenshot illustrating aspects of the interactivity in *Hi-5* Segment Repetition.

Figure 3.6 demonstrates aspects of the interactivity available in this prototype. The screenshot on the top right of Figure 3.6 shows the screen during the first viewing of the Charli segment. The screenshot on the bottom right of Figure 3.6 shows Bingo providing the call to action, with a red button and Charli icon appearing at the bottom of the screen. The screenshot on the left of Figure 3.6 shows the screen as it appears during the repeated segment. For this second viewing, the red button and Charli icon appear throughout the segment in confirmation of the participant's choice.

3.3.7 *Hi-5* Presenter Choice

Interactivity can provide viewers with the ability to make choices about the content they view. When provided with a choice, viewers can select the content that is of greatest appeal or interest to them. In this application participants can choose which presenters' segment to view.

In the control version of this episode, the five presenters' segments are viewed in a pre-determined order. The third and fourth segments are presented by Nathan and Tim, respectively. In Presenter Choice the viewer can choose whether they see the Nathan or Tim segment next. After the second segment, Bingo invites the viewer to choose who they see next. Bingo invites participants to press the blue button to see Nathan next, or the yellow button to see Tim next. If the viewer chooses to interact, they are presented with the selected presenter's segment. When that segment concludes the viewer is then presented with the non-selected presenter's segment. In this way, the participant views all of the program segments, and just selects the order in which they are viewed. If the participant does not make a choice, they view the segments in the pre-determined order.

This application is suited to *Hi-5* because of its segment-based format, and because the five presenters are a strong feature of the program. Unlike *Play School*, the same presenters are present in every episode, making the choice of presenter possible on an ongoing basis. This application also requires no additional content.

Figure 3.7: Screenshots illustrating aspects of the interactivity in *Hi-5* Presenter Choice.

Figure 3.7 demonstrates aspects of the interactivity featured in this prototype. The screenshot on the left of Figure 3.7 shows Bingo providing the call to action, asking the viewer to chose between watching Nathan or Tim next. This screenshot shows the yellow button and Tim icon, and the blue button with the Nathan icon. The screenshot in the top right of Figure 3.7 shows the outcome occurring if the Nathan segment is selected. The Nathan icon moves to indicate the button press has been registered, and the Nathan segment then plays. The blue button and Nathan icon continue to appear throughout the segment to confirm the viewers' choice. The screenshot in the bottom right of Figure 3.7 shows the outcome occurring if the viewer selects the Tim segment. The Tim icon moves to indicate the button press has been registered, and the Tim segment then plays. The yellow button and Tim icon continue to appear throughout the segment to confirm the viewer's choice.

3.3.8 *Hi-5* Collecting Cards

Interactive programs can be used to elicit remote control use from viewers periodically throughout a program, thus encouraging sustained attention. This application was designed to reward children for their continuing attendance to the prototype. In the control version of this episode, participants view all segments. In Collecting Cards participants view the same five segments, but with a collectable icon (card) featuring in each presenter's segment. During each segment a card featuring the presenter appears on the screen. Participants can 'collect' the card at any time during the segment by pressing the red button. Potentially, participants can collect all cards throughout the prototype.

Figure 3.8: Screenshots illustrating aspects of the interactivity in *Hi-5* Collecting Cards.

Figure 3.8 demonstrates aspects of the interactivity in this prototype. The screenshot on the top right of Figure 3.8 shows the screen during the first segment, featuring Kellie. As shown, there are five cards 'face down' on the left of the screen. A red button and a Kellie card appear on the bottom of the screen. In order to collect the Kellie card, the participant presses the red button. The screenshot on the left of Figure 3.8 shows Nathan's segment, with the red button and Nathan card appearing at the bottom of the screen. On the left of the screen, the cards previously collected by the viewer are featured. The screenshot on the bottom right of Figure 3.8 depicts the screen as it would appear during the prototype's closing song if all five cards had been collected.

3.3.9 *Play School* Control

Play School is also a narrative-based program. The four *Play School* prototypes were adapted from series #135, 'Cats and Dogs'.

3.3.10 *Play School* Theme Repetition

As suggested, interactive television can be used to provide the repetition of content. In this application, the participants can choose to view content that repeats a theme previously featured in the episode. In the control version of this episode, two presenters sing a song called "My dog, Bill". In Theme Repetition, the presenters sing this song, and the participant has the option of viewing another song about a dog. The viewer is directed to press the red button if they would like to view another song about a dog. If the viewer chooses to view another song, a segment featuring another dog song is presented. If the participant does not choose to see another song, the prototype continues as in the control prototype.

This application is well suited to *Play School* because the program often explores objects in different contexts and formats. For example, an episode about frogs might feature songs, stories and a dance about frogs. Consequently there is a large archive of segments available to *Play School* for this application. This enhancement would therefore require little additional production and is consistent with the program's segment-based format.

Figure 3.9: Screenshots illustrating aspects of the interactivity in *Play School* Theme Repetition.

Figure 3.9 demonstrates aspects of the interactivity featured in this prototype. The screenshot on the top right of Figure 3.9 shows the screen during the first dog song. The screenshot on the left of Figure 3.9 shows Andrew providing the call to action, with a red button and a dog icon appearing at the bottom of the screen. The screenshot on the bottom right of Figure 3.9 shows the screen as it would look if the participant elected to view another dog song. For this viewing, the red button and dog icon appear throughout the segment to confirm the participant's choice.

3.3.11 *Play School* Story Choice

As discussed, interactivity can provide viewers with the ability to make choices about the content they view. When provided with a choice, viewers can select the content that is of greatest appeal or interest to them. In this application, participants can choose which story they would like to view. In the control version of this episode, the participant views a story about a dog during the regular story segment. In *Play School* Story Choice, the participant can choose between a story about dogs and a story about cats. Andrew invites the viewer to push the red button to hear the dog story, or the blue button to hear the cat story. After viewing either the dog or cat story, the prototype resumes as in the control prototype.

It is consistent with *Play School*'s ethos to explore themes of interest to children. This application requires little additional production for *Play School* given their extensive archives. As with *Hi-5* Presenter Choice, this enhancement allows the viewer to select from two familiar options. It is assumed that cats and dogs are familiar and well-understood concepts to children of this age.

Figure 3.10: Screenshots illustrating the interactivity in *Play School* Story Choice.

Figure 3.10 demonstrates aspects of the interactivity featured in this prototype. The screenshot on the left of Figure 3.10 shows Andrew providing the call to action, asking the viewer to choose between the dog and cat stories. This screenshot shows the red button with a dog icon, and the blue button with a cat icon. The screenshot in the top right of Figure 3.10 shows the outcome occurring if the participant selected the dog story. The red button next to the dog icon flashed to indicate that the button press had been registered, and the dog story was viewed. The red button and dog icon continue to appear throughout the segment to confirm the participant's choice. The screenshot in the bottom right of Figure 3.10 shows the outcome occurring if the participant selected the cat story. The blue button next to the cat icon flashed to indicate the button press has been registered, and the cat story then played. The blue button and cat icon continued to appear throughout the segment to confirm the participant's choice.

3.3.12 *Play School* Task Participation

Interactive television can be used to elicit participation from the viewer. In this application, the viewer is able to participate in a task being performed by using the remote control. In the control version of this program, presenter Justine plays a matching game. Attached to a pin board, Justine has cardboard cut-outs of four people; a builder, surfer, chef, and a pilot. Justine holds cardboard cut-outs of four bags which belong to the four people. In the game, Justine matches the bags with their owners and often asks the viewer if she matching the bags correctly. In *Play School* Task Participation, the viewer can indicate whether Justine has correctly matched the bags, using the remote control. For example, when Justine holds the beach bag next to the surfer, the viewer is invited to press the red button if they think the bag is correctly matched. If the participant correctly identifies the bag as belonging to the surfer by pressing the red button at the correct time, a star appears on the left-hand side of the screen. If the participant incorrectly identifies a bag as belonging to a person by pressing the red button when a bag is matched to the wrong person, a ‘try again’ audio tone occurs and no star appears. Whether the viewer chooses to participate or not, the segment moves on at the same pace. After this segment is completed, the rest of the prototype continues as in the control prototype.

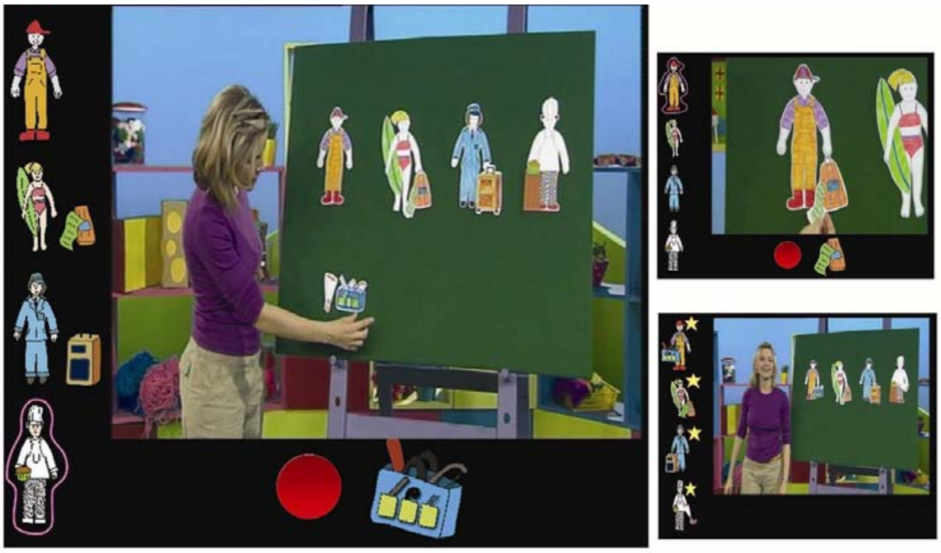


Figure 3.11: Screenshots illustrating the interactivity in *Play School* Task Participation.

Figure 3.11 demonstrates aspects of the interactivity featured in this prototype. The screenshot on the upper right of Figure 3.11 shows the screen at the start of this segment. The four bagless people appear on the left of the screen. As Justine deliberates which bag belongs to which person, she holds the bag next to each person in turn. As seen in this screenshot, Justine is holding the beach bag next to the builder. The red button and an icon of the beach bag appear at the bottom of the screen as Andrew provides the call to action, inviting the viewer to press the red button if they think the bag has been correctly matched. The screenshot on the left of Figure 3.11 shows Justine further into the segment. On the left of the screen, the people who have been correctly matched with their bags are featured. The screenshot on the bottom right of Figure 3.11 shows the screen as it appears at the end of the segment if all four people were correctly matched with their bags. At this point, a star appears next to each person to confirm the activity has been correctly completed.

3.3.13 Prototype summary

The nine interactive prototypes developed for the larger project have been discussed. The prototypes developed for each of the programs are presented in Table 3.1.

Table 3.1: Summary of prototypes developed for each program.		
Dora the Explorer	***Play School***	***Hi-5***
Control	Control	Control
Character Assistance	Theme Repetition	Segment Repetition
Minor Narrative Choice	Story Choice	Presenter Choice
Major Narrative Choice	Task Participation	Collecting Cards

As discussed in Chapter 1, my role in the project was to evaluate children's responses to the 12 prototypes and determine the effect the different interactive applications have on children's viewing behaviour.

CHAPTER 4 – METHOD

4.1 Participants

498 children participated in the study. Participants were aged between 4 years 1 month and 5 years 9 months at the time of testing (mean age 5 years 0 months). Participants comprised 248 boys (49.7%) and 250 girls (50.3%) females.

4.1.1 School type

Participants were recruited from primary schools in metropolitan Perth, Western Australia. In order to obtain a sample representative of Perth children, participants were recruited from Government, Catholic and Independent schools. Children were recruited from primary school kindergartens, as this provided a cohort at the target age (4 years 2 months to 5 years 2 months at the time of recruitment). According to Western Australian Department of Education and Training data for 2004, 73% of the state's primary school children attend Government schools (J. Harris, personal communication, June 7, 2004). The remaining 27% attend Catholic and Independent schools.

4.1.2 Sample size

The current study contained 12 conditions; nine conditions where interactive prototypes were viewed and three where control prototypes were viewed. Given the paucity of research examining children's responses to interactive television, it was unclear what effect sizes could be expected in the current study. Therefore, it was decided that 40 participants would be sought for each condition. It was thought that 40 participants would provide a reasonable chance of adequate statistical power although, ideally, larger cell sizes would have been sought to maximise the chance of identifying the effect of the interactive prototypes compared with the control prototypes. However, the number of conditions in the study placed logistical constraints on the number of children that could be tested. Therefore, 480 participants were required for the study (40 participants in each of the 12 conditions).

Consent to collect data was obtained from the parents of 595 children. However, the final number of usable participants for the study was 498. Thirty seven of the children were absent on the days data collection was conducted at their schools and 39 children had changed schools in the period between recruitment and testing. Four children declined to participate in the study (these were usually particularly shy children who did not want to be separated from their teacher). Seventeen children were tested but were later excluded from the overall analysis due to a variety of reasons. Two of these children were diagnosed with Autism and were nonverbal, preventing the collection of comprehension data. One child was an elective mute, and was not able to provide comprehension data. One child was diagnosed with Down's syndrome and was also unable to provide comprehension data and 13 participants were also excluded from analysis because of technical or equipment difficulties. Of these 13 cases, two related to insufficient audio quality, three were due to inadequate lighting in the laboratory, and eight were excluded because the laptop playing the DVD's crashed several times on one testing day. The final number of participants was 498.

4.1.3 Selection of schools and participant recruitment

Thirty schools were approached to take part in the study. The 30 schools initially contacted were selected according to their geographic location and the socio-economic status of the suburb in which the school was located. Government schools were selected on the basis of their H-index score. The H-index is a rating system used by the Western Australian Department of Education and Training to rate the socio-economic status of a school population (J. Harris, personal communication, June 7, 2004). The H-index incorporates demographic information about the parents of children attending the school, including their income, occupation and level of education. The Department of Education and Training declined to provide the H-index for each school but did provide a list of all Government primary schools, ranked in order of their H-index. From this list, 22 Government schools were selected and contacted for the study. The list of ranked schools was divided into thirds, with seven schools selected from the first and third portion of the list and eight from the middle third. Schools were also selected so that the different geographic regions of Perth were represented.

Unfortunately, no H-index or equivalent information existed for the Catholic and Independent schools in Perth. Therefore, a different procedure was required to select these schools. Prior to approaching schools, no information about parents' income, occupation or education was available. However, a socio-economic measure of the school, and its families, was required as an equivalent selection procedure to the H-index. It was decided that the socio-economic status of the Catholic and Independent schools would be assessed based on the median house price of the suburb in which the school was located. Although this was an indirect measure of the parents' socio-economic status, this measure was considered to be a suitable basis for selecting schools for involvement in the study.

The Catholic Education Office and the Association of Independent Schools each provided a list of their metropolitan primary schools. A list of Perth suburbs and the median house price for each suburb was obtained from the Real Estate Institute of Western Australia (REIWA, 2004). The Catholic and Independent schools were then ranked according to the median house price of their suburb, and the list divided into thirds. Two of the five Catholic schools selected were drawn from suburbs with median house prices of under $200 000, three were drawn from suburbs with median house prices between $200 000 – $350 000, and the remaining two were drawn from schools in suburbs priced over $350 000. Three Independent schools were also selected for the study, with one school drawn from each third of the ranked list.

The Principals of selected schools were initially contacted by letter informing them of the nature of the study and requesting the participation of their school. As an incentive to participate, schools were offered a *Kodak*™ or *BenQ*™ digital camera. The information letter sent to Principals is attached as Appendix A. One week after sending information letters, the Researcher contacted each Principal by telephone. The nature of the study was again outlined, and the Principal was invited to participate in the study. Of the 30 school Principals approached, eight declined and 21 agreed to participate. One school could not be contacted by telephone despite numerous attempts. It was decided to exclude this school from the study. The response rate for schools was 70%.

The Researcher and the Research Assistant then met with each school Principal and the kindergarten teacher/s where possible, to discuss the requirements of the study. A purpose built testing facility, the Portable Audience Research Centre, was used for data collection (see section 4.2.2). During the meeting with the school staff, arrangements were made for the location of the Research Centre during testing. The Research Centre was located in a secure position in close proximity to a power source and as close as possible to the kindergarten classroom.

The kindergarten teachers were provided with parent information letters and consent forms to distribute to the parents of their kindergarten children. Along with the information letter and consent form, parents were provided with a questionnaire designed to gather basic demographic and television-viewing information about participants. The information letter requested that parents return the completed consent form and questionnaire to their child's teacher within a two-week period. It was thought that this was a sufficient amount of time for parents to read the provided information and complete the consent form and questionnaire, but not long enough for the material to be lost or overlooked. After the two-week period had passed, the Researcher collected the consent forms and questionnaires from each school.

In total, 944 questionnaires were distributed to parents; 659 by Government schools, 221 by Catholic schools and 64 by Independent schools. The overall response rate from parents was 63.0%, with 595 completed consent forms and questionnaires returned. The response rate from Government schools was 59.5%, 71.0% from Catholic schools and 71.9% from Independent schools.

4.1.4 Allocation of participants to experimental conditions

Each participant was allocated to an experimental condition prior to the commencement of data collection. The study contained 12 conditions; nine with participants viewing interactive prototypes and three with participants viewing the control prototype (non-interactive) prototypes. Participants were allocated to one of the conditions based on the information provided by parents. In addition to demographic information, the questionnaire asked parents to indicate their child's familiarity with *Play School, Hi-5, Dora the Explorer,* and another Nickelodeon program, *Blue's Clues*. Participants were first assigned to a condition on the basis of the television programs they were familiar with. The rationale for this was two-fold. Firstly, the literature suggests that children respond with greater visual attention when they are watching unfamiliar material (Crawley et al., 2002). It was thought that an attention ceiling-effect might be avoided by having children view programs that they had seen before, and therefore program formats they were familiar with. Second, it was thought that participants should be assigned to watch programs they were familiar with because less than one third of participants (24.5%) had previously seen *Dora the Explorer*, while 88% of participants had seen *Hi-5* and 97% had seen *Play School*. The relatively low proportion of participants who had previously viewed *Dora the Explorer* is attributed to the fact that this program is not available on free-to-air television, and can only be seen on pay-TV. The proportion of children who had previously viewed *Dora the Explorer* (24.5%) is consistent with estimates that Nickelodeon is received in the homes of 23% of Australian preschoolers (Lees, 2004). If participants were randomly assigned to a condition, it is likely that children assigned to view a *Hi-5* or *Play School* prototype would be familiar with the program, where only one third of those assigned to view a *Dora the Explorer* prototype would be familiar with the program. This would create a confound of program familiarity to the study that might particularly impact on visual attention. Therefore, it was decided that all children who had previously viewed *Dora the Explorer* would be assigned to view one of the four *Dora the Explorer* prototypes. While a minimum of 160 participants were required to view the four *Dora the Explorer* prototypes, only 146 participants had previously seen the program. The remaining participants required to view the *Dora the Explorer* prototypes were selected from those children who were familiar with *Blue's Clues*. As discussed in Chapter 1, *Dora the Explorer* and *Blue's Clues* are similar in that they were both designed to elicit responses from the viewer by directly requesting particular verbal and nonverbal behaviours (such as asking the viewer to point to objects on the screen). Therefore, it was decided that participants who were familiar with the format of *Blue's Clues* would be suitable to view the *Dora the Explorer* prototypes. There were no participants who had not previously viewed *Play School* or *Hi-5*. Therefore, the 71 participants who had not previously seen *Hi-5* were assigned to view a *Play School* prototype, and the 17 participants who were not familiar with *Play School* were assigned to view a *Hi-5* condition. The remaining participants were assigned to viewing either a *Hi-5* or *Play School* prototype.

Once participants were allocated to viewing prototypes of a particular program (*Dora the Explorer, Hi-5* or *Play School*), they were allocated to view a specific prototype. The participants were assigned to view a prototype so that each of the conditions for each program were equivalent for gender, school type (Government, Catholic or Independent school) and the amount of television viewed by the child. The parent questionnaire asked for an estimate of the number of hours their child viewed television on an average weekday, and each day of an average weekend. Parents were asked to estimate whether their child viewed less than 1 hour, 1-2 hours, 2-3 hours, 3-4 hours, 4-5 hours, 5-6 hours, 6-7 hours, or 8 or more hours on a normal weekday and weekend day. For the purpose of calculating mean hours viewed weekly, the upper limit of each range was used for all of the possible responses with the exception of the final category, which was treated as 8 hours. The mean number of hours viewed by each child was then calculated by summing the number of hours viewed on weekdays multiplied by five with the number of hours viewed on each weekend day multiplied by two.

After participants were allocated to view a prototype, a check was conducted to ensure that participants viewing each of the four prototypes for each program were equivalent in their previous use of remote controls. It was found that participants assigned to some of the prototypes were not equivalent in this respect, and some participants were reallocated to correct this. Finally, a check was conducted to ensure that the mean age of participants in each condition was similar.

The demographic characteristics of participants assigned to view each of the prototypes are presented in Table 4.1.

Table 4.1: Participant demographic characteristics after assignment to prototypes and prior to testing.

Prototype	*N*	*Age in years (x)**	*Gender (%)*	*School type (%)*	*Hours of TV viewed per week (x)**	*Previous use of remote control (%)*
Dora the Explorer Control	52	4.79 (.35)	Boys 51.9 Girls 48.1	Government 75.0 Catholic 17.3 Independent 7.7	19.5 (6.5)	Unsupervised 42.3 Only supervised 38.5 Does not use 19.2
Dora the Explorer Character Assistance	49	4.74 (.30)	Boys 49.0 Girls 51.0	Government 75.5 Catholic 22.4 Independent 2.0	20.5 (8.9)	Unsupervised 34.7 Only supervised 34.7 Does not use 30.6
Dora the Explorer Minor Narrative Choice	50	4.69 (.36)	Boys 54.0 Girls 46.0	Government 74.0 Catholic 20.0 Independent 6.0	21.8 (8.0)	Unsupervised 42.0 Only supervised 32.0 Does not use 26.0
Dora the Explorer Major Narrative Choice	46	4.81 (.30)	Boys 52.2 Girls 47.8	Government 78.3 Catholic 21.7 Independent 0.0	23.0 (9.6)	Unsupervised 47.8 Only supervised 30.4 Does not use 21.8
Hi-5 Control	50	4.80 (.26)	Boys 46.0 Girls 54.0	Government 60.0 Catholic 30.0 Independent 10.0	17.2 (8.4)	Unsupervised 38.0 Only supervised 40.0 Does not use 22.0
Hi-5 Segment Repetition	49	4.71 (.34)	Boys 55.1 Girls 44.9	Government 65.3 Catholic 26.5 Independent 8.2	17.1 (5.9)	Unsupervised 24.5 Only supervised 42.9 Does not use 32.6
Hi-5 Presenter Choice	48	4.78 (.36)	Boys 52.1 Girls 47.9	Government 64.6 Catholic 29.1 Independent 6.3	17.7 (7.9)	Unsupervised 41.7 Only supervised 39.6 Does not use 18.7
Hi-5 Collecting Cards	50	4.83 (.32)	Boys 50.0 Girls 50.0	Government 60.0 Catholic 30.0 Independent 10.0	20.2 (8.5)	Unsupervised 36.0 Only supervised 42.0 Does not use 22.0
Play School Control	49	4.84 (.28)	Boys 51.0 Girls 49.0	Government 61.2 Catholic 30.6 Independent 8.2	19.0 (9.3)	Unsupervised 36.7 Only supervised 30.6 Does not use 32.7
Play School Theme Repetition	51	4.71 (.31)	Boys 54.9 Girls 45.1	Government 60.8 Catholic 25.5 Independent 13.7	17.6 (6.2)	Unsupervised 33.3 Only supervised 39.2 Does not use 27.5
Play School Story Choice	51	4.75 (.34)	Boys 54.9 Girls 45.1	Government 58.8 Catholic 31.4 Independent 9.8	18.7 (8.3)	Unsupervised 37.3 Only supervised 39.2 Does not use 23.5
Play School Task Participation	50	4.67 (.29)	Boys 52.0 Girls 48.0	Government 58.0 Catholic 34.0 Independent 8.0	19.1 (8.7)	Unsupervised 34.0 Only supervised 42.0 Does not use 24.0

* Standard deviations in parentheses

4.2 Materials

4.2.1 Parent questionnaire

An information letter detailing the nature of the study, a consent form, and the questionnaire were distributed to the parents prior to data collection. As discussed, the questionnaire was used to gather demographic information about participants and requested information about the child's television viewing history. Information regarding the number of hours of television regularly viewed by the child, their previous experience with television remote controls, and their experience with different television programs was collected. As a general measure of socio-economic status, parents were asked to provide their postcode. From this, the median house price of the suburb where each participant lived could be calculated. Although measures such as parental income and education would have provided more direct measures of socio-economic status, there was concern that personal questions such as this may reduce the response rate. Therefore, it was decided that a non-intrusive socio-economic indicator would be used. The questionnaire required approximately 10 minutes to complete. A copy of the parent information letter and consent form is attached as Appendix B, and the parent questionnaire is attached as Appendix C.

4.2.2 Portable Audience Research Laboratory

All data collection was conducted in the Institute's Portable Audience Research Centre, which was transported to each school for the duration of testing. The Research Centre is a renovated caravan, measuring 2.3m by 6.7m. The Research Centre contains three separate rooms; two identical audience viewing rooms and an observation room. An external view of the Research Centre is shown in Figure 4.1.

The Research Centre was purpose built by the Institute for audience research, and was designed so that two participants could be individually tested at the same time in each of the viewing rooms. The room in the middle of the Research Centre was designed to be an observation area for researchers. From the observation room, the two viewing rooms can be monitored through one-way mirrors. The observation room is also used to store recording and computer equipment.

Figure 4.1: External view of the Portable Audience Research Centre located at a primary school.

<u>4.2.3 Research Centre décor</u>

Each of the viewing rooms contained a 52cm *Panasonic*™ television set, on which participants viewed the prototypes. The television set was placed on a shelf recessed into the interior wall of the viewing area. For this study, a beanbag was used to seat participants, and was located 1.6m from the television. The one-way mirror was located on the wall above the television set, allowing a clear view of the participants' face from the observation room. The décor in the viewing rooms was intended to be comfortable and non-threatening for participants. It was hoped that by providing a comfortable viewing environment natural television viewing behaviour would be elicited from participants compared with an unfamiliar or austere environment. Beanbag chairs rather than armchairs were provided for participants because they are comfortable and familiar to children, and allow participants' feet to touch the floor, even if they are particularly small. The viewing rooms were also decorated with posters. The participant chair and the one-way mirror above the television set are shown in Figures 4.2 and 4.3.

Figure 4.2: Participant chair in the viewing room of the Research Centre.

Figure 4.3: One-way mirror as seen from the viewing area.

Given the age of participants, either the Researcher or the Research Assistant was present with the child in the viewing room during testing. The Researcher was seated in an armchair to one side of the participant, also facing the television set. A small coffee table was placed between the participant and the researcher. These are shown in Figure 4.4.

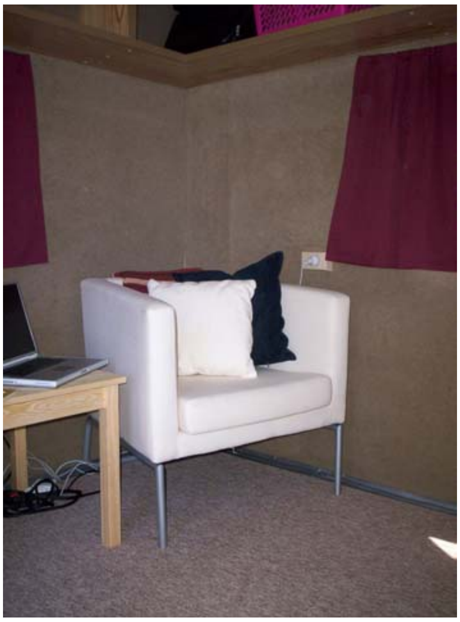


Figure 4.4: View of the Researcher's chair and coffee table.

4.2.4 Viewing equipment

Participants used a remote control to interact with the prototypes. The remote control used was a *Keyspan*™ Express Remote (model number URM-17A). This particular remote control is smaller than a domestic television remote control, and in other ways looks different and contains fewer buttons than many other remote controls. This remote was selected for the study because it was programmable, and had four adjacent coloured buttons of the same size. Many of the other remotes considered for the project did not have programmable buttons of the same size and shape. The four buttons on this remote were coloured red, green, yellow and blue, and it was understood that four and five-year old children would be able to identify these colours by name, and distinguish clearly between them (C. Ricci, personal communication, May 29, 2003). This remote was also selected because its small size made it easy to handle by young children. Given that the remote contained fewer buttons than a domestic remote control, it was thought that it would be easier for participants to identify the active buttons. The remote control is shown in Figure 4.5.[3]

Figure 4.5: The remote control held by a five-year old participant.

The interactive prototypes evaluated by this study were played from a DVD in conjunction with software program *Director*™. The non-linear nature of DVD allowed the prototype to play the selected segment when a choice was available, and to omit segments that were not selected. *Director*™ controlled the display of the icons during the prototype calls to action, and of the collected cards during *Hi-5* Collecting Cards. *Director*™ also received data from the remote control indicating the choice made by participants, and directed the playback of the DVD accordingly. Both the DVD and *Director*™ were played on an *Apple*™ G4 laptop. The laptop was operated by the Researcher from the viewing room and was placed on the coffee table.

The remote control receiver was placed next to the television set, allowing for natural remote control use. With the receiver located next to the television, the remote control

[3] The frequency and timing of participants' remote control presses was recorded during data collection for analysis and reporting by the student examining the prototypes' usability, and is not addressed in this thesis.

was operated by pointing it toward the television, as would be done in a home viewing environment, rather than toward the laptop, where the remote control signal was actually being received.

4.2.5 Recording equipment

All test sessions were recorded for subsequent analysis. A 3cm by 3cm black-and-white camera was used to record the video image of test sessions. The camera was mounted on top of the television set and captured participants' head, torso, and hands clearly. This particular camera was selected because its size made it inconspicuous and unobtrusive. An advantage of recording in black-and-white rather than colour is that all remote control activity, which utilises infra-red light, is recorded as a distinctive flash of light on black-and-white recordings. When subsequently viewing the recorded test sessions, these flashes of light made it easy for the Researcher to identify which participants had used the remote control.

A shotgun microphone was used to capture audio data during testing. The microphone was concealed under the coffee table, located next to the participant's chair. The proximity of the microphone to the participant provided a clear audio recording, which was required to analyse the content of participant verbalisations. The audio and visual captures were recorded onto DVD's using a *Sony*™ DVD Recorder located in the observation room. A picture-in-picture device was used to record the television image in the corner of the participant image. This allowed the Researcher to view the events taking place in the prototype, concurrent with the image of the participant, when conducting the analysis.

4.2.6 Prototypes

The 12 prototypes are attached on separate DVD's as Appendix D. Given that the prototypes were designed to be viewed in conjunction with *Director™,* viewing the DVD's alone does not recreate the viewing experience of participants. While the appended DVD's contain all the content available in each prototype, the segments are not necessarily presented in viewing order. For the purposes of clarity, an additional DVD is attached as Appendix E. This DVD contains simulations of the interactivity enabled in each of the interactive prototypes, and represents the sequence of material viewed by participants during a test session. These simulations were created by the prototype developer and were used to demonstrate the design of the prototypes for the partners (Baldwin, 2006).

4.2.6.1 *Dora the Explorer* Control

The original episode of *Dora the Explorer* was 24 minutes long. The prototype designer edited the episode to create the control prototype, which was 14 minutes 50 seconds in duration.

4.2.6.2 *Dora the Explorer* Character Assistance

In the control prototype, Dora, Boots and Benny have an encounter with Dora's nemesis, Swiper the Fox. In the control prototype, Swiper sneaks up on Dora, and manages to approach her without being detected. He then picks up Benny (who by this time is a potato) and throws him into the bushes. Dora and Boots then have to recover Benny before they can resume their journey. In this interactive prototype, *Dora the Explorer* Character Assistance, the viewer can warn Dora that Swiper is approaching by using the remote control. Approximately 6 minutes 02 seconds into the prototype, Dora provides the call to action, inviting the viewer to let her know if they see Swiper by pressing the red button on the remote control. The instructions given by Dora are, “Remember to press your Swiper button if you see that pesky Swiper”. Accompanying the call to action, an icon appeared in the corner of the television screen featuring a picture of Swiper and a red button.

Dora then resumes her journey, and for the next 33 seconds, Swiper tries to sneak up on her. If the viewer pressed the red button during this time, Dora turns and sees Swiper, and his efforts to swipe Benny are thwarted. If however, the viewer did not press the red button during this time, Swiper reaches Dora and throws Benny into the bushes, as occurs in the control prototype. The duration of the prototype is therefore different depending on whether the viewer interacted with the prototype. If the viewer interacted, the prototype was 15 minutes 04 seconds in duration. If the viewer did not interact, the prototype was 15 minutes 22 seconds in duration.

4.2.6.3 *Dora the Explorer* Minor Narrative Choice

In the interactive prototype *Dora the Explorer* Minor Narrative Choice, the viewer is able to choose between two coloured wagons for Benny. The call to action occurs 5 minutes 15 seconds into the prototype, and Dora says, “I need your help. Which colour wagon should we carry Benny in? Press the coloured button that matches the wagon we should carry Benny in”. Concurrent with the call to action, two icons appeared on the television screen. One icon featured a picture of a yellow wagon next to a yellow button, and the other featured a picture of a blue wagon next to a blue button. If a wagon colour was selected, Benny was placed in the chosen wagon, and the journey resumed. The coloured wagon selected by the viewer then featured for most of the remaining prototype.

If the viewer did not select a colour within 3 seconds of the call to action, Dora said, “Press the blue button for the blue wagon, or press the yellow button for the yellow wagon”. If the viewer did not make a selection within a further two seconds, Dora said, “Blue, great. We’ll carry Benny in the blue wagon” and the prototype defaulted to the blue wagon option. The prototypes were of identical length whether the blue or yellow wagon was selected, and was 14 minutes 58 seconds in duration. If the viewer did not make a selection and the prototype defaulted to the blue wagon, the prototype was 15 minutes 06 seconds in duration.

4.2.6.4 *Dora the Explorer* Major Narrative Choice

In the control prototype, Dora and Boots take Benny past the magic garden on their way to the Wizard’s castle. In the interactive prototype *Dora the Explorer* Major Narrative Choice, Dora invites the viewer to decide whether she should pass the giant flowers, or go past the sleeping dragon on her way to the Wizard. This occurs 7 minutes 40 seconds into the prototype. As a call to action, Dora says “I need your help. Which path should I take to the magic garden? Should I take the path that goes to the giant flowers or the path that goes to the sleeping dragon?” Concurrent with this call to action, two icons appeared on the television screen; one icon featured a picture of a flower next to a blue button, and the other featured a dragon next to a yellow button.

If the viewer pressed the blue button, they viewed a segment with Dora passing the giant flowers in the same way as those viewing the control prototype. If the participant pressed the yellow button; they viewed a segment with Dora passing the sleeping dragon instead. This segment was not viewed in the control prototype. At the conclusion of the dragon segment, the prototype resumed at the same point as the control prototype does at the end of the giant flowers segment. If the viewer did not make a selection within 3 seconds of the call to action, Dora says, “You choose using the buttons on your remote control. Press the blue button to go to the giant flowers or the yellow button to take the path that goes to the sleeping dragon. Are you going to choose which path you want me to take? Giant flowers or the sleeping dragon?”

If the viewer did not make a selection after this instruction, Dora says, “Yellow, the sleeping dragon” and the prototype defaulted to the dragon option. If the viewer selected the giant flowers segment, the prototype was 15 minutes 38 seconds). If the viewer selected the dragon segment the prototypes was 15 minutes 15 seconds in duration. If the viewer did not make a selection and defaulted to the dragon segment the prototype was 15 minutes 20 seconds in duration.

4.2.6.5 *Hi-5* Control

The control prototype was edited from the original episode, 24 minutes in duration, to 13 minutes 50 seconds.

4.2.6.6 *Hi-5* Segment Repetition

In the control prototype, the second segment viewed featured presenter, Charli. In this segment, Charli sings a lullaby to her teddy bear and rocks it to sleep. In the interactive prototype *Hi-5* Segment Repetition, the puppet Bingo appears at the end of the Charli segment and provides the call to action. This occurs 4 minutes 05 seconds into the prototype, with Bingo saying, “Did you enjoy Charli’s song? Would you like to see Charli sing that song again? You can see Charli sing that song again using your remote control. If you want to see Charli sing that song again, press the red button now”.

Concurrent with the call to action, an icon appeared on the television screen featuring a picture of Charli and a red button.

If the viewer pressed the red button within 4 seconds of the call to action, the Charli segment was repeated in its entirety. The subsequent segment, featuring presenter Nathan, was omitted for participants repeating the Charli segment. This decision was made by the prototype designer to preserve the length of the prototype. The viewer was not aware that by repeating the segment they would miss a subsequent segment. If the viewer did not press the red button within 4 seconds of the call to action, Bingo said "Ok, let's watch some more *Hi-5*". The prototype then resumed from the Nathan segment. The prototype was 13 minutes 51 seconds in duration if the segment was repeated, and 14 minutes 27 seconds in duration if the segment was not repeated.

4.2.6.7 *Hi-5* Presenter Choice

In the control prototype, the third and fourth segments feature presenters Nathan and Tim respectively. In the interactive prototype *Hi-5* Presenter Choice, the call to action occurs 4 minutes 05 seconds into the prototype, at the end of the Charli segment. Bingo invites the viewer to select the segment that they would like to see next. He says, "Who would you like to see next; Nathan or Tim? You can choose by using your remote control. To see Nathan next, press the blue button. To see Tim next, press the yellow button. Press the blue button for Nathan or the yellow button for Tim. So who would you like to see next?" Concurrent with the call to action two icons appeared on the television screen; one featured a picture of Nathan and a blue button, the other featured a picture of Tim and a yellow button.

If the viewer selected the blue button they viewed the Nathan segment immediately followed by the Tim segment before the remainder of the prototype was viewed. If the viewer selected the yellow button they viewed the Tim segment immediately followed by the Nathan segment before the remainder of the prototype resumed. If no selection was made within two seconds of the call to action, Bingo said, "Ok, let's try pressing yellow. Yellow, we chose Tim" and the prototype defaulted to the Tim segment. Both the Nathan and Tim segment were viewed by participants, with only the order of presentation being chosen. Therefore, the duration of the prototypes was the same irrespective of which segment was chosen, at 14 minutes 21 seconds in duration. If no selection was made, the prototype was 14 minutes 11 seconds in duration.

4.2.6.8 *Hi-5* Collecting Cards

In the control prototype, the five presenters' segments are viewed. In the interactive prototype *Hi-5* Collecting Cards, the participant is invited to collect a card for each presenter. Before the first segment begins, 36 seconds into the prototype, Bingo appears and says, "Today you can collect *Hi-5* cards on your television screen. There's one card for each *Hi-5* person; so that's one, two, three, four, five cards altogether. To collect the *Hi-5* cards all you have to do is press the red button when you see a card like this appear on the screen". The prototype then resumed playing. During each presenter's segment an icon featuring the presenter appeared on the television screen next to a red button. If the viewer pressed the red button at any time during the segment, that presenter's card was collected and appeared on the left of the screen for the remainder of the prototype. The participant was able to collect all five cards in this way. If the participant did not collect a card during a segment, they missed the opportunity to collect that card. The interactive prototype was 14 minutes 16 seconds in duration.

4.2.6.9 *Play School* Control

The control prototype was 11 minutes 26 seconds in duration, and was edited down from the usual *Play School* episode length of 25 minutes.

4.2.6.10 *Play School* Theme Repetition

In the control prototype the first segment features presenters Andrew and Karen singing a song about a dog. After this segment concluded, at two minutes 09 seconds into the prototype, Andrew gave the call to action. Andrew said, "Would you like to sing another song about a dog? Press the red button if you want to sing another song about a dog". Concurrent with the call to action an icon featuring a picture of a dog and a red button appeared on the screen. If the participant pressed the red button they viewed Karen singing another dog song. At the conclusion of this song the prototype resumed as it would in the control prototype except that a subsequent segment, featuring another presenter, Justine, was omitted. As with *Hi-5* Segment Repetition, this decision was made by the prototype designer to preserve the length of the prototype, and participants were not aware that they missed seeing this segment.

If the viewer did not press the red button within two seconds of the call to action, Andrew said "Press the red button if you want to sing another song about a dog". If the viewer did not press the red button within a further one second, the prototype resumed as in the control prototype. If the participant chose to view the additional dog song, the prototype was 9 minutes 57 seconds in duration. If the viewer did not view an additional dog song, the prototype was 11 minutes 00 seconds in duration.

4.2.6.11 *Play School* Story Choice

In the control prototype, a story about a dog is told during *Play School's* regular story segment. In the interactive prototype *Play School* Story Choice, the viewer is able to choose between a dog story and a cat story. The cat story did not feature in the control prototype. At two minutes 49 seconds into the prototype, Andrew provides the call to action and says, "It's time for the story. Would you like to hear a story about a dog, or a story about cats? For a story about dogs, press the red button. For a story about a dog press the red button. For a story about cats press the blue button". Concurrent with the call to action, two icons appeared on the television screen. One icon featured a picture of a dog and a red button, and the other featured a picture of a cat and a blue button.

If the red button was pressed, the dog story was viewed and the remainder of the prototype resumed as in the control prototype. If the blue button was pressed, the cat story was viewed. At the conclusion of the cat story, the prototype resumed at the same point as the control prototype, at the end of the dog story. If no selection was made within two seconds of the call to action, Andrew said "For a story about a dog press the red button. For a story about cats press the blue button". If no selection was made in a further 3 seconds, Andrew said "Let's have a story about a dog" and the program defaulted to the dog option. If the dog story was selected, the prototype was 11 minutes 37 seconds in duration. If the cat story was selected, the prototype was 11 minutes 13 seconds in duration. If no selection was made and the prototype defaulted to the cat story, the prototype was 11 minutes 37 seconds in duration.

4.2.6.12 *Play School* Task Participation

In the control prototype, the penultimate segment features presenter Justine playing a game where she matched a series of people with their bags. A builder, surfer, pilot and chef were matched with a tool box, beach bag, brief case and icing bag. Justine holds up a picture of each bag next to a picture of each person and deliberates about whether they are correctly matched. In the interactive prototype *Play School* Task Participation, the viewer can instruct Justine on whether each bag match is correct. Seven minutes 09 seconds into the prototype, Andrew gives the call to action, saying “You can play along with Justine if you like. Press the red button for the person you think the bag belongs to”. Concurrent with the call to action, four icons appeared on the side of the television screen, featuring pictures of the builder, surfer, pilot, and chef.

Each time Justine held a picture of a bag next to a person and pondered the match, Andrew says again “If you think this bag belongs to this person press the red button”. Every time the viewer correctly identified a bag/person match, they received a bell tone, and a star appeared next to the icon of that person. If the red button was pushed during an incorrect match, a lower ‘try again’ tone occurred. The duration on the prototype was 12 minutes 30 seconds irrespective of whether the viewer participated.

4.2.7 Distracter materials

As discussed in Chapter 2, children’s attention toward television is artificially high when there are no alternative activities available to them (Lorch et al., 1979). To avoid an attention ceiling effect in the present study, it was decided that alternative activities would be provided to participants. Two ‘Little Golden Books’, *The Pokey Little Puppy* and *The Tawny Scrawny Lion* were placed next to the participant’s chair in the viewing room. Participants were also provided access to a wood-mounted *Toy Story* puzzle. These books and the puzzle were designed to appeal to four and five-year old children. At the beginning of the session, participants were explicitly told that they could play with the puzzle and the books if they wanted to. The viewing room was also decorated with brightly coloured posters that were selected to appeal to participants. The posters and toys provided alternative visual stimuli to the prototypes.

4.2.8 Comprehension questions

After viewing the assigned prototype, participants were asked a series of comprehension questions designed to be equivalent across all conditions. The comprehension questions comprised a combination of recognition and recall questions, and are attached as Appendix F. It was decided that skills acquisition questions would not be included in the comprehension questions, as it would be difficult to design comparable questions for the three programs. A set of comprehension questions specific to the four *Dora the Explorer* prototypes were designed, as were equivalent questions for the four *Hi-5* prototypes and the four *Play School* prototypes. Question 1 required participants to identify the presenters or characters appearing in the prototypes. Participants were shown five pictures of presenters or characters appearing in each program, which were placed in a fixed order on a sheet of laminated cardboard. Of the five pictures, only three depicted presenters or characters that had appeared in the prototypes. Participants were asked "Can you show me who you saw on *Dora the Explorer/Hi-5/Play School* today?" Participants were then asked to name the presenters or characters they had identified. For scoring purposes, each correct character identification (by pointing) and character naming was awarded one point, with a total of six points available for this question. Participants were provided only with neutral feedback during the comprehension questions, such as 'ok' or 'thanks'. If a participant did not respond to a question, the Researcher repeated the question once. If no response was provided after repeating the question, the Researcher moved on to the next question.

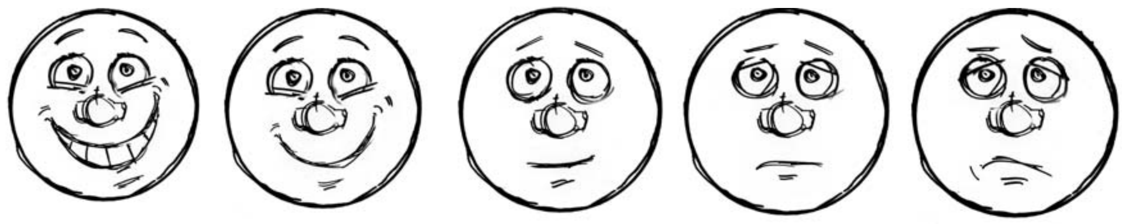
Questions 2 to 5 related to specific events occurring during the programs, and participants received a maximum of four points for each of these questions depending on the level of detail provided. The criteria used to score responses to these questions are attached as Appendix G. Question 6 required the participant to indicate whether they had used the remote control during the prototype, and if so, what they had done with the remote control. Participants received one point for correctly identifying whether they had used the remote control. Accordingly, participants who did not use the remote control were given one point for correctly identifying this. Given that participants viewing the control conditions did not utilise the remote control, they were allocated one point if they correctly stated that they had not used the remote. Points were also allocated for the participant's explanation of what they had done with the remote control. A maximum of two points was allocated for this section of the question. A total of three points could be obtained for question 6.

The points obtained from questions 1 to 6 were summed, with the possible raw score range of 0 to 25. To calculate a comprehension score, the raw score was divided by 25 and then multiplied by 100. Therefore, the comprehension scores used for analysis represent the percentage of potential points obtained by each participant. An obvious limitation to this scoring system is that some participants did not have the opportunity to obtain all of the 25 points. Participants viewing the control prototypes, and the participants who did not interact (or repeat) during the interactive conditions, did not use the remote control and therefore could not indicate what they did with it. This prevented these participants from obtaining two of the three available points for question 6. Therefore, the comprehension scores for these participants were calculated as a percentage of 23, rather than 25 points. The scoring was also modified for *Hi-5* Segment Repetition, and *Play School* Theme Repetition. Participants repeating the segment in *Hi-5* Segment Repetition were not shown a segment occurring later in the prototype. The prototype designers opted to omit a subsequent segment for repeating participants in order to preserve the length of the prototype. The comprehension question relating to this subsequent segment was therefore omitted for participants repeating the segment in *Hi-5* Segment Repetition. A maximum of four points could have been obtained for this question. Therefore, participants repeating the segment in *Hi-5* Segment Repetition had comprehension scores calculated as a percentage of 21, rather than 25.

Participants repeating the song in *Play School* Theme Repetition were also not shown a segment occurring later in the prototype. This decision was also made by the prototype designers to preserve the length of the prototype. The comprehension question relating to this subsequent segment was therefore omitted for participants repeating the segment in *Play School* Theme Repetition. A maximum of four points could have been obtained for this question. The segment omitted for repeating participants featured a presenter that did not appear in any other part of the prototype. This presenter was one of the three prototype characters available for participants to identify in question 1. Given that repeating participants did not view this presenter during the prototype, they were also unable to point to the presenter as someone they had seen in the prototype, and they were unable to name her. This prevented repeating participants from obtaining two of the six points available in question 1. Therefore, participants repeating the song in *Play School* Theme Repetition had comprehension scores calculated as a percentage of 19, rather than 25.

4.2.9 Enjoyment assessment

Participants were asked to rate their enjoyment of the prototype they viewed on a five-point scale. Participants were presented with a series of five face drawings, shown in Figure 4.6. The faces were designed for the study.



5 4 3 2 1

Figure 4.6: Face scale used to assess participant enjoyment

Participants were given the following instructions regarding the face scale:

> "I've got some faces here to show you. These faces are people who have been watching *Dora the Explorer/Hi-5/Play School*. This person (point to face #5) thought that watching *Dora the Explorer/Hi-5/Play School* was really, really fun. But this person (point to face #1) thought that watching *Dora the Explorer/Hi-5/Play School* was really boring. This person (point to face #3) thought that watching *Dora the Explorer/Hi-5/Play School* was just ok. This person (point to face 4) thought that it was fun, but not as fun as this (point to face #5). And this person (point to face #2) thought that it was boring, but not as boring as this (point to face #1). So if you think about all those faces, which one is what you thought about watching *Dora the Explorer/Hi-5/Play School* today?"

The face indicated by participants was recorded as a score between one and five, corresponding with the face number. Therefore, participants selecting face #5 were recorded as having an enjoyment rating of five, through to an enjoyment rating of one as provided by participants selecting face #1. It is noted that face #1 was designed to appear bored or frustrated, rather than sad or unhappy, as has been used in other studies (Lewis et al., 2000; Stifter & Fox, 1986).

4.3 Procedure

4.3.1 Test session

Participants were collected from their classrooms by the Researcher and the Research Assistant. Two children were withdrawn together from class and taken to the research centre. The research centre allowed the testing of two participants simultaneously, with the Researcher accompanying one participant in one of the viewing rooms, and the Assistant accompanying a second participant in the other viewing room. The research centre was located as close as possible to the participants' classroom/s to minimise the distance travelled by participants. While walking with participants to the research centre the Researcher and Research Assistant chatted with participants to try to make them feel at ease. It was decided to test participants individually to avoid the potential influence that co-viewers might have on the participant's responses to the program. The literature suggests that young children viewing in groups can influences each other's attention to program materials (Anderson et al., 1981; Fisch & Bernstein, 2001).

Participants were invited to sit in the beanbag chair and were told that they were going to watch *Dora the Explorer, Hi-5,* or *Play School*, depending on the condition they were assigned to. Participants were invited to look at the books and the puzzle if they wanted to, as it was thought that some children may resist using the distracter materials if they were not given permission to do so. All participants were then handed the remote control, whether they were assigned to view an interactive or control prototype, and were told they could use the remote if they wanted to. Participants were not provided with any additional instructions about the remote control by the Researcher. The Researcher then initiated the play of the prototype by opening the necessary *Director*™ file. The Researcher then sat in the armchair, and did not initiate eye contact or conversation with the participant while the prototype played. If the participant asked a question or initiated conversation, the Researcher answered the child briefly and attempted not to engage the child further.

When the prototype finished, the Researcher sat on the floor next to the participant and asked the comprehension and enjoyment questions. The participant was then thanked for their help and was offered a sticker before being returned to class. In total, the testing session for each participant was approximately 25 minutes long.

4.3.2 Transformation of attention data

The visual attention of participants was determined from viewing the recorded test sessions. The term 'attention' is used in place of visual orientation, which Anderson and Lorch define as the proportion of time that the participant's gaze is oriented toward the television screen (1983). Attention was measured as a continuous variable, as reported in many studies of children's attention including Crawley and colleagues (2002; 1999) and Lorch and Castle (1997). The clarity of the video recordings made it easy to determine whether the participant was looking toward, or away from, the television at any given time. A simple computer program was designed to calculate the proportion of attention exhibited by participants. The program was run from a laptop computer and was operated by the Researcher as the test sessions were viewed. For the duration of the prototypes, the Researcher depressed a key on the laptop when the participant's gaze was oriented toward the television and released the key for the periods of the prototype when the participant's gaze was oriented away from the television. The computer program then calculated the proportion of the prototype in which the participant attended to the television. In this way, a visual attention percentage was calculated for each participant.

The calculation of participants' attention percentage required one viewing of each participant's test session in real-time. The Researcher and the Research Assistant calculated the percentage of attention for all participants in this way. To ensure consistency between the two observers, six sessions were independently viewed by both observers, and the percentage of visual attention was calculated. Using the Pearson's r correlation, inter-rater reliability was found to be .996.

4.3.3 Transformation of engagement data

As discussed in Chapter 2, engagement refers to certain overt behaviours exhibited in response to the television program. Modified versions of interaction measures used by Crawley and colleagues (2002; 1999) were used to measure engagement in the present study. As in Crawley and colleagues, overt verbal and non-verbal behaviours were assessed. Verbal engagement was specifically defined as behaviours constituting i) verbal answers to questions posed by program characters, ii) instructions to characters (such as "Swiper is behind you"), iii) repetition of sounds or words used in the program, and iv) comments about program content. To be considered a form of verbal engagement, a comment needed to be directly related to the program content, rather than a general comment. For example, a comment about a character such as "He's wearing a hat" would be considered verbal engagement whereas a comment such as "I have a hat" would not. Nonverbal engagement behaviours were categorised as either, i) a nonverbal answer (such as nodding or shaking of the head in response to a question), or ii) imitation of a character's actions.

Some of the behaviours observed by Crawley and colleagues were classified differently in the present study. Singing was classified as an 'other' verbal interaction previously, but is classified as verbal imitation in the present study. Laughter was also included as a verbal interaction by Crawley and colleagues, but is classified as an enjoyment behaviour in the present study (see section 4.3.4). Consequently, no verbal 'other' category was included in the present study. Similarly, dancing was categorised by Crawley and colleagues as a nonverbal 'other' interaction, but is grouped as a nonverbal interaction in the present study. No nonverbal 'other' category was used.

Crawley and colleagues (2002; 1999) recorded verbal and nonverbal behaviours as continuous measures. In contrast, partial-interval time sampling was used in the present study. Time sampling has been used to assess children's attention and engagement while viewing *Sesame Street* (Cole et al., 2001). Sulzer-Azaroff and Maher (1977) suggest that time sampling recording be used when observing behaviours that are continuous, or where it is difficult to determine when one instance of a behaviour stops and another begins. The time sampling method involves dividing the observation period (in this case, the duration of the prototypes) into fixed time intervals, and then noting whether the behaviours of interest are present or absent during each interval. It was decided that a partial-interval time sampling method would be used to record the engagement and enjoyment behaviours in the current study because it is more sensitive and is likely to result in a greater number of recorded behaviours than whole-interval sampling (Sulzer-Azaroff & Maher, 1977).

Sulzer-Azaroff and Maher (1977) recommend observation intervals of between 10 and 80 seconds to maximise accuracy and minimise disruption to the observer. For this reason, 10-second observation and recording intervals were used in the current study. A recording sheet was designed to assist with the recording of verbal and nonverbal engagement behaviours (See Appendix H). To assist with the partial-interval recording of engagement behaviours, a cassette tape with pre-recorded audio tones was used. The cassette tape contained a high audio tone, followed ten seconds later by a low audio tone. The high and low tones played alternately every ten seconds. These tones indicated the beginning and ending of each observation and recording period while the observer viewed the test sessions. Upon hearing the high tone, the observers watched the test session and monitored for engagement behaviours. Upon hearing the low tone, the observer would record any engagement behaviours noted on the recording sheet. The use of the cassette tape allowed the observer to keep track of whether they were supposed to be observing or recording behaviours without having to look at a watch or timer. Fisch and Bernstein (2001) report *Sesame Street* researchers using a similar audio system to track time intervals. The transformation of engagement data required a second viewing of each test session in real-time. The percentage of intervals where each type of verbal and nonverbal engagement behaviour was observed was then calculated for each participant.

Given that the Researcher and the Research Assistant both coded test sessions for engagement behaviours, inter-rater reliability was calculated for six participants. Sulzer-Azaroff and Maher (1977) suggest the following reliability formula for partial interval recording:

$$\frac{\text{number of intervals where there is agreement between raters}}{\text{number of agreements + number of disagreements}}$$

Using this formula, the inter-rater reliability was calculated to be .922.

4.3.4 Transformation of enjoyment data

In addition to the self-report measure of enjoyment used in the present study, enjoyment was also assessed observationally. The observed enjoyment of participants was also recorded using the partial-interval time sampling method. Observed enjoyment behaviours were classified as either i) smiling or ii) laughter. For recording purposes, a smile was defined as being one second or longer in duration. Laughter was considered distinct from smiling if an accompanying audible sound was observed. Enjoyment behaviours were observed and recorded concurrent with engagement behaviours using the abovementioned recording sheet. The percentage of intervals where observed enjoyment behaviours occurred was calculated for each participant.

CHAPTER 5 - RESULTS: DEPENDENT VARAIBLES AND SAMPLE DEMOGRAPHICS

5.1 Demographic Characteristics of Participants in each Condition

As discussed in Chapter 4, participants were assigned to one of the 12 conditions so that each condition was equivalent in terms of participant gender, age, school type, amount of television viewed per week, and previous use of the television remote control. Of the 595 children assigned to a condition, 498 usable participants remained. As detailed in Chapter 4, the 97 participants assigned to a condition but excluded from analysis were absent from school during data collection, had changed schools prior to data collection, declined to participate, provided incomplete comprehension data, or had a session with technical or equipment difficulties. The demographic characteristics of the participants assigned to each of the prototypes were presented in Table 4.1. In contrast, Table 5.1 presents the demographic characteristics of the 498 usable participants viewing each prototype.

As shown in Table 5.1, the mean number of participants in each condition was 41.5. However, there were two conditions where the number of participants varied considerably from the mean; *Play School* Theme Repetition, containing 49 participants, and *Play School* Story Choice, which contained only 34 participants. There is no systematic reason for why this imbalance occurred, and it appears that a larger number of children assigned to Story Choice, and a smaller number of children assigned to Theme Repetition, were absent, or excluded from the final analysis compared to the other conditions. Table 5.1 also shows that the mean age of participants at the time of testing was very similar across all conditions. A one-way ANOVA confirmed that there were no significant differences in participant age across conditions (F (11, 467) = .988;

p > .05). Chi-square analysis also confirmed that the percentage of boys and girls in the different conditions was not significantly different (χ^2 (11) = 3.706; p > .05).

Table 5.1: Participant demographic characteristics of the 498 usable participants at the time of testing.

Condition	*N*	*Mean age in years* *	*Gender (%)*	*School type (%)*	*Mean hours of TV viewed per week**	*Previous use of remote control (%)*
Dora the Explorer Control	42	5.08 (.38)	Boys 53.7 Girls 46.3	Government 71.4 Catholic 19.0 Independent 9.5	19.6 (7.0)	Unsupervised 48.8 Only supervised 37.7 Does not use 19.5
Dora the Explorer Character Assistance	37	5.01 (.30)	Boys 43.2 Girls 56.8	Government 70.3 Catholic 27.0 Independent 2.7	21.2 (9.7)	Unsupervised 37.8 Only supervised 37.8 Does not use 24.3
Dora the Explorer Minor Narrative Choice	41	5.01 (.37)	Boys 51.2 Girls 48.8	Government 73.2 Catholic 22.0 Independent 4.9	21.2 (7.8)	Unsupervised 42.5 Only supervised 35.0 Does not use 22.5
Dora the Explorer Major Narrative Choice	42	5.04 (.31)	Boys 50.0 Girls 50.0	Government 76.2 Catholic 23.8 Independent 0.0	22.7 (9.9)	Unsupervised 51.2 Only supervised 31.7 Does not use 17.1
Hi-5 Control	44	5.04 (.31)	Boys 50.0 Girls 50.0	Government 61.4 Catholic 27.3 Independent 11.4	17.8 (8.6)	Unsupervised 38.6 Only supervised 40.9 Does not use 20.5
Hi-5 Segment Repetition	41	4.94 (.42)	Boys 51.2 Girls 48.8	Government 63.4 Catholic 29.3 Independent 7.3	17.0 (6.2)	Unsupervised 20.0 Only supervised 42.5 Does not use 37.5
Hi-5 Presenter Choice	41	5.00 (.40)	Boys 51.2 Girls 48.8	Government 63.4 Catholic 31.7 Independent 4.9	16.9 (7.8)	Unsupervised 41.5 Only supervised 39.0 Does not use 19.5
Hi-5 Collecting Cards	42	5.08 (.35)	Boys 50.0 Girls 50.0	Government 54.8 Catholic 33.3 Independent 11.9	19.7 (7.8)	Unsupervised 39.0 Only supervised 36.6 Does not use 24.4
Play School Control	42	5.07 (.32)	Boys 42.9 Girls 57.1	Government 61.9 Catholic 33.3 Independent 4.8	19.4 (9.7)	Unsupervised 39.0 Only supervised 31.7 Does not use 29.3
Play School Theme Repetition	49	4.97 (.35)	Boys 51.0 Girls 49.0	Government 61.2 Catholic 26.5 Independent 12.2	17.8 (6.4)	Unsupervised 39.1 Only supervised 32.6 Does not use 28.3
Play School Story Choice	34	4.97 (.34)	Boys 58.8 Girls 41.2	Government 55.9 Catholic 38.2 Independent 5.9	17.7 (8.6)	Unsupervised 36.4 Only supervised 42.4 Does not use 21.2
Play School Task Participation	43	4.92 (.32)	Boys 48.8 Girls 51.2	Government 51.2 Catholic 39.5 Independent 9.3	19.1 (9.1)	Unsupervised 35.0 Only supervised 40.0 Does not use 25.0

* Standard deviations in parentheses

It was found, however, that there was a significant difference in the mean number of television hours viewed by participants in the different conditions (F (11, 472) = 1.985; p < .05). A Tukey's HSD test found that participants viewing *Dora the Explorer* Major Narrative Choice viewed more hours of television per week than participants viewing

Hi-5 Segment Repetition ($p < .08$) and *Hi-5* Presenter Choice ($p < .07$). These differences approached significance. Again, there is no systematic explanation for why this imbalance occurred.

Participants were assigned so that equal proportions of children from Government, Catholic and Independent schools viewed the different prototypes. However, it can be seen in Table 5.1 that a higher proportion of Government school children and a lower proportion of Independent school children viewed at *Dora the Explorer* prototypes as compared with the *Hi-5* and *Play School* prototypes. Of the three Independent schools involved with the study, two were evangelical Christian schools. Both of these schools requested that their students not be placed in any of the *Dora the Explorer* conditions. This request was made because the particular episode of *Dora the Explorer* used in the study contained magical content (a wizard and a magic wand), and magical themes are inconsistent with the ethos of these schools. Therefore, the participants from these schools who were familiar with *Dora the Explorer*, and had been assigned to one of the *Dora the Explorer* conditions, were re-assigned to other conditions. This meant that the proportion of participants from Independent schools viewing *Dora the Explorer* prototype versions was low. Consequently, there are a greater proportion of Government school children in these conditions.

5.1.1 Gender

Table 5.1 demonstrated that the proportion of boys and girls were similar across the different conditions. Table 5.2 demonstrates the different comprehension scores exhibited by boys and girls across all conditions. As discussed in Chapter 5, comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.

Table 5.2: Independent samples t-test comparing comprehension scores for boys and girls across all conditions. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.

	N	Mean	sd	Levene's test *(sig.)*	*df*	*t*	*Sig.*
Boys	249	39.19	14.91	.494	494	-3.218	.001
Girls	247	43.65	15.95				

As shown in Table 5.2, girls achieved significantly higher comprehension scores than boys. This finding is in contrast to that reported by Alvaraz and colleagues, who found no comprehension differences between boys and girls in their nine study meta-analysis (Alvarez et al., 1988). However, one study of five-year olds found significantly higher comprehension for girls (Field & Anderson, 1985). There are three potential explanations for the present finding. First, the higher comprehension scores of girls may simply reflect a greater understanding of the prototype content than boys. Second, girls may have achieved higher comprehension scores because they were better able to verbally articulate their responses than boys. Third, girls may have been more willing to articulate their answers than boys.

The first explanation for this finding seems unlikely. There is no empirical support for the suggestion that preschool girls (or girls of any other age) have higher IQ scores than boys (Anastasi, 1958; Gambell & Hunter, 1999; Maccoby, 1966; Prior et al., 1993), or that they have any other information processing ability that would make them more likely to understand the content of these prototypes than boys (Prior et al., 1993). There is also no reason to believe that these prototypes were more salient to girls than boys, given that the *ABC, Kids Like Us* and *Nickelodeon* all designed these prototypes to have equal appeal to boys and girls. There are also no aspects of the prototype design or execution that would be expected to increase the comprehension of girls relative to boys.

The second explanation for this finding is that girls are more able to articulate their responses to the comprehension questions than boys, enabling them to achieve higher comprehension scores. As discussed in Chapter 2, it is widely held that girls have more highly developed language skills than boys, (Gambell & Hunter, 1999; Hallman, 2000; Maccoby & Jacklin, 1987), and that boys have a higher incidence of language difficulties and delays than girls (Prior et al., 1993). It is reasonable to expect that greater comprehension scores could result from an increased ability to articulate what was understood about the prototype. However, Hyde and Linn (1988) have argued that the differences in boys' and girls' verbal abilities are negligible. Indeed, if girls are better able to articulate their answers to comprehension questions than boys, it would be expected that such differences would have been observed by Alvarez and colleagues (1988). Therefore, the second explanation also seems unlikely.

Finally, girls may have obtained higher comprehension scores than boys because they were more willing to articulate their answers, and provide detailed responses, than boys were. This explanation is consistent with many studies finding that girls are more compliant and co-operative with teachers and adults generally when compared with boys (Maccoby, 1990; Prior et al., 1993; Rothbart, 1989). Alternatively, the girls in the current study may have felt more comfortable communicating their answers with the researchers, who were both female. Maccoby has noted that preschool and primary school aged girls show a clear preference for the company of other girls, while boys show the same preference for the company of boys (1990; Maccoby & Jacklin, 1987). It may be the case that boys were less comfortable and less willing to discuss their answers with the female researchers. Interestingly, Hyde and Linn report that female researchers are more likely to find evidence for a female advantage in verbal abilities than are male researchers (1988). They suggest that this may occur because female researchers unconsciously design data collection and the research environments in a way that makes female participants more comfortable than males. While Alvarez and colleagues did not report on researcher gender in their analyses, it may be that few female researchers were involved. Consequently, the research designs and environments may not have advantaged girls as may have occurred in the present study.

Table 5.3 compares the attention exhibited and enjoyment reported by boys and girls in all conditions.

Table 5.3: Mann-Whitney U tests comparing the attention and enjoyment of boys and girls across all conditions. Attention is reported as a percentage of time the participant looked toward the television screen. Enjoyment is reported on a one to five scale.

	Boys $N = 249$			**Girls** $N = 248$			Mann-Whitney U	*Z*	*Sig.*
	Mean	Mean Rank	Sum of Ranks	Mean	Mean Rank	Sum of Ranks			
Attention	83.62	236.79	58960.50	85.39	261.26	64792.50	27835.50	-1.899	.058
Enjoyment	4.21	234.04	57575.00	4.49	259.94	64196.00	27194.00	-2.270	.023

As shown in Table 5.3, girls reported greater enjoyment of the prototypes than boys, with this difference approaching significance. Girls also exhibited higher attention than boys, with this difference approaching significance. Several previous studies have found that young boys are significantly more attentive to television programs than girls (Alvarez et al., 1988). Given the outcomes from other studies, it is puzzling to observe the opposite effect in the present study. As with the finding that girls achieved higher comprehension scores, there are a number of potential explanations for why girls would exhibit higher attention and report greater enjoyment.

First, the girls in the current study may have directed more of their attention to the prototypes than boys because they required additional attention to comprehend the prototype material. However, the finding that girls exhibited higher comprehension scores than boys detracts from this explanation. If girls comprehended less of the prototypes than boys, necessitating greater attention, it is unlikely that they would achieve higher comprehension scores. Alternatively, it is possible that the higher attention of girls allowed them to gain a greater understanding of the prototype, as suggested by early ‘passive’ conceptualisations of attention (Anderson & Lorch, 1983). However, the difference in mean percentage of attention exhibited by boys and girls seems too small to support this explanation either.

It is also possible that the prototypes were more appealing to the girls than they were to the boys. However, there is no reason to believe that the prototypes would favour girls in this way. As discussed, the program makers designed *Dora the Explorer, Hi-5* and *Play School* to be equally appealing to boys and girls by using major characters of both genders, and employing a mix of ‘active’ and ‘passive’ prototype attributes.

Finally, the previously discussed tendency for girls to be more compliant and co-operative than boys (Maccoby, 1990; Prior et al., 1993; Rothbart, 1989) could also account for the finding that girls exhibited higher attention and report higher enjoyment. Girls may have been more likely to attend to the prototypes if they perceived this is what the researcher wanted them to do. Likewise, girls may have also reported elevated enjoyment scores in order to please the researchers.

5.1.2 Age

The comprehension, attention and enjoyment of older and younger participants were compared across all conditions. The median age of participants was 5.01 years at the time of testing. Therefore, it was decided to compare the responses of those aged 5.01 years and older (five-year olds) with those of participants aged less than 5.01 years (four-year olds). Table 5.4 presents an independent samples t-test comparing the comprehension scores of older and younger participants.

Table 5.4: Independent samples t-test comparing comprehension scores for four and five-year old participants across all conditions. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.

	N	Mean	sd	Levene's test *(sig.)*	*df*	*t*	*Sig.*
Five-year olds	241	42.73	15.25	.262	476	1.908	.057
Four-year olds	237	40.00	16.03				

As shown in Table 5.4, the five-year old children exhibited higher comprehension scores than the four-year olds, with this difference approaching significance. It is consistent with logical expectations that older children would exhibit higher comprehension than younger children (Huston et al., 1990). Five-year old children would be expected to have more knowledge about television formats, the specific prototype being viewed, and about the world generally, than four-year olds. Huston and colleagues (1990) argue that age-related changes in TV viewing would be expected with developmental change. Higher comprehension would also be expected for five-year old children because they would have more developed language skills than four-year olds, allowing them to better articulate their answers to comprehension questions. Empirical studies have also found that older children achieve significantly higher comprehension scores (Crawley et al., 2002; Crawley et al., 1999; Rolandelli et al., 1991).

Table 5.5 compares the attention and enjoyment of four- and five-year old participants.

Table 5.5: Mann-Whitney U tests comparing the attention and enjoyment of four and five-year old participants across all conditions. Attention is reported as a percentage of time the participant looked toward the television screen. Enjoyment is reported on a one to five scale.

	Five-year olds *N* = 241			**Four-year olds** *N* = 237			Mann-Whitney U	*Z*	*Sig.*
	Mean	Mean Rank	Sum of Ranks	Mean	Mean Rank	Sum of Ranks			
Attention	84.72	239.56	57973.00	84.84	239.44	56508.00	28542.00	-.009	.993
Enjoyment	4.39	239.87	57568.00	4.31	237.07	55007.00	27512.00	-.429	.668

As shown in Table 5.5, there were no differences in the attention exhibited by four and five-year olds across all conditions. The attention exhibited by four and five-year olds can be interpreted in conjunction with the comprehension of these two groups. As shown in Tables 5.4 and 5.5, five-year old children were able to comprehend more of the prototypes than four-year olds, despite directing equivalent amounts of attention to them.

It was also found that the enjoyment reported by four and five-year olds did not differ. It is suggested that the prototypes are likely to have been equally appealing to older and younger children, because each of the prototypes was designed to appeal to children in both age groups. At the time of testing, participants ranged in age from 4 years 1 month to 5 years 9 months. The 'target age' of each of the prototypes is two to five years for *Play School* (H. Martin, personal communication, June 16, 2003), two to eight years for *Hi-5* (H. Harris, personal communication, June 17, 2003), and four to five for *Dora the Explorer* (C. Ricci, personal communication, May 29, 2003). As the current participants' ages are within these target age groups, it is to be expected that no differences in enjoyment would be reported.

5.1.3 Median house price

As with age, the median house price of the suburbs where participants lived was divided into two categories using a median split. The comprehension scores of participants living in suburbs with median house prices of $275 250 and over (more affluent suburbs) were compared with those of participants living in suburbs with median house prices of less than $275 250 (less affluent suburbs). It is noted that the median price of participant suburbs ($275 250) was similar to the Perth metropolitan median house price of $250 000 (REIWA, 2004).

Table 5.6: Independent samples t-test comparing comprehension scores for participants living in more and less affluent suburbs across all conditions. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.							
	N	Mean	sd	Levene's test (sig.)	*df*	*t*	*Sig.*
More affluent	269	42.56	15.97	.333	481	1.856	.064
Less affluent	214	39.91	15.15				

As shown in Table 5.6, participants living in more affluent suburbs achieved notably higher comprehension scores than those living in less affluent suburbs, however, this difference was not significant. Table 5.7 shows the differences in attention and enjoyment of participants living in more and less affluent suburbs.

Table 5.7: Mann-Whitney U tests comparing the attention and enjoyment of participants living in more and less affluent suburbs across all conditions. Attention is reported as a percentage of time the participant looked toward the television screen. Enjoyment is reported on a one to five scale.									
	More affluent *N* = 269			**Less affluent** *N* = 294			Mann-Whitney U	*Z*	*Sig.*
	Mean	Mean Rank	Sum of Ranks	Mean	Mean Rank	Sum of Ranks			
Attention	83.85	246.51	66557.00	85.29	237.44	50813.00	27808.00	-.708	.479
Enjoyment	4.24	227.95	61090.50	4.50	256.37	54349.50	25044.50	-2.510	.012

As shown in Table 5.7, there were no differences in the attention exhibited by participants living in more and less affluent suburbs. These findings suggest the prototypes were equally interesting and comprehensible to participants with higher and lower socio-economic backgrounds. Again, it is to be expected that the prototype makers would design their prototypes to be appealing to children from a range of backgrounds. However, it is interesting to note that children from less wealthy suburbs reported significantly higher prototype enjoyment than children from wealthier suburbs. This difference in enjoyment is clearly not a reflection of differences in attention or comprehension, as no differences were found for either of these measures.

One possible explanation for this finding is that the role and status of television differs according to socio-economic status. As discussed in Chapter 2, Brunsdon argues that working-class people view television more positively than the middle and upper-classes (1997). Leal's (1990) ethnographic work suggests that working-class people view television as one of their main leisure activities, a view not shared by wealthier groups who had a wide range of leisure options available to them. Therefore, it is reasonable to expect that children living in less affluent suburbs would report greater enjoyment when viewing the different prototypes.

5.1.4 Amount of television viewed

Data on the number of hours of television viewed by participants in a regular week was collected for each participant. It was found that the median number of hours viewed in a week was 16.5. As discussed, estimates of television viewing in the published literature vary considerably. Estimates of mean weekly TV viewing for three- to five-year olds in the United States vary from 13.4 hours (Anderson, Field, Collins, Lorch, & Nathan, 1985), to 19-20 hours (Clancy-Hepburn, Hickey, & Nevill, 1974; Galst & White, 1976; Huston et al., 1990; Robinson et al., 1993; Ross & Pate, 1987; Shannon, Peacock, & Brown, 1991; Taras, Sallis, Patterson, Nader, & Nelson, 1989; Tucker, 1986), to over 25 hours (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004; Neilson, 1981). Estimates of Australian preschoolers' viewing are between 10 and 15 hours weekly (AC Neilson, 1990 as cited by Neville, Thomas, & Bauman, 2005) The estimates of weekly viewing in the current study are at the lower end of those reported by United States studies, but are consistent with those reported in Australia.

The comprehension of participants viewing less than 16.5 hours weekly was compared with those of participants viewing 16.5 hours or more. The results are presented in Table 5.8.

Table 5.8: Independent samples t-test comparing comprehension scores for participants viewing more or less than 16.5 hours of television per week across all conditions. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.

	N	Mean	sd	Levene's test *(sig.)*	*df*	*t*	*Sig.*
16.5 hours and over	241	41.67	15.96	.564	481	.360	.719
Less than 16.5 hours	242	41.16	15.42				

As shown in Table 5.8, the comprehension scores achieved by participants watching more or less than 16.5 hours of television weekly were not significantly different. This finding appears to be inconsistent with the expectations outlined in the published literature. As with the expectation that older participants would have more developed schema with which to understand prototype content than younger participants, it would be expected that more experienced television viewers (those who watch more hours of television weekly) would have more developed television comprehension schema than less experienced viewers (those who view fewer hours of television weekly). Therefore, it would be expected that children viewing more television weekly would find it easier to understand the prototype content than children who view less television. However, this finding can be interpreted along with the data presented in Table 5.9. Table 5.9 shows that children viewing more than 16.5 hours of television weekly exhibited significantly lower attention compared with participants viewing less than 16.5 hours weekly. The findings from both Tables 5.8 and 5.9 demonstrate that more experienced television viewers were able to achieve similar levels of comprehension to less experienced viewers, but that they exhibited significantly less attention. This is consistent with the findings reported by Crawley and colleagues (2002) that experienced viewers required less attention to obtain the same comprehension scores as less experienced viewers.

Table 5.9 presents the results of comparisons between the attention and enjoyment of participants watching more and less than 16.5 hours of television per week.

Table 5.9: Mann-Whitney U tests comparing the attention and enjoyment of participants viewing more or less than 16.5 hours of television per week across all conditions. Attention is reported as a percentage of time the participant looked toward the television screen. Enjoyment is reported on a one to five scale.

	16.5 hours and over *N* = 241			**Less than 16.5 hours** *N* = 242			Mann-Whitney U	*Z*	*Sig.*
	Mean	Mean Rank	Sum of Ranks	Mean	Mean Rank	Sum of Ranks			
Attention	82.81	225.76	54633.00	86.54	259.24	62737.50	25230.00	-2.634	.008
Enjoyment	4.32	238.16	57159.00	4.38	242.84	58281.00	28239.00	-.415	.678

As shown in Table 5.9, it was also found that more and less experienced television viewers did not report any differences in their enjoyment of the prototypes. This finding suggests that increased experience with television viewing does not modify the appeal of programming.

5.1.5 Interacting and non-interacting participants

A series of comparisons were made to determine whether there were any significant differences between participants who did and did not make an interactive choice during the nine interactive prototypes. For seven of the nine interactive prototype versions, it is relatively simple to determine which participants made an interactive choice and which did not. For these seven interactive prototype versions, the call to action is worded in such a way that using the remote is considered an interaction, and that not using the remote is not considered an interaction. For example, in the condition *Dora the Explorer* Major Narrative Choice, the participant is invited to help Dora choose whether to go through the giant flowers or past the dragon. The participant is invited to press the blue button to pass through the giant flowers or to press the yellow button to pass the dragon. A participant pressing either the blue or yellow button following the call to action is considered to have interacted with the prototype. Conversely, if participants do not select the blue or yellow buttons, this inaction led to participants being classified as non-interactors. This distinction between participants who did and did not interact is clear for the conditions *Dora the Explorer* Character Assistance, *Dora the Explorer* Minor Narrative Choice, *Dora the Explorer* Major Narrative Choice, *Hi-5* Presenter Choice, *Hi-5* Collecting Cards, *Play School* Story Choice, and *Play School* Task Participation.

However, the distinction between participants who did and did not interact is less clear for the conditions *Hi-5* Segment Repetition and *Play School* Theme Repetition. In both of these conditions, the call to action invites the participant to press the red button if they would like to hear a song. In *Hi-5* Segment Repetition, the participant is able to hear the song sung by presenter, Charli, again; and in *Play School* Theme Repetition the participant is able to hear another song about a dog. The difficulty in determining which participants did not interact is that the participant is not given an alternative to viewing another song other than by not pressing the red button. This makes it difficult to distinguish between the kind of inaction that is noted for the other seven interactive prototypes, and inaction that is a deliberate choice to avoid another song. For this reason, the participants who did and did not interact with *Hi-5* Segment Repetition and *Play School* Theme Repetition cannot be clearly differentiated. Consequently, participants in these conditions will not be analysed in the comparisons of participants who did and did not interact. The comparison of interacting and non-interactive participants also excludes those viewing the control prototype, as no interactions were possible for these participants.

Table 5.10 presents the results of an independent samples t-test comparing the comprehension scores of interacting and non-interacting participants.

Table 5.10: Independent samples t-test comparing comprehension scores for interacting and non-interacting participants viewing the interactive prototype versions. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.*

	N	Mean	sd	Levene's test *(sig.)*	*df*	*t*	*Sig.*
Interacting	205	43.20	15.51	.894	276	3.411	.001
Non-interacting	73	36.55	13.68				

*NB: This analysis excludes participants viewing *Hi-5* Segment Repetition, *Play School* Theme Repetition, and the control prototypes.

As shown in Table 5.10, participants interacting with the prototypes achieved significantly higher comprehension than those who did not interact. One interpretation of this finding is that participants with higher levels of comprehension were more likely to be able to follow the calls-to-action and interact. Conversely, the act of interacting with the prototypes may have increased the comprehension of participants. To understand the mechanism by which interaction and comprehension are related, a detailed examination of the individual interactive prototypes is required. This issue is examined in detail in Chapter 6.

Table 5.11 presents the results of several Mann-Whitney U tests comparing the attention exhibited and enjoyment reported by interacting and non-interacting participants.

Table 5.11: Mann-Whitney U tests comparing the attention and enjoyment of interacting and non-interacting participants viewing the interactive prototypes. Attention is reported as a percentage of time the participant looked toward the television screen. Enjoyment is reported on a one to five scale.*

	Interacting participants *N* = 205			**Non-interacting participants** *N* = 73			Mann-Whitney U	*Z*	*Sig.*
	Mean	Mean Rank	Sum of Ranks	Mean	Mean Rank	Sum of Ranks			
Attention	85.84	136.02	28020.50	86.82	151.23	11039.50	6699.50	-1.383	.167
Enjoyment	4.34	140.08	28715.50	4.37	137.88	10065.50	7364.50	-.224	.823

*NB: This analysis excludes participants viewing *Hi-5* Segment Repetition, *Play School* Theme Repetition, and the control prototypes.

Table 5.11 shows that the attention and enjoyment exhibited by interacting and non-interacting participants did not differ. It is interesting to note that comprehension, rather than attention or enjoyment, is the measure separating interacting from non-interacting participants.

Table 5.12 examines the proportion of interacting and non-interacting participants who had previously used a television remote control unsupervised, supervised, or had not used a remote control. As shown in Table 5.12, participants who had used the remote control alone, only with supervision, or had not previously used a remote control, were all equally likely to have interacted with the prototypes. A chi-square goodness of fit test confirmed that the percentage of interacting and non-interacting participants with different prior remote control use were not significantly different (χ^2 (2) = .568; p > .05). The finding that inexperienced remote control users were equally likely to interact suggests that the calls-to-action and the interface were sufficiently clear so that children with no experience of the remote control were able to interact.

Table 5.12: Frequency and percentage of participants with different prior experience with a television remote control who did and did not interact with the interactive prototypes.*

	Prior use of remote control					
	Uses remote unsupervised		Uses remote only when supervised		Does not use remote	
	N	%	*N*	%	*N*	%
Interacting participants	83	74.77	46	77.96	70	68.63
Non-interacting participants	28	25.33	13	22.03	32	31.37
Total	111	100	59	100	102	100

*NB: This analysis excludes participants viewing *Hi-5* Segment Repetition, *Play School* Theme Repetition, and the control prototypes.

5.2 Participant Understandings of the Interactive Choices

The interactive prototype makers designed the nine interactive prototypes to test particular models of interactivity. Each of the interactive prototypes was intended to provide different meaningful choices to preschool aged children. Therefore, in determining the effect of the interactive prototypes, it is important to establish how participants interpreted the interactive choices provided. It is possible that preschool aged children interpreted and enjoyed the interactive choices in the way the prototype designers intended. However, it is also possible that children might have found some of the interactive choices difficult to understand, or that they might have interpreted the choices provided differently than originally intended. Similarly, the choices may have been comprehensible but unappealing to participants.

There are several indicators in the data that can be used to determine how participants interpreted and enjoyed the interactive choices. One indication of how participants understood and enjoyed the different interactive choices is whether they followed the instructions provided in the call to action. Another indication is the proportion of participants that articulated the choice they had made. Finally, the comments made by participants who explained their interactive choices can be examined. These three indicators will be explored.

5.2.1 Responses to calls to action

One indication of how comprehensible and enjoyable the interactive choices were is to examine the number of children viewing each interactive prototype who were able to, or who chose to, follow the call to action and make an interactive choice.

Table 5.13 presents the percentage of interacting and non-interacting participants viewing each of the interactive prototype versions.

Table 5.13: Percentage of participants who did and did not interact with the different interactive prototypes.

Prototype	Prototype	Interacting participants (%)	Non-interacting participants (%)	Total (%)
Dora the Explorer	Character Assistance	86.5	13.5	100
	Minor Narrative Choice	68.3	31.7	100
	Major Narrative Choice	71.4	28.6	100
Hi-5	Presenter Choice	67.5	32.5	100
	Collecting Cards	66.7	33.3	100
Play School	Story Choice	67.6	32.4	100
	Task Participation	88.4	11.6	100

NB: This table does not include data for *Hi-5* Segment Repetition, *Play School* Theme repetition, or the control prototypes.

As shown in Table 5.13, the percentage of participants interacting in each of the interactive prototypes is varied. A chi-square test for goodness of fit was conducted to establish whether the percentage of interacting participants was equal across the different prototypes. It was found that the percentage of interacting participants across the different prototypes was not significantly different (χ^2 (6) = 5.591; $p > .05$). While the participants viewing *Hi-5* Segment Repetition and *Play School* Theme Repetition cannot be confidently described as ‘interacting’ or ‘non-interacting’, they can be classified depending on whether they chose to repeat the song. The proportion of participants repeating the song in *Hi-5* Segment Repetition was 68.29% (31.71% did not repeat). The proportion of participants repeating the song in *Play School* Theme Repetition was 87.76% (12.24% did not repeat).

The data presented in Table 5.13 shows that the majority of participants assigned to view the interactive prototypes were willing and able to interact. This suggests that the interactive choices provided were comprehensible and meaningful for four- and five-year old children. Lower rates of participation might indicate that the interactive choices were difficult for participants to understand, or that they lacked interest for the participants.

Although the proportion of interacting (and non-interacting) participants was not significantly different across the different prototypes, it is noted that some interactive prototypes had higher rates of participation than others. In particular, *Dora the Explorer* Character Assistance, *Play School* Task Participation and *Play School* Theme Repetition had interaction rates of above 85%. This may indicate that these particular prototypes were the most readily understood by, or were most appealing to, participants.

5.2.2 Number of participants describing the interactive choice

One way to determine the participants' interpretations of the enhancements is to examine responses from particular comprehension questions. Participants were asked to indicate "what they did" with the remote control. Most participants responded by explaining which buttons they had pushed, but some elaborated further and explained what happened as a result of the button push; the 'effect' of their remote control use.

Table 5.14 demonstrates the number of participants viewing each interactive prototype who provided detail about their use of the remote control. As shown, there is considerable variation in the percentage of interacting participants who detailed their use of the remote control. Notably, participants viewing *Dora the Explorer* Character Assistance and *Hi-5* Collecting Cards were most likely to have detailed their use of the remote control. It may be that the interactivity in these prototypes was particularly simple to describe, or was particularly salient to participants. Conversely, few participants in the *Play School* Story Choice and *Play School* Task Participation conditions explained their use of the remote control. It is interesting to note that few participants were able to explain their remote use during *Play School* Task Participation given that this condition had a high participation rate, as shown in Table 5.13. It may be that the call to action for this condition was relatively simple to follow, while explaining the nature of the interaction was more difficult for participants.

Table 5.14: Percentage of interacting participants who did and did not detail their use of the remote control.

Prototype	Prototype	Number of interacting participants	Number of interacting participants who detailed effect of remote use	% of participants who detailed effect of remote use
Dora the Explorer	Character Assistance	32	11	34.4
	Minor Narrative Choice	28	5	17.9
	Major Narrative Choice	30	4	13.3
Hi-5	Segment Repetition	41*	5	12.2
	Presenter Choice	27	6	22.2
	Collecting Cards	28	12	42.9
Play School	Theme Repetition	49*	12	24.5
	Story Choice	23	2	8.7
	Task Participation	38	3	7.9

* Denotes conditions where the distinction between interacting and non-interacting participants cannot be determined. In these cases, percentages reflect all participants, not just those deemed to be 'interacting'.

5.2.3 Descriptions of interactive choices

Table 5.15 demonstrates the descriptions of remote use provided by participants viewing each of the interactive prototypes. As shown, participants described their use of the remote control, and the effect of their choice, in different ways. Participants' interpretations of the different interactive choices are discussed in section 5.3.

Table 5.15: Descriptions of remote control use provided by interacting (or repeating) participants viewing each interactive prototype. Each comment represents the description of one participant.

Program	Prototype	Comments
Dora the Explorer	Character Assistance (n = 11)	1. "I pressed the red button to catch Swiper" 2. "I pressed the red button to see Swiper" 3. "Cause I saw the fox" 4. "When I saw Swiper I pressed the red button" 5. "I pressed the red button to stop Swiper" 6. "When I clicked the red button to make Swiper go away" 7. "I pressed my Swiper button" 8. "Fox go away" 9. "Had to press red button when Swiper was coming" 10. "Because Swiper was going to swipe" 11. "Pressed the Swiper button"
	Minor Narrative Choice (n = 5)	1. "Picked the wagon colour. It was blue" 2. "They only had blue and yellow for the wagon" 3. "I pressed the yellow button because I wanted a yellow wagon" 4. "I used it to chose a colour" 5. "The colour of the wagon"
	Major Narrative Choice (n = 4)	1. "Told it to go through the sleeping dragon" 2. "When the dragon said which way to go I said yellow" 3. "Helped them to get to the flowers" 4. "Pressed the buttons to show him which way to go"
Hi-5	Segment Repetition (n = 5)	1. "I pressed the red button but she didn't sing again" 2. "Heard some songs two times" 3. "I pressed the red button then it happened again" 4. "Got it to play the song again" 5. "Pressed the red button and somebody sang a song"
	Presenter Choice (n = 6)	1. "Pressed to coloured buttons to get what I wanted" 2. "Because that boy told me. He said would I like to push Nathan or Tim" 3. "I pressed on someone" 4. "I pressed for Nathan" 5. "I pressed to see which character I wanted to see next" 6. "I pressed the blue button to chose the person I wanted to see next"
Hi-5	Collecting Cards (n = 12)	1. "I pressed all the cards" 2. "I turned over some cards with it, just two. I tried to get another one turned over but I couldn't." 3. "I pressed red, I won points" 4. "I did collect the cards. I only missed one" 5. "I pressed the red and with the cards going around" 6. "I pressed the red button because it made pictures" 7. "Just to press a card over" 8. "Pressed the red button to show pictures" 9. "I pressed the red button and then it made pictures" 10. "To make the cards turn" 11. "To press the red button to get the pictures" 12. "I got all of the cards, there was five"

Table 5.15: Continued.		
Program	**Prototype**	**Comments**
Play School	Theme Repetition (n = 12)	1. "Pressed this to go to a song again" 2. "I pressed the doggie one" 3. "I pressed the red button to see another dog show. Because the person put up a number that looks like this to put up another dog part" 4. "If you wanted to go again you have to press the red button" 5. "I pressed the red button to see another song" 6. "I pressed it to make songs" 7. "Listen to songs" 8. "I got songs' 9. "I pressed a red button for the dog" 10. "I pressed a red button so it made another song" 11. "I pressed a red button to listen to another song" 12. "I pushed the red button and I wanted to hear another song"
	Story Choice (n = 2)	1. "I pressed red for the dog story" 2. "I pressed the red button, I chose the doggie"
	Task Participation (n = 3)	1. "I pressed the red button and played with Justine for the right bag" 2. "Try to match the same things" 3. "I pressed the red button with the people. Because you have to say whose bag it is"

5.3 Interpretations of the Interactive Prototypes

5.3.1 Interpretation of *Dora the Explorer* Character Assistance

In this prototype, the viewer is able to warn Dora that Swiper is approaching. By pressing the red button on the remote control, Dora is alerted to Swiper's presence and he is unable to 'swipe' anything from Dora. If the viewer does not press the red button, Swiper sneaks up on Dora and throws Benny into the bushes. This prototype involves replacing a non-technological form of interaction with a technological one. In the control prototype, the viewer is encouraged to verbally warn Dora that Swiper is approaching. However, the interactive prototype allows the viewer to warn Dora using the remote control. Unlike the other *Dora the Explorer* interactive prototypes, which allow the child to make choices about an aspect of the narrative, this prototype allows the viewer to directly assist a program character. While interacting or not interacting with this prototype does have an impact on the narrative (i.e. Swiper is thwarted or not) the interaction is not presented to viewers as a choice of outcomes or options, but as a way of helping the characters. It is this ability to 'help' that separates this interaction from the narrative choices offered in the other *Dora the Explorer* prototypes.

Table 5.14 demonstrates that over one-third of interacting participants were able to explain their use of the remote. As shown in Table 5.15, participants who described their use of the remote for this enhancement specifically mentioned Swiper, and that their use of the red button had stopped Swiper or made him go away. This confirms that most participants interpreted the interaction as a way of stopping Swiper from approaching. However, one participant indicated that he had pressed the red button because he wanted to see Swiper. As shown in Table 5.13, over 85% of participants viewing the *Dora the Explorer* Character Assistance interacted with the prototype. The high proportion of interacting participants viewing this prototype suggests that the interactive choice provided was comprehensible and appealing to participants.

5.3.2 Interpretation of *Dora the Explorer* Minor Narrative Choice

In this prototype, the viewer is able to choose the colour of the wagon Dora uses to carry Benny. Although the use of the wagon to transport Benny is important to the narrative, the colour of the wagon is peripheral to the main story. The viewer is given approximately 10 seconds to select a blue or yellow wagon for Benny. If a selection is not made in this time, the prototype defaults to a blue wagon. The wagon selected can be seen for the majority of the remaining prototype.

It was also noted in Table 5.14 that only 17.9% of participants interacting in this condition elaborated on their use of the remote control. However, Table 5.15 demonstrates that those participants who did explain their use of the remote did so in terms of choosing a wagon colour. As shown in Table 5.13, 68.3% of participants viewing *Dora the Explorer* Minor Narrative Choice interacted by selecting a wagon colour. This is notably lower than the number interacting with *Dora the Explorer* Character Assistance, for example, suggesting that this choice may have been more difficult or less appealing for participants.

5.3.3 Interpretation of *Dora the Explorer* Major Narrative Choice

In this prototype, the viewer is able to choose part of the pathway that Dora takes on the way to her final destination. The viewer can choose for Dora to pass the giant flowers or the dragon by pressing their blue or yellow buttons. This represents a narrative choice because the viewer sees different content, and Dora has a different experience as a result of this choice. The viewer is given approximately 10 seconds to select the giant flowers or dragon segment. If a selection is not made in this time, the prototype defaults to the dragon.

While 71.4% of participants interacted with this prototype, Table 5.14 shows that only 13.3% of these participants elaborated on their use of the remote control. Table 5.15 demonstrates that those participants who did explain their use of the remote did so in terms of ‘telling’ which way the characters should go. This confirms that participants interpreted the choice as a choice of seeing the giant flowers segment or the dragon segment.

5.3.4 Interpretation of *Hi-5* Segment Repetition

This prototype allows the viewer to repeat an entire segment from the prototype. This segment featured presenter Charli singing to her teddy bear. After seeing this segment for the first time, the participant is invited to press the red button if they would like to see Charli sing to her teddy bear again. The participants had approximately 10 seconds to respond to the call to action. If the participant does not press the red button, the prototype continues as it does in *Hi-5* Control. If the participants did press the red button, they viewed the segment again. They then viewed the remainder of the prototype in the same way as those viewing *Hi-5* Control, except that one subsequent segment was removed to preserve the length of the prototype. Participants were not aware that this segment had been omitted. It is assumed that the appeal of this interaction to young children is that it provides the opportunity for repetition.

As discussed, 68.29% of participants repeated the segment. Table 5.14 shows that 12% of participants assigned to view *Hi-5* Segment Repetition elaborated on their use of the remote control. As shown in Table 5.15, the participants describing their use of the remote control explained the interaction as hearing a song again. This confirms that participants interpreted the interactive choice in terms of repeating the song contained in the Charli segment.

5.3.5 Interpretation of *Hi-5* Presenter Choice

In this prototype, the viewer is able to choose one of two segments that they would like to see next. The viewer could choose to see either the Nathan segment next by pressing the blue button, or the Tim segment next by pressing the yellow button. The viewer would first view the segment they selected, and would view the other segment immediately after. The viewer was given 10 seconds to make a selection after the call to action. If no selection was made, the prototype defaults to the order of presentation used in the control prototype, viewing the Nathan segment first and the Tim segment immediately after. It is noted that this is the only prototype providing two choices where the participant views both segments. It is only the order of presentation that the participant selects. It was assumed that this interactive choice would be appealing because it allows the child to select a favourite or preferred option from two familiar presenters.

As shown in Table 5.13, 67.5% of participants assigned to view this prototype interacted. Table 5.14 shows that over 20% of interacting participants explained their use of the remote control while Table 5.15 demonstrates that the interactive choice presented in this enhancement was understood in terms of using the remote to choose the person they wanted to see next.

5.3.6 Interpretation of *Hi-5* Collecting Cards

This prototype allows the participant to collect up to five cards throughout the prototype. There are five cards available for collection in this way. The collected cards appeared as a graphic over-laying the prototype image on the side of the television screen. However, collecting the cards did not provide the viewer any additional or different segments than a non-interacting participant, or a participant viewing the control prototype.

The viewer has the opportunity to collect the card from the beginning of each presenter's segment until that segment ends. The viewer potentially has the entire duration of the prototype to interact by collecting a character's card at any time during that presenter's segment. In this sense, this prototype provides the longest period of opportunity for participants to interact. Participants were considered 'interacting' if they collected any of the cards during the prototype. As shown in Table 5.15, participants discussed their use of the remote in terms of collecting or 'getting' the cards. Despite this, only 66.7% of participants in this condition interacted with the prototype. This suggests that the concept of collecting the cards may have been a difficult one for this age group. Among those participants who did interact, 42.9% detailed their use of the remote control. This is the highest proportion of interacting participants describing their remote use across the interactive prototypes, suggesting that while the concept of this interaction may have been difficult, nearly half of the interacting participants were willing and able to describe their remote control use.

5.3.7 Interpretation of *Play School* Theme Repetition

After viewing a song about a dog, the viewer was invited to push the red button to see another song about a dog. The participant was given approximately 10 seconds to respond to this call to action. If the participant did not press the red button in this time, the prototype continued to be viewed as it was for *Play School* Control. If the participants did press the red button, they viewed an additional song about a dog. They then viewed the remainder of the prototype in the same way as those viewing the control prototype, except that one subsequent segment was removed to preserve the length of the prototype. Participants were not aware that this segment had been omitted. It is assumed that the appeal of this prototype to young children is that it provides the opportunity for repetition.

Table 5.14 shows that 24.5% of participants assigned to view *Play School* Theme Repetition elaborated on their use of the remote control. As shown in Table 5.15, participants described their use of the remote control as hearing another song, and some participants mentioned hearing another dog song. This confirms that the interaction was viewed by participants in terms of hearing another song similar to the one they had already experienced. As discussed, 87.76% of participants repeated the segment, meaning this interaction rate is very high compared to many of the other interactive prototypes. This may suggest that the interactive choice was particularly comprehensible or appealing, relative to the other interactive prototypes.

5.3.8 Interpretation of *Play School* Story Choice

In this prototype, the viewer is able to choose one of two stories that they would like to see during the prototype's story-time. The viewer can choose to see either a story about dogs by pressing the red button, or a story about cats by pressing the blue button. The viewer is given 10 seconds to make a selection after the call to action. If no selection is made, the prototype defaults to the dog story. The dog story is also the story seen in the control prototype. Unlike *Hi-5* Presenter Choice, the participant sees one story or the other, but not both.

Table 5.14 shows that only 8.7% (n = 2) of the participants interacting with this prototype detailed their use of the remote control. This is a much smaller proportion than for most of the other interactive prototypes, suggesting that this interactive choice may have been difficult to understand for this age group, or may have been especially uninteresting. As shown in Table 5.15, the two children who did explain their use of the remote did so in terms of choosing to see the dog. Neither of the participants describing their remote use for this condition described a choice of stories, or the option to see the cat story. This also suggests that this interactive choice was not well understood by participants. As shown in Table 5.13, 67.6% of participants assigned to view this prototype interacted.

5.3.9 Interpretation of *Play School* Task Participation

This prototype allows the viewer to participate in a task being undertaken by *Play School* presenter, Justine. The participant can interact with the prototype by indicating whether Justine is matching the bag to its correct owner. Participants assigned to *Play School* Control view the segment without any invitations to indicate a correct match. In many ways, this prototype is similar to *Dora the Explorer* Character Assistance in that the viewer can use the remote to assist a character. Both of these enhancements also replace a non-technological form of interaction with a technological form, in that participants use the remote to indicate a correct bag match rather than verbally 'instructing' Justine.

As shown in Table 5.13, 88.4% of participants in *Play School* Task Participation interacted with the prototype. This was the highest proportion of interacting participants across all of the prototypes in the study. However, this prototype also resulted in the smallest number of participants who explained their use of the remote control (7.9% as shown in Table 5.14). This small proportion might indicate that this interaction was particularly difficult for participants to understand or articulate. However, Table 5.15 shows that participants who did describe their use of the remote control seemed to understand the interaction in terms of matching bags with people.

5.4 Properties of Dependent Variables

Six dependent variables were used to understand participants' responses to the prototypes; comprehension, attention, verbal engagement, nonverbal engagement, observed enjoyment and reported enjoyment. The method used to measure each of these variables and rationale for doing so was outlined in Chapter 4. With the exception of attention, there is little published information about the properties of these variables when they are measured in this way, and the psychometric properties of these measures when used in an interactive context are unknown. Therefore, the properties of each of the variables are examined in Figures 5.1 - 5.6.

5.4.1 Comprehension

Figure 5.1 demonstrates the distribution of comprehension scores of all participants in a frequency histogram. As discussed in Chapter 4, participants were asked six comprehension questions, and their responses were systematically scored. Each participant's score was converted to a percentage of the highest possible scores for analysis.

As shown in Figure 5.1, the distribution of comprehension scores exhibited by participants resembles a normal distribution. To detect outliers, the comprehension scores representing three standard deviations above and below the mean were calculated. It was found that one participant exhibited a comprehension score more than three standard deviations above the mean, and no participants exhibited a comprehension score three standard deviations below the mean. This participant's comprehension score was removed from further analyses.

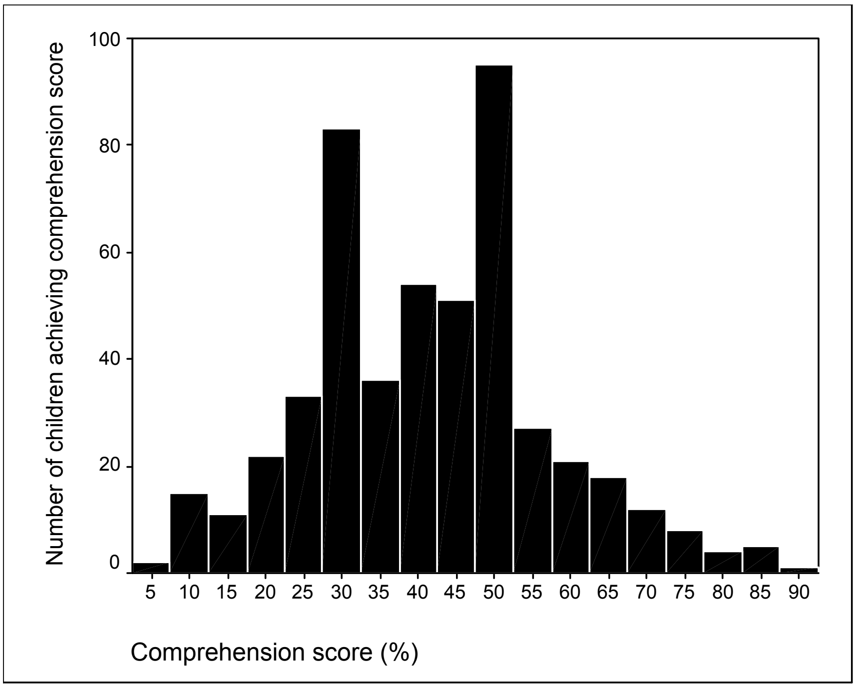


Figure 5.1: Frequency histogram of comprehension scores obtained by all participants.

5.4.2 Attention

As discussed in Chapter 4, attention was measured as a continuous variable. Each participant's viewing session was continuously coded according to whether they were visually oriented toward the television screen or away from it, using a computer program developed for this purpose. The program then calculated the proportion of the prototype where the participant was visually attending, as a percentage. This raw percentage score was not transformed for analysis.

Figure 5.2 demonstrates the distribution of attention scores of participants in a frequency histogram.

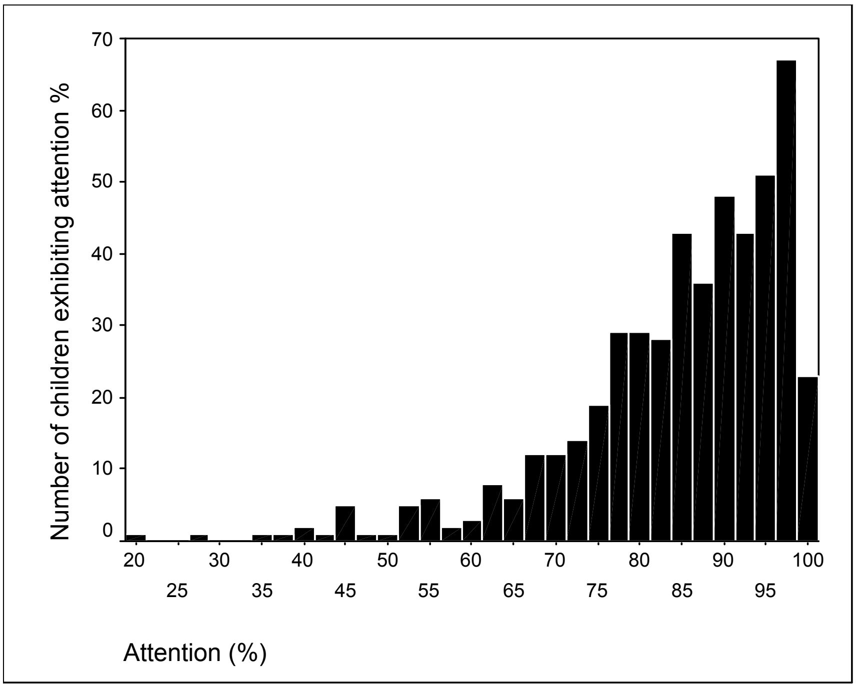


Figure 5.2: Frequency histogram of percentage attention directed by all participants.

As shown in Figure 5.2, the attention scores calculated for participants were not normally distributed. The distribution is negatively skewed, with a skew of -1.494. Smithson and Verkuilen (*in submission*) have noted that heavily skewed distributions are often found in variables with natural upper or lower limits, and that these distributions can be desirable. It is suggested that this distribution is desirable in this context given that the prototypes were designed to elicit high attention from children.

5.4.3 Verbal engagement

Due to the low incidence of verbal engagement behaviours, the four categories of behaviour constituting verbal engagement (verbal answers, instructions to characters, repeating words, and comments) were analysed together. As discussed in Chapter 4, verbal engagement was measured using the partial interval time sampling method. The period of the prototype was divided into 10-second intervals, and the presence or absence of verbal engagement behaviours was recorded for each interval. In order to compare prototypes of different lengths, and therefore with different numbers of intervals, the number of intervals containing verbal engagement behaviours was divided by the total number of intervals. This number was then multiplied by 100 to obtain a percentage of intervals containing verbal engagement behaviours. Figure 5.3 shows the distribution of verbal engagement behaviours exhibited by participants in a frequency histogram.

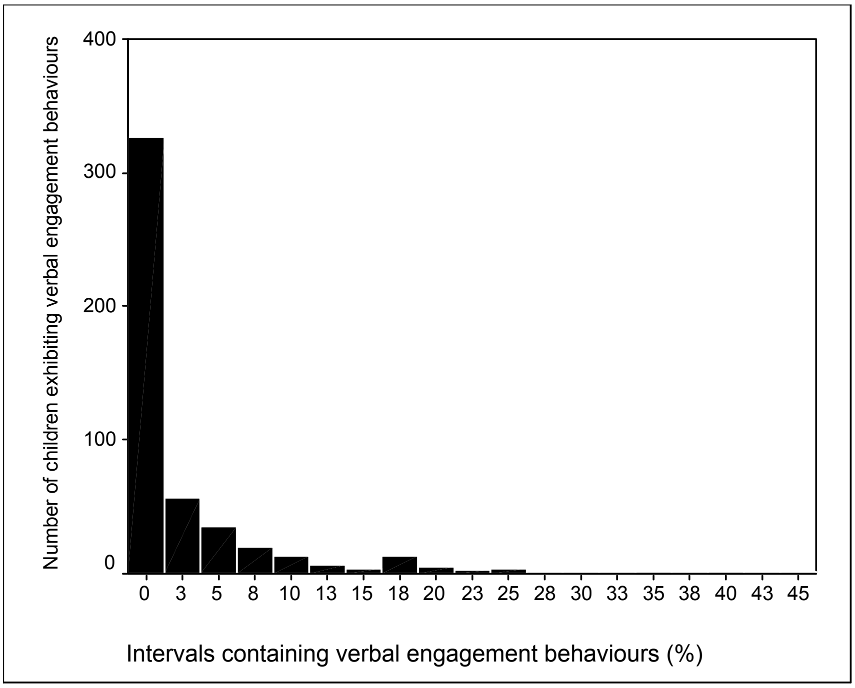


Figure 5.3: Frequency histogram of verbal engagement behaviours exhibited by participants.

As shown in Figure 5.3, the distribution of verbal engagement behaviours exhibited by participants is positively skewed (skew = 3.042). Given that 330 of 498 participants elicited no verbal engagement behaviours, and that only a mean of 3% of intervals contained verbal engagement behaviours, it was decided not to proceed with reporting and interpretation of these data. However, all analyses of verbal engagement behaviours are attached as Appendix I.

5.4.4 Nonverbal engagement

Due to the low incidence of nonverbal engagement behaviours, the two categories of behaviour constituting nonverbal engagement (nonverbal answers and imitation of actions) were analysed together. Nonverbal engagement was also measured using the partial interval time sampling method, and the data were transformed for analysis into the percentage of prototype intervals containing nonverbal engagement behaviours. The distribution of nonverbal engagement behaviours exhibited by participants is presented in a frequency histogram in Figure 5.4.

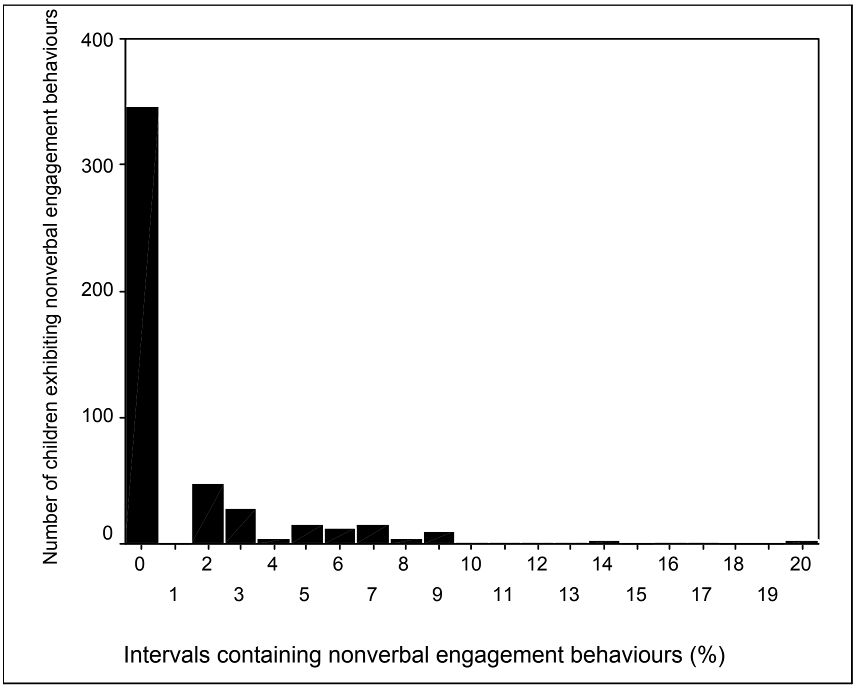


Figure 5.4: Frequency histogram of nonverbal engagement behaviours exhibited by participants.

As shown in Figure 5.4, the distribution of nonverbal engagement behaviours exhibited by participants is positively skewed (skew = 2.819). As with verbal engagement, the majority of participants exhibited no nonverbal engagement behaviours. Those who did exhibit these behaviours did so for a mean of 1.6% of prototype intervals. Given that these behaviours occurred so infrequently, it was decided not to proceed with the reporting and interpretation of these data. However, all analyses of nonverbal engagement behaviours are attached as Appendix J.

The finding that verbal and nonverbal engagement behaviours occurred infrequently is consistent with other studies using similar measures (Anderson et al., 1981; Crawley et al., 2002; Crawley et al., 1999). Crawley and colleagues presented aggregate data in their analyses. These studies may have had sufficient data for analysis because they aggregated verbal and nonverbal behaviours (i.e. Crawley et al., 1999) and because they measured these behaviours as continuous variables. Partial-interval recording was used in the present study, and this is known to be a conservative measure (Sulzer-Azaroff & Maher, 1977).

5.4.5 Observed enjoyment

Due to the low incidence of observed enjoyment behaviours, the two categories of behaviour constituting observed enjoyment (smiling and laughing) were analysed together. Observed enjoyment was measured using the partial interval time sampling method, and the data were transformed for analysis into the percentage of prototype intervals containing observed enjoyment behaviours. Figure 5.5 shows the distribution of observed enjoyment behaviours exhibited by participants in a frequency histogram.

As shown in Figure 5.5, the distribution of observed enjoyment behaviours exhibited by participants is also positively skewed (skew = 2.083). As with the data shown in Figures 5.3 and 5.4, this variable is also infrequently occurring, with a modal score of 0.

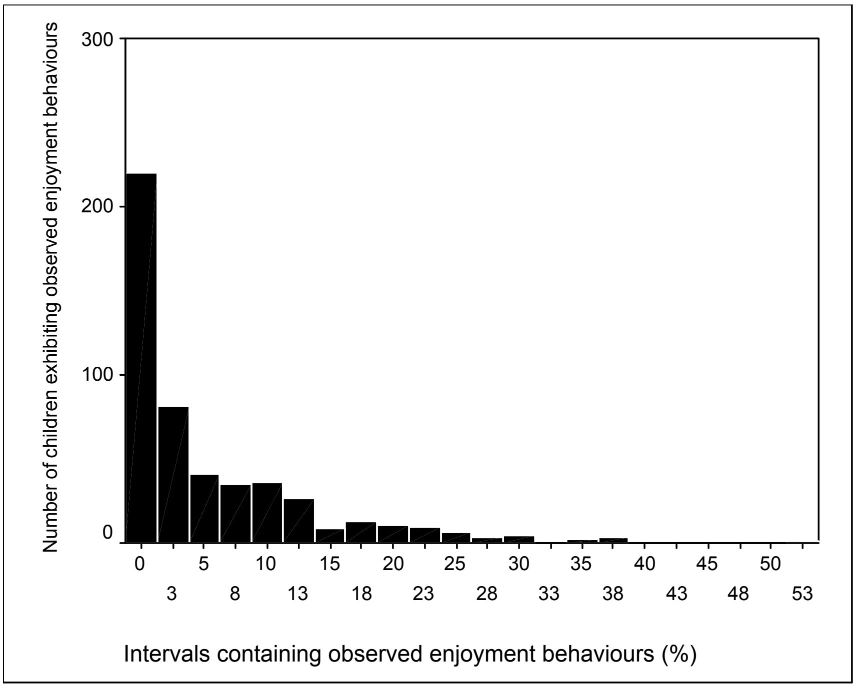


Figure 5.5: Frequency histogram of observed enjoyment behaviours exhibited by participants.

Despite the expectation that participants would exhibit laughter and smiling while viewing the prototypes, it was found that most of the participating children did not engage in these behaviours. As discussed, the partial-interval method used to record the incidence of smiling and laugher is a conservative one (Sulzer-Azaroff & Maher, 1977), and this may partially account for why these behaviours were observed so infrequently. However, it is also suggested that these behaviours may have been exhibited infrequently because they are social behaviours. Given that the participants were viewing the prototypes individually, smiling and laughter may have been absent because there was no child co-viewer to communicate enjoyment to, rather than because enjoyment was not experienced.

There are no reports of equivalent enjoyment measures in the published literature, preventing any comparisons being made with these data. Given that enjoyment behaviours were observed infrequently, it was decided that this variable would not be reported on further. However all analyses are attached in Appendix K.

5.4.6 Reported enjoyment

Enjoyment was reported on a five-point faces scale, with possible responses ranging from 1 to 5. These raw scores were not transformed for analysis. The distribution of reported enjoyment exhibited by participants is presented in a frequency histogram in Figure 5.6.

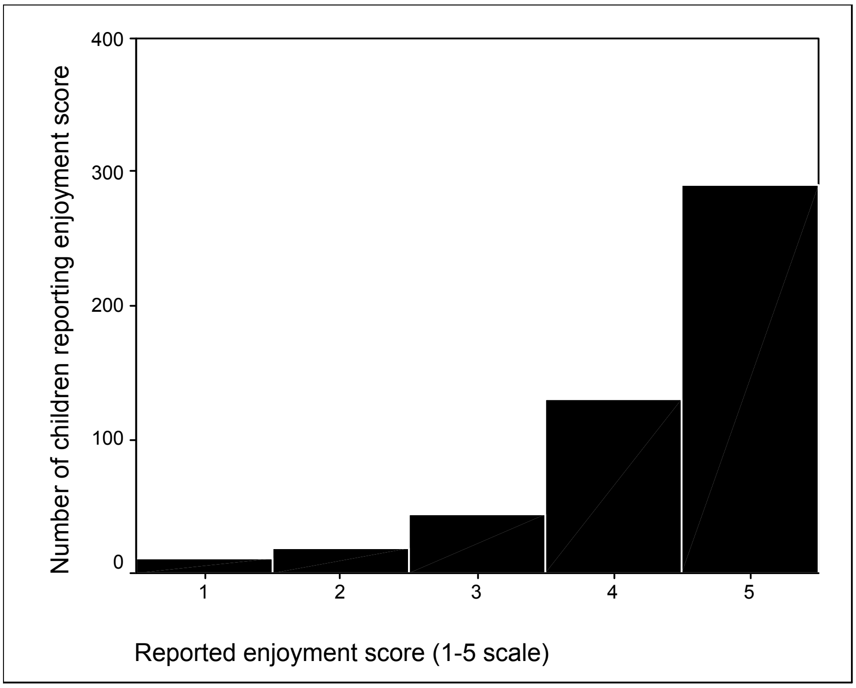


Figure 5.6: Frequency histogram of reported enjoyment given by participants.

As shown, the distribution of observed enjoyment behaviours exhibited by participants is negatively skewed (skew = -1.650). This is consistent with Read and colleagues' observation that young children tend to uniformly provide high enjoyment ratings (Read et al., 2006). It is noted that the enjoyment observed in participants (Figure 5.5) is skewed in a different direction than the enjoyment reported by participants, as shown in Figure 5.6. Although this distribution is skewed, it is suggested that this pattern is a desirable one. The prototypes were designed to elicit high levels of enjoyment from participants, and were all variations of broadcast programs that are popular with children in the same age group as participants. Therefore, it is to be expected that a 'natural ceiling effect' would be found for this variable (Smithson & Verkuilen, *in submission*).

Given the skewness of these distributions, power transformations were considered to permit parametric analysis. Power transformations can be used to change the shape of a distribution, thereby reducing asymmetry (Emerson & Stoto, 2000). By converting the distribution of scores to a more normal distribution, parametric analysis can be conducted. However, a disadvantage of power transformations is that the resulting new scale can limit intuitive understanding of the data and may make interpretation difficult (Emerson & Stoto, 2000). Emerson and Stoto (2000) suggest some ‘rules of thumb’ for determining whether power transformations are worthwhile. First, they suggest that power transformations are best able to alter the shape of a distribution when the range of scores is large. They advise calculating the ratio between the largest data value and the smallest data value (largest value/smallest value). They suggest that large ratios of 20 or more result in greater distribution change than smaller rations. An examination of the ratios for attention and reported enjoyment are both five. These small ratios suggest that power transformations will not notably alter the shape of the attention and reported enjoyment distributions.

Another caution from Emerson and Stoto (2000) is that transformations can limit the interpretability of the new scale. For these reasons, it was decided that these variables would not be transformed. Therefore, attention and enjoyment will be analysed nonparametrically. However, it is recognised that nonparametric tests are less powerful than their parametric counterparts, and as such are less likely to identify significant differences between groups (Coakes & Steed, 1999). Parametric tests will be used in comparing the comprehension of different groups as this distribution is normal.

CHAPTER 6 – RESULTS: INDEPENDENT VARIABLES

6.1 Background to Analysis

Three main assumptions underlie the analysis reported in this chapter. First, the interactive prototype versions differ from the control prototypes because they contain an interactive segment. It is assumed that the interactive segments, as the most obvious point of difference between the interactive and control prototypes, will primarily be the portion of the prototypes where participants' comprehension and attention will differ. Essentially, if there are any differences in the comprehension and attention of participants viewing the interactive prototype and the control prototype, they are likely to be found during the interactive segments. Therefore, the comprehension and attention exhibited during the interactive segments for participants who interacted, did not interact, or viewed the control will be compared for each interactive prototype.

Second, if differences in comprehension or attention are found during the interactive segments, it is expected that these differences may also be observed for the portion of the prototype after the interactive segments. For example, if interacting with a prototype requires or elicits additional attention from participants, it may be that this increased attention is maintained even after the interactive segment ceases. The comprehension of participants for the period after the interactive segments can be calculated for most prototypes because there are comprehension questions specifically relating to content seen after the interactive segments. The percentage of attention participants direct toward the prototype can also be calculated for the portion of the prototype after the interactive segments. Therefore, the comprehension and attention exhibited after the interactive segments for participants who interacted, did not interact, or viewed the control will be compared for each prototype.

Third, it is assumed that any differences in comprehension and attention found during the interactive segments, and possibly after the interactive segments, may be large enough that differences are maintained across the whole prototypes. Therefore, the comprehension achieved and attention exhibited over the whole of the prototype will be compared for participants who interacted, did not interact, or viewed the control prototype.

For each of the nine interactive prototypes, these three kinds of comparisons are made where possible. Some comparisons are not possible for individual prototypes due to aspects of their design. For example, the interactive segment in *Hi-5* Collecting Cards spans the duration of the prototype. Therefore, it is not possible to isolate the interactive segment as separate from the period after the interactive segment, for comparison with *Hi-5* Control.

In summary, the comprehension of participants who interacted, did not interact, and viewed the control prototype will be compared for the period during the interactive segments. The comprehension of these groups will also be compared for the portion of the prototype after the interactive segments, and for the whole prototypes. Similarly, the percentage of attention exhibited by interacting, non-interacting and control-viewing participants will be compared for the period during the interactive segments, for the period after the interactive segments, and for the whole prototypes. Finally, the enjoyment reported by interacting and non-interacting participants and those viewing the control prototypes will be compared for the whole prototypes. The enjoyment reported by participants cannot be isolated for the period during or after the interactive segments, because enjoyment was measured as a global rating for the whole prototypes rather than as a continuous measure.

6.2 Comparisons between *Dora the Explorer* Character Assistance and *Dora the Explorer* Control

6.2.1 Defining the interactive segments for Character Assistance

The 'interactive segment' of this prototype begins when Dora invites the child to watch out for Swiper, and to press the red button if they see him. After this call to action, Swiper begins to creep up on Dora. For the purposes of the following analyses, the 45-second period between the call to action and the end of the Swiper segment in Character Assistance and the control prototype are referred to as the interactive segments.

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Dora the Explorer,* question 3, specifically refers to this segment (see Appendix F). Therefore, the comprehension scores of interacting and non-interacting participants, and participants viewing the control prototype, can be compared for question three. The raw scores for question 3, with a possible range of 0 to 4 were converted to percentages for analysis. The attention of participants during this segment was compared for a random subset of participants (26 in Control and 20 in Character Assistance). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as the percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

Comprehension and attention can also be isolated for the period after the interactive segments. The period of time remaining in the prototype after the interactive segments was 7 minutes 39 seconds for Character Assistance, and 7 minutes 44 seconds for

Control. Comprehension for this period was assessed by examining the responses to comprehension question 5. This question relates specifically to a segment occurring after the interactive segments. The raw scores for question 5, with a possible range of 0 to 4, were converted to percentages for analysis. Attention for the period after the interaction was also calculated for the same subset of participants. Finally, comprehension, attention and enjoyment were compared for the whole prototypes.

6.2.2 Comprehension

Table 6.1 presents the results of the comprehension comparisons made between interacting and non-interacting participants viewing Character Assistance, and participants viewing the control prototype. Three one-way ANOVAs were used to compare the comprehension exhibited by participants during the interactive segments, the period after the interactive segments, and for the whole prototypes.

Table 6.1: Comprehension during *Dora the Explorer* Character Assistance.
One-way ANOVAs comparing comprehension scores for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Character Assistance. Comprehension scores are compared for the period during the interactive segments, for the period of the prototype after the interactive segments, and for the whole prototypes. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.

***Dora the Explorer* Control**			***Dora the Explorer* Character Assistance**						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Interacted			**Did not interact**						
N	Mean	sd	*N*	Mean	Sd	*N*	Mean	sd				
During the interactive segments												
42	32.74	17.01	32	25.78	23.32	5	25.00	.00	1.02	2, 76	1.302	.278
After the interactive segments												
42	50.60	26.18	32	50.78	29.43	5	70.00	32.60	.630	2, 76	1.123	.331
Whole prototypes												
42	41.81	9.96	32	45.00	11.94	5	48.80	4.38	.070	2, 76	1.475	.235

As shown in Table 6.1, no differences were found between the comprehension scores of interacting, non-interacting and control participants for the duration of the interactive segments. Similarly, no differences in comprehension were found between these groups for the period after the interactive segments, or for the whole prototypes.

6.2.3 Attention and enjoyment

Table 6.2 presents the results of the attention and enjoyment comparisons made between interacting and non-interacting participants viewing Character Assistance, and participants viewing the control prototype. Three Kruskal-Wallis tests were used to compare the percentage of attention exhibited by participants during the interactive segments, the period after the interactive segments, and for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by participants for the whole prototypes.

Table 6.2: Attention and enjoyment for *Dora the Explorer* Character Assistance. Kruskal-Wallis tests comparing attention and enjoyment for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Character Assistance. Attention is reported as a percentage of the time the participant is looking toward the television, and is compared for the period during the interactive segments, for the period of the prototype after the interactive segments, and for the whole prototypes. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using a Kruskal-Wallis test.

***Dora the Explorer* Control**			***Dora the Explorer* Character Assistance**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments											
26	89.29	23.62	18	96.66	22.47	2	99.80	31.25	.843	2	.656
Attention after the interactive segments											
26	90.21	22.81	18	89.35	24.50	2	85.09	23.50	.169	2	.919
Attention for the whole prototypes											
42	88.43	39.10	32	87.86	40.38	5	91.58	45.20	.331	2	.848
Enjoyment											
41	4.66	42.27	32	4.53	36.19	5	4.60	38.00	1.906	2	.386

Table 6.2 shows that the attention exhibited at all points of Character Assistance and Control was very high. For the period of the interactive segments, after the interactive segments and for the whole prototypes, attention was above 87%. Given that attention was consistently high for interacting, non-interacting and control viewers, no

significant differences in attention were found. It is noted, however, that attention was markedly higher during the interactive segment for all participants viewing Character Assistance prototype compared with those viewing the control prototype. It is suggested that a ‘ceiling effect’ may be occurring during the interactive segment of this prototype. It is argued that, with the attention of control viewers being so high (89.29%), and with a natural attention ceiling of 100%, significantly higher attention could not occur for the interacting and non-interacting participants. For this reason, it is difficult to interpret the effect that viewing this prototype had on participants’ attention.

Table 6.2 also shows that participants who did and did not interact with Character Assistance and those who viewed the Control prototype did not exhibit significant differences in attention for the period after the interactive segment, or for the whole prototypes.

As shown in Table 6.2, the enjoyment reported by participants who interacted, did not interact, or viewed the control prototype did not differ. It is noted, however, that the enjoyment reported by Control viewers was very high (4.66 of a possible 5) and this may have prevented any significant increase in enjoyment being detected between the groups.

6.2.4 Discussion

It was surprising to find that comprehension, attention and enjoyment did not differ between interacting and non-interacting participants and those viewing the control prototype. It is suggested that the design and experience of the interactive segments in the control prototype may account for the lack of difference found between interacting, non-interacting and control viewing participants. This particular prototype allows the child to use a technological interaction, pressing the red button to warn of Swiper's approach, in place of a non-technological interaction, calling out and pointing to the television to warn of Swiper's approach. The results demonstrated that participants are equally likely to comprehend, attend to, and enjoy, the non-technological interaction as the technological interaction. However, the potential ceiling effects noted for attention and enjoyment make interpreting these findings difficult.

6.3 Comparisons between *Dora the Explorer* Minor Narrative Choice and *Dora the Explorer* Control

6.3.1 Defining the interactive segments for Minor Narrative Choice

The 'interactive segment' of this prototype begins when Dora invites the child to help her select a wagon for Benny. The interactive segment is considered to end when Benny is placed in the wagon and Dora begins pushing him along the path. In total, the interactive segment lasts 58 seconds in both Minor Narrative Choice and the control prototype. For the purposes of the following analyses, these portions of the prototypes are referred to as the interactive segments.

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Dora the Explorer,* question 2, specifically refers to this segment (see Appendix F). Therefore, the scores of interacting and non-interacting participants, and participants viewing the control prototype, can be compared for question 2. The raw scores for question two, with a possible range of 0 to 4, were converted to percentages for analysis. The attention of participants during this segment was compared for a random subset of participants (25 in the control prototype and 28 in Minor Narrative Choice). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as a percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

Comprehension and attention can also be isolated for the period after the interactive segments. The period of time remaining in the prototype after the interactive segments was 9 minutes 12 seconds for Minor Narrative Choice and the control prototype. Comprehension for this period was assessed by examining the responses to comprehension questions 3 and 5. These questions relate specifically to segments occurring after the interactive segments. The summed raw scores for questions 3 and 5, with a possible range of 0 to 8, were converted to percentages for analysis. Attention for the period after the interaction was also calculated for the same subset of participants. Finally, comprehension, attention and enjoyment were compared for the whole prototypes.

6.3.2 Comprehension

Table 6.3 presents the results of the comprehension comparisons made between interacting and non-interacting participants viewing Minor Narrative Choice, and participants viewing the control prototype. Three one-way ANOVAs were used to compare the comprehension scores of participants during the interactive segments, the period after the interactive segments, and for the whole prototypes.

As seen in Table 6.3, there was a significant difference in the comprehension of participants during the interactive segments. Post-hoc analysis was conducted to determine which groups exhibited significant differences. A Tukey's HSD test found that participants interacting by choosing the blue wagon exhibited significantly higher comprehension during the interactive segments than participants who did not interact, thereby defaulting to the blue wagon ($p < .05$). It is noted that no such differences were noted for participants selecting the yellow wagon.

Table 6.3: Comprehension during *Dora the Explorer* Minor Narrative Choice.
One-way ANOVAs comparing comprehension scores for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Minor Narrative Choice. Interacting participants were able to choose a blue or yellow wagon. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, for the period after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Minor Narrative Choice**												
			Interacted – Blue Wagon			**Interacted – Yellow Wagon**			**Did not interact – Default to Blue Wagon**			Levene's test *(sig.)*	*df*	*F*	*Sig.*
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments															
42	21.43	21.79	16	29.69	20.85	9	11.11	18.16	16	9.38	15.48	.823	3, 79	3.343	.023
After the interactive segments															
42	41.67	16.26	16	39.84	22.46	9	34.72	20.52	16	26.56	22.76	.063	3, 79	2.495	.066
Whole prototypes															
42	41.81	9.96	16	48.00	11.96	9	39.56	10.48	16	30.50	14.38	.181	3, 79	6.664	.001

Table 6.3 shows that the differences incomprehension exhibited by the groups of participants approached significance for the period after the interaction, with the lowest comprehension shown by non-interacting participants and the highest shown by those interacting participants selecting the blue wagon and participants viewing the control prototype.

It was also found that there was a significant difference between the comprehension scores of these groups of participants for the whole prototypes. Tukey's HSD post-hoc analysis found that participants interacting by choosing the blue wagon showed significantly higher comprehension for the whole prototype than did non-interacting participants who defaulted to the blue wagon ($p < .001$). As with comprehension during the interactive segments, it is unclear why no differences in comprehension after the interactive segments were noted for participants selecting the yellow wagon. It was also found that participants viewing the control prototype exhibited significantly higher comprehension for the whole prototype than the non-interacting participants ($p < .01$).

6.3.3 Attention and enjoyment

Table .64 presents the results of the attention and enjoyment comparisons made between interacting and non-interacting participants viewing Minor Narrative Choice, and participants viewing the control prototype. Three Kruskal-Wallis tests were used to compare the percentage of attention exhibited by participants during the interactive segments, after the interactive segments, and for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by participants for the whole prototypes.

Table 6.4: Attention and enjoyment for *Dora the Explorer* Minor Narrative Choice. Kruskal-Wallis tests comparing attention and enjoyment for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Minor Narrative Choice. Interacting participants were able to choose a blue or yellow wagon. Attention is reported as the percentage of time participants looked toward the television, and is compared for the period during the interactive segments, for the period after the interactive segments, and for the whole prototypes. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using a Kruskal-Wallis test.

***Dora the Explorer* Control**			***Dora the Explorer* Minor Narrative Choice**											
			Interacted – Blue Wagon			**Interacted – Yellow Wagon**			**Did not interact – Default to Blue Wagon**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments														
25	89.28	30.88	12	86.05	23.92	4	76.88	17.00	12	78.68	25.33	3.882	3	.274
Attention after the interactive segments														
25	89.44	30.88	12	87.19	23.92	4	92.68	17.00	12	87.86	25.33	3.336	3	.343
Attention for the whole prototypes														
42	88.43	42.19	16	85.43	38.19	9	89.24	42.78	16	86.15	44.88	.640	3	.887
Enjoyment														
41	4.66	47.32	16	4.06	37.34	9	4.33	41.50	16	3.88	30.75	8.255	3	.041

As seen in Table 6.4, there were no significant differences in the attention shown by participants who interacted, did not interact, or viewed the control prototype; either during the interactive segments, after the interactive segments, or for the whole prototypes. It is also shown in Table 6.4 that the enjoyment reported by participants who interacted, did not interact and those who viewed the control prototype differed significantly. Post-hoc analysis was conducted to determine which pairs of groups exhibited significant differences. The results of a Mann-Whitney U test found that the enjoyment reported by participants viewing the control prototype was significantly higher than that reported by participants who did not interact during Minor Narrative Choice (Mann-Whitney U = 189.50; $p < .01$).

6.3.4 Discussion

It is noted that significant differences in comprehension were found between interacting and non-interacting participants, and also between control and non-interacting participants. In both cases, non-interacting participants achieved lower comprehension scores. No significant differences were observed between control and interacting participants.

A possible explanation for this pattern of results is that the non-interacting participants may be systematically different from participants viewing the control prototype, and participants interacting with the interactive prototype, in a way that affects their program comprehension. For example, it may have been that children with lower levels of media literacy were less likely to interact with the prototype than children with higher media literacy. It is plausible that children with lower media literacy may also achieve lower comprehension scores as compared to children with higher media literacy. Therefore, it is possible that the non-interacting participants achieved lower comprehension than the control viewers because of some pre-existing factor, such as media literacy. However, this explanation does not account for why the non-interacting participants achieved lower comprehension than the participants selecting the blue wagon, but not compared to those selecting the yellow wagon.

An alternative explanation for the findings is that the non-interacting participants were not systematically different from the interacting participants and the control viewers in pre-existing ways, and that the act of not interacting with the prototype caused the observed differences in comprehension. The only difference in the experiences of non-interacting participants and control prototype viewers was that instructions and a choice were presented to the non-interacting participants. It is possible that being presented with instructions and a choice may have influenced comprehension in some way. However, it is also difficult to account for why differences in comprehension were observed for participants selecting the blue wagon compared to the other groups, but not the yellow wagon compared to the other groups. There is no particular reason to conclude that the colour blue would elicit effects not found for the colour yellow.

The interpretation of the findings is also influenced by the uneven cell sizes in the groups being compared. Only nine participants selected the yellow wagon, while 16 participants selected the blue wagon, and a further 16 participants did not interact with the prototype. It is unclear whether different findings would have occurred had the distribution of participants across these three groups been more even.

6.4 Comparisons between *Dora the Explorer* Major Narrative Choice and *Dora the Explorer* Control

6.4.1 Defining the interactive segments for Major Narrative Choice

The interactive segment of this prototype begins when Dora invites the child to help her decide whether to go through the giant flowers or past the dragon. The interactive segment finished at the conclusion of the giant flowers or dragon segment. In total, the giant flowers segment was 2 minutes 30 seconds in duration, and the dragon segment was 2 minutes 03 seconds in duration. For the purposes of the following analyses, these portions of the prototypes are referred to as the interactive segments.

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Dora the Explorer,* question 5, relates to this segment (see Appendix F). Therefore, the comprehension scores of interacting and non-interacting participants, and participants viewing the control prototype, can be compared for question 5. The raw scores for question 5, with a possible range of 0 to 4, were converted to percentages for analysis. The attention of participants during this segment was compared for a random subset of participants (25 in the control prototype and 21 in Major Narrative Choice). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as a percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

The period of time remaining in the prototype after the interactive segment was 4 minutes 56 seconds. Unfortunately, comprehension for the period after the interactive segment could not be isolated for this prototype version. There were no comprehension questions specifically relating to the period after the interactive segments for this prototype. However, attention could be isolated for the period after the interactive segments. Attention for the period after the interaction was also calculated for the same subset of participants. Finally, comprehension, attention and enjoyment were compared for the whole prototypes.

6.4.2 Comprehension

Table 6.5 presents the comparisons of comprehension scores between interacting and non-interacting participants viewing Major Narrative Choice, and participants viewing the control prototype. Two one-way ANOVAs were used to compare the comprehension achieved by participants during the interactive segments, and for the whole prototypes.

Table 6.5: Comprehension during *Dora the Explorer* Major Narrative Choice.
One-way ANOVAs comparing comprehension scores for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Major Narrative Choice. Interacting participants were able to choose the giant flowers or the dragon. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Major Narrative Choice**												
			Interacted – Giant flowers			**Interacted – Dragon**			**Did not interact – Default to Dragon**			Levene's test *(sig.)*	*df*	*F*	*Sig.*
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments															
42	50.60	26.18	17	48.53	24.16	9	63.89	30.90	16	46.88	27.20	.890	3, 80	.891	.450
Whole prototypes															
42	41.81	9.96	17	45.18	9.77	9	47.11	13.38	16	38.25	11.40	.607	3, 80	1.843	.146

As shown in Table 6.5, there were no differences in the comprehension scores achieved during the interactive segments for participants who interacted, did not interact, or viewed the control prototype. Likewise, there were no differences in comprehension scores for the whole prototypes for any of these groups.

6.4.3 Attention and enjoyment

Table 6.6 presents the results of the attention and enjoyment comparisons made between interacting and non-interacting participants viewing Major Narrative Choice, and participants viewing the control prototype. Three Kruskal-Wallis tests were used to compare the percentage of attention exhibited by participants during the interactive segments, after the interactive segments, and for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by participants for the whole prototypes.

Table 6.6: Attention and enjoyment for *Dora the Explorer* Major Narrative Choice. Kruskal-Wallis tests comparing attention and enjoyment for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Major Narrative Choice. Interacting participants were able to choose the giant flowers or the dragon. Attention is reported as the percentage of time the participant is looking toward the television, and is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using a Kruskal-Wallis test.

***Dora the Explorer* Control**			***Dora the Explorer* Major Narrative Choice**											
			Interacted – Giant flowers			**Interacted – Dragon**			**Did not interact – Default to Dragon**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments														
25	92.36	27.52	8	88.69	19.00	6	83.23	9.00	7	92.99	26.71	10.55	3	.014
Attention after the interactive segments														
25	89.55	24.22	8	80.52	15.13	6	88.69	20.92	7	95.81	32.71	6.708	3	.082
Attention for the whole prototypes														
42	88.43	43.93	17	85.25	33.29	9	87.84	37.89	16	91.85	51.13	4.888	3	.180
Enjoyment														
42	4.66	44.74	17	3.88	33.79	9	4.33	41.11	16	4.53	41.60	3.690	3	.297

As seen in Table 6.6, there were significant differences in the attention shown by participants in the different groups during the interactive segments. Post-hoc analysis was conducted to determine where the significant differences occurred. It was found that participants selecting the dragon exhibited significantly lower attention than those viewing the control prototype (Mann-Whitney U = 20.00; $p < .01$). It was also found that participants selecting the dragon segment exhibited significantly lower attention than participants who did not interact, and therefore defaulted to the dragon segment (Mann-Whitney U = 4.00; $p < .05$). It is noted that no differences were observed between participants selecting the giant flowers segment and the other groups.

As shown in Table 6.6, participants showed no differences in attention for the period after the interactive segment, or for the whole prototypes. It can also be seen in Table 6.6 that interacting participants choosing either the giant flowers or dragon segments reported the lowest enjoyment. It is noted, however, that the enjoyment of participants who interacted, did not interact, and those who the control prototype did not differ significantly.

6.4.4 Discussion

The finding that attention was significantly higher for participants viewing the control prototype compared with participants choosing the dragon needs to be interpreted with caution. Participants viewing the control prototype watched the giant flowers segment instead of the dragon segment. Therefore, the finding that attention was higher for participants viewing the giant flowers segment in the control prototype than for participants interacting by choosing the dragon is difficult to interpret. Attention may be different between these groups simply because they viewed different segments rather than as an effect of the interaction.

Although no differences in comprehension were observed between interacting, non-interacting and control prototype viewers, significant differences in attention were observed. As with Minor Narrative Choice, the significant differences for this prototype were observed between interacting and non-interacting participants, and between control and interacting participants. In both cases, attention was lowest for interacting participants selecting the dragon. Again, a possible explanation for this pattern of results is that the interacting participants were systematically different to the non-interacting and control prototype viewers in a way that influenced their attention. Using the same example as was used for Minor Narrative Choice, it may be that interacting participants were more media literate than the other groups of participants. Participants with higher media literacy may have required less attention to comprehend the segment than participants with lower media literacy.

Another explanation for the findings is that interacting with the prototype may have lead to a decrease in attention. This may have occurred because participants knew what content they were about to see (they knew they were going to see a dragon) and participants may consequently have required less attention to understand the material than they would have if they could not anticipate the content. Alternatively, having made a choice, the interacting participants may have found the dragon segment relatively uninteresting, and therefore directed less of their attention to it.

It is difficult to account for why differences in attention were noted for participants choosing the dragon compared with the other groups, but not for participants choosing the giant flowers compared with other groups. Given that no non-interacting participants viewed the giant flowers segment, it is not clear whether the same effect would have been found for the non-interacting participants viewing the giant flowers segment. Similarly, there is no comparable control group to compare the dragon segment viewers with.

6.5 Comparing *Hi-5* Segment Repetition with *Hi-5* Control

6.5.1 Defining the interactive segments for *Hi-5* Segment Repetition

The interactive segment for this prototype is the segment featuring presenter Charli. Participants assigned to *Hi-5* Segment Repetition have the option of viewing this segment twice, while participants assigned to *Hi-5* Control view the segment once only. In Segment Repetition, Bingo, appears at the end of the Charli segment and invites the child to watch the segment again by pressing the red button. The child had 14 seconds to press the red button. If the child pressed the red button, the segment was repeated. The prototype then resumed as in the control prototype, expect that a subsequent segment is omitted to preserve the prototype length. This was a creative decision made by the prototype designers to replicate the constraints anticipated in a live-broadcast context. If the viewer did not press the red button within the allocated time, the prototype resumed exactly as in the control prototype. Participants viewing the control prototype watch the Charli segment once and then the remainder of the prototypes without having the option to repeat the Charli segment.

For participants repeating the Charli segment, the interactive segment is considered to end after the segment concludes for the second time. For non-repeating participants, and those viewing the control prototype, the interactive segment is considered to be the first (and only) viewing of the Charli segment. This segment was 1 minute 17 seconds in duration. For the purposes of the following analyses, these portions of the prototypes are referred to as the interactive segments.

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Hi-5,* question 2, specifically refers to this segment (see Appendix F). Therefore, the comprehension scores of repeating and non-repeating participants, and participants viewing the control prototype, can be compared for question 2. The raw scores for question two, with a possible range of 0 to 4, were converted to percentages for analysis.

The attention of participants during this segment was compared for a random subset of repeating participants, comparing the attention during the first and second viewings of the Charli segment (11 participants). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as a percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

The omission of a subsequent segment to maintain the length of the prototype for repeating participants means that the period after the interactive segments is not comparable for repeating, non-repeating, and the control prototype viewing participants. For this reason, comprehension and attention were not calculated for the period of the prototype after the interactive segments.

Finally, comprehension, attention and enjoyment were compared for the whole prototypes. As discussed in Chapter 5, the participants viewing Segment Repetition (and *Play School* Theme Repetition) were not classified as 'interacting' and 'non-interacting' because not pressing the red button could be attributed to a deliberate choice not to see the content offered in a way that not using the remote during the other interactive prototypes could not. Therefore, participants viewing these prototypes were classified as 'repeating' and 'non-repeating'.

6.5.2 Comprehension

Table 6.7 presents the results of the comprehension comparisons made between repeating and non-repeating participants viewing Segment Repetition, and participants viewing the control prototype. Two one-way ANOVAs were used to compare the comprehension scores achieved by participants during the interactive segments, after the interactive segments, and for the whole prototypes. As shown, participants who did and did not repeat the segment in Segment Repetition, and participants viewing the control prototype did not differ in their comprehension scores for the interactive segment.

However, it was found that these groups showed differences in comprehension for the whole prototypes. Post-hoc analysis was conducted to determine where the significant differences were, and the results of a Tukey HSD test found that participants repeating the segment achieved significantly higher comprehension for the whole prototype than participants viewing the control prototype ($p < .05$).

Table 6.7: Comprehension for *Hi-5* Segment Repetition.
One-way ANOVAs comparing comprehension scores for participants viewing *Hi-5* Control with those who did and did not repeat the segment in *Hi-5* Segment Repetition. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, and for the whole prototypes.

***Hi-5* Control**			***Hi-5* Segment Repetition**						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Repeated			**Did not repeat**						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
44	23.30	23.75	28	28.57	20.09	13	26.92	23.85	.934	2, 82	.492	.613
Whole prototypes												
44	34.27	15.39	28	44.90	15.19	13	41.14	22.32	.240	2, 82	3.687	.029

6.5.3 Attention and enjoyment

Tables 6.8 and 6.9 present the results of the attention and enjoyment comparisons made between repeating and non-repeating participants viewing Segment Repetition, and participants viewing the control prototype. A Wilcoxon signed ranks test was used to compare the attention exhibited by participants repeating the segment during their first and second viewings. The results are presented in Table 6.8.

Table 6.8: Wilcoxon Signed Ranks tests comparing the attention of participants repeating the segment in *Hi-5* Segment Repetition during the first and second viewings.

First viewing				**Second viewing**				*Z*	*Sig.*
N	Mean	Mean Rank	Sum of Ranks	*N*	Mean	Mean Rank	Sum of Ranks		
11	77.40	6.50	52.00	11	69.92	4.70	14.00	-1.689	.091

As shown in Table 6.8, participants repeating the segment exhibited reduced attention during their second viewing of the segment, however, this reduction was not significant. In Table 6.9, the results of three Kruskal-Wallis tests are presented comparing the attention and enjoyment of participants who did and did not repeat the segment, and those viewing the control prototype. Two Kruskal-Wallis tests were used to compare the percentage of attention exhibited by participants after the interactive segments, and for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by participants for the whole prototypes.

Table 6.9: Attention and enjoyment for *Hi-5* Segment Repetition.
Kruskal-Wallis tests comparing attention for participants viewing *Hi-5* Control with those who did and did not repeat the segment in *Hi-5* Segment Repetition. Attention is reported as the percentage of time the participant is looking toward the television, and is compared for the period after the interactive segments, and for the whole prototypes. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using a Kruskal-Wallis test.

***Hi-5* Control**			***Hi-5* Segment Repetition**								
			Repeated			**Did not repeat**			Chi-square	*df*	*Sig.*
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
Attention for the whole prototypes											
44	81.13	42.00	28	83.48	41.46	13	87.52	49.69	1.136	2	.567
Enjoyment											
44	4.39	43.06	27	4.11	38.24	12	4.38	46.58	1.447	2	.485

As shown in Table 6.9, there were no differences in the attention exhibited by participants who repeated and did not repeat the segment, and those viewing the control prototype, for the whole prototypes. Table 6.9 also shows that the reported enjoyment of participants did not vary for repeating, non-repeating and control viewing participants.

6.5.4 Discussion

Significantly higher comprehension was shown by repeating participants compared with those viewing the control prototype. This finding is consistent with the expectation that additional viewings of material would increase comprehension (Crawley et al., 1999). It is interesting to note, however, that the difference in comprehension between repeating participants and control prototype viewers was shown for the whole prototypes and not specifically for the repeated segment. It is unclear why this might have occurred.

The literature suggests that while comprehension increases with repetition, attention often decreases (Crawley et al., 1999). This decrease in attention reflects the child's increased understanding of the content and therefore their diminished requirement to attend to as much of the prototype as they previously required in order to understand it (Crawley et al., 1999). Therefore, it was to be expected that attention would decrease significantly from the first to the second viewings of the repeated segment. Contrary to this expectation, attention was not significantly lower for the second viewing of the segment although the difference approached significance. This finding may suggest that the Charli segment was a particularly complex one, which required more than one viewing to be fully understood. If this is the case, it may also account for why comprehension was not higher for repeating participants during the interactive segments.

6.6 Comparing *Hi-5* Presenter Choice with *Hi-5* Control

6.6.1 Defining the interactive segments for *Hi-5* Presenter Choice

The interactive segment of this prototype begins when Bingo invites the child to choose which character they would like to see next. The interactive segment was considered to end at the conclusion of the selected segment. The selected interactive segment was compared with the same segment in *Hi-5* Control. In total, the Nathan segment was 1 minute and 54 seconds in duration and the Tim segment was three minutes and 30 seconds in duration. For the purposes of the following analyses, these portions of the prototypes are referred to as the interactive segments.

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Hi-5,* question 3, specifically refers to the Nathan segments (see Appendix F). Therefore, the scores of interacting and non-interacting participants, and participants viewing the control prototype, can be compared for question 3. The raw scores for question 3, with a possible range of 0 to 4, were converted to percentages for analysis. Another of the comprehension questions for *Hi-5,* question 4, specifically refers to the Tim segment (see Appendix F). Therefore, the scores of interacting and non-interacting participants, and participants viewing the control prototype, can be compared for question 4. The raw scores for question 4, with a possible range of 0 to 4, were converted to percentages for analysis.

The attention of participants during the interactive segments was compared for a random subset of participants (20 in the control prototype and 18 in Presenter Choice. Of these 18, five selected the Nathan segment, nine selected the Tim segment, and five did not interact). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as a percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

Comprehension and attention can also be isolated for the period after the interactive segments. Comprehension for this period was assessed separately depending on the selection made. Participants selecting the Nathan segment during Presenter Choice, and those viewing this segment in the control prototype, saw a further 7 minutes and 52 seconds of programming after the interactive segment. The comprehension of these participants after the interactive segments was calculated by examining the responses to comprehension questions 4 and 5, which relate specifically to segments occurring after the interactive segment. The summed raw scores for questions 4 and 5, with a possible range of 0 to 8, were converted to percentages for analysis. Attention for the period after the interactive segment was also calculated for the same subset of participants.

Participants selecting the Tim segment during Presenter Choice, and those who did not interact, saw a further 6 minutes and 16 seconds of programming after the interactive segment. The comprehension of these participants after the interactive segments was calculated by examining the responses to comprehension questions 3 and 5, which relate specifically to segments occurring after the interactive segments. The summed raw scores for questions 3 and 5, with a possible range of 0 to 8, were converted to percentages for analysis. Attention for the period after the interaction was also calculated for the same subset of participants. Finally, comprehension, attention and enjoyment were compared for the whole prototypes.

6.6.2 Comprehension

Table 6.10 presents the results of the comprehension comparisons made between interacting and non-interacting participants viewing Presenter Choice, and participants viewing the control prototype. Independent samples t-tests were used to compare the comprehension scores achieved by participants who selected Nathan with those participants viewing the Nathan segment in the control prototype. Three t-tests were used to examine the comprehension achieved by these two groups during the interactive segments, for the period after the interactive segments, and for the whole prototypes. In addition, Table 6.10 presents the results of one-way ANOVAs used to compare the comprehension achieved by participants who selected Tim with those who did not interact (and defaulted to the Tim segment), and those viewing the Tim segment in the control prototype. Three ANOVAs were used to examine the comprehension achieved by these groups during the interactive segments, after the interactive segments, and for the whole prototypes.

Table 6.10: Comprehension for *Hi-5* Presenter Choice.
In *Hi-5* Presenter Choice, participants were able to select the Nathan or Tim segment. Independent samples t-tests were used to compare the comprehension scores achieved by participants who interacted by choosing the Nathan segment with those of participants viewing the Nathan segment in *Hi-5* Control. One-way ANOVAs were used to compare the comprehension scores of participants who interacted by choosing the Tim segment with those of participants who did not interact (and therefore defaulted to the Tim segment) and those who viewed the Tim segment in *Hi-5* Control. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.

***Hi-5* Control – Nathan segment**			***Hi-5* Presenter Choice**									
			Interacted – Nathan segment			**Did not interact**			Levene's test *(sig.)*	*df*	*t*	*Sig.*
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
44	23.30	26.63	11	43.18	37.23	N/A			.097	53	2.039	.046
After the interactive segments												
44	26.42	21.77	11	34.09	28.00	N/A			2.104	53	.986	.329
Whole prototypes												
44	34.27	15.39	11	45.45	18.78	N/A			.135	53	2.062	.044

***Hi-5* Control – Tim segment**			***Hi-5* Presenter Choice**									
			Interacted – Tim segment			**Did not interact – Default to Tim segment**			Levene's test *(sig.)*	*df*	*F*	*Sig.*
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
44	22.16	25.41	16	23.44	33.50	13	15.38	24.01	.741	2, 70	.380	.685
After the interactive segments												
44	30.68	28.97	16	39.06	35.31	13	32.69	27.74	.193	2, 70	.451	.639
Whole prototypes												
44	34.27	15.39	16	40.25	14.20	13	36.00	16.41	.237	2, 70	.893	.414

As presented in Table 6.10, participants who interacted by selecting Nathan achieved significantly higher comprehension for the interactive segments than participants viewing the control prototype. It was also found that participants selecting Nathan achieved significantly higher comprehension for the whole prototype than did participants viewing the control prototype. However, the comprehension of these groups did not differ for the period of the prototype after the interactive segments. It is also demonstrated that participants interacting by selecting Tim did not show different comprehension scores during the interactive segment compared to non-interacting participants and those viewing the control prototype. In addition, no differences in comprehension were observed after the interactive segments, or for the whole prototypes.

6.6.3 Attention and enjoyment

Table 6.11 presents the results of the attention and enjoyment comparisons made between interacting and non-interacting participants viewing Presenter Choice, and participants viewing the control prototype. Mann-Whitney U tests were used to compare the attention observed and enjoyment reported by participants who interacted by selecting Nathan, with those of participants viewing the Nathan segment in the control prototype. Three Mann-Whitney U tests were used to examine the attention exhibited by these two groups during the interactive segments, after the interactive segments, and for the whole prototypes. A Mann-Whitney U test was also used to compare the enjoyment reported by these two groups. In addition, Table 6.11 presents the results of Kruskal-Wallis tests used to compare the attention exhibited and enjoyment reported by participants who interacted by selecting Tim with those who did not interact (and defaulted to the Tim segment), and with those viewing the Tim segment in the control prototype. Three Kruskal-Wallis tests were used to examine the attention exhibited by these three groups during the interactive segments, after the interactive segments, and for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by these three groups.

Table 6.11: Attention and enjoyment for *Hi-5* Presenter Choice.
In *Hi-5* Presenter Choice, participants were able to select the Nathan or Tim segment. Mann-Whitney U tests were used to compare the attention and enjoyment of participants who interacted by selecting Nathan with those of participants viewing the Nathan segment in *Hi-5* Control. Kruskal-Wallis tests were used to compare the attention and enjoyment of participants who interacted by selecting Tim with those of participants who did not interact (and therefore defaulted to the Tim segment) and those who viewed the Tim segment in *Hi-5* Control. Attention is reported as the percentage of time participants were looking toward the television, and enjoyment is reported on a one to five scale.

***Hi-5* Control – Nathan segment**			***Hi-5* Presenter Choice**						Mann-Whitney U	*Z*	*Sig.*
			Interacted – Nathan segment			**Did not interact**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
20	88.05	13.55	4	81.65	7.25		N/A		19.00	-1.628	.115
After the interactive segments											
20	82.42	12.60	4	88.23	12.00		N/A		38.00	-.155	.911
Whole prototypes											
44	81.13	28.75	11	82.52	25.00		N/A		209.00	-.694	.487
Enjoyment											
44	4.39	28.01	11	4.50	27.95		N/A		241.50	-.012	.991

***Hi-5* Control – Tim segment**			***Hi-5* Presenter Choice**						Chi-square	*df*	*Sig.*
			Interacted – Tim segment			**Did not interact – Defaulted to Tim segment**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
20	82.11	16.45	9	85.66	20.33	5	80.80	16.60	.992	2	.609
After the interactive segments											
20	82.42	17.17	9	87.95	20.83	5	81.14	12.80	2.144	2	.342
Whole prototypes											
44	81.13	35.23	16	86.61	42.13	13	81.21	36.69	1.243	2	.537
Enjoyment											
44	4.39	36.90	16	4.56	40.25	13	4.23	33.35	.959	2	.619

As seen in Table 6.11, there were no differences in the observed attention of participants who selected Nathan compared with participants who viewed Nathan in the control prototype, either for the interactive segments, after the interactive segments, or for the whole prototypes. Similarly, no differences were found for any of these periods between participants selecting Tim compared with those who did not interact and those viewing the Tim segment in the control prototype.

The enjoyment reported by participants selecting Nathan did not differ from that reported by participants viewing the control prototype. Similarly, the enjoyment of participants interacting by selecting Tim did not differ from that reported by non-interacting participants and those viewing the control prototype.

6.6.4 Discussion

The same difficulties in interpretation occurring for *Dora the Explorer* Minor Narrative Choice and *Dora the Explorer* Major Narrative Choice apply to this prototype. It is difficult to meaningfully interpret the findings observed for one interactive option but not the other. Given that a difference in comprehension was observed between the interacting participants selecting Nathan and participants viewing the control prototype, it might be concluded that allowing participants to choose their preferred character resulted in increased comprehension. It is puzzling, however, why this pattern was not also observed for participants selecting the Tim segment.

One possible explanation for this inconsistency is that the Tim segment was longer than the Nathan segment (3 minutes 30 seconds for Tim compared with 1 minute 54 seconds for Nathan). It is possible that the effect of the Presenter Choice was time limited, and 'wore off' after a few minutes. This might account for why comprehension effects were observed for participants selecting Nathan but not for participants selecting Tim. The 'time limited effect' explanation might also account for why many of the effects found in this study were limited to the period of the interactive segments, and were not found for the portion of the prototype after the interactive segments.

6.7 Comparing *Hi-5* Collecting Cards with *Hi-5* Control

6.7.1 Defining the interactive segments for *Hi-5* Collecting Cards

The interactive segment of *Hi-5* Collecting Cards spanned the entire length of the prototype. In each of the prototype's five segments, the viewer had the opportunity to collect a trading card. Given that the entire prototype was interactive, no comparison can be made for the periods during and after the interactive segment. Analysis of this prototype is limited to whole prototype comparisons with *Hi-5* Control.

6.7.2 Comprehension

Table 6.12 shows the results of a one-way ANOVA comparing the comprehension scores achieved for the whole prototypes of those who did and did not interact with Collecting Cards with those viewing the control prototype. Participants were classified as 'interacting' if they collected any of the five available cards.

Table 6.12: Comprehension for *Hi-5* Collecting Cards.
A one-way ANOVA was used to compare the comprehension scores achieved by participants viewing *Hi-5* Control and those who did and did not interact with *Hi-5* Collecting Cards. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points.

***Hi-5* Control**			***Hi-5* Collecting Cards**						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Interacted			**Did not interact**						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
44	34.27	15.39	28	43.14	18.51	14	32.57	11.83	.139	2, 83	3.234	.044

As shown in Table 6.12, there was a significant difference in the comprehension scores achieved by these groups. A Tukey HSD test found that interacting participants achieved significantly higher comprehension scores than participants viewing the control prototype ($p < .07$).

6.7.3 Attention and enjoyment

Table 6.13 presents the results of Kruskal-Wallis tests comparing the attention and enjoyment of participants who did and did not interact with Collecting Cards, with those of participants viewing the control prototype.

Table 6.13: Attention and enjoyment for *Hi-5* Collecting Cards.
Kruskal-Wallis tests comparing attention and enjoyment for participants viewing *Hi-5* Control with those who did and did not interact with *Hi-5* Collecting Cards. Attention is reported as a percentage of the time that participants were looking toward the television, and enjoyment is reported on a one to five scale. Attention and enjoyment are compared for the whole prototypes.

***Hi-5* Control**			***Hi-5* Collecting Cards**								
			Interacted			**Did not interact**			Chi-square	*df*	*Sig.*
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
Attention											
44	81.13	37.43	28	91.77	54.02	14	88.44	41.54	7.653	2	.022
Enjoyment											
44	4.39	41.89	28	4.45	44.86	14	4.50	45.86	.508	2	.776

As shown in Table 6.13, there were significant differences in the attention exhibited for the whole prototypes. Post-hoc analysis was conducted to determine which pairs of groups exhibited significantly different attention. It was found that interacting participants exhibited significantly higher attention than participants viewing the control prototype (Mann-Whitney U = 389.0; $p < .01$). Table 6.13 also shows that there was no difference in the enjoyment reported by interacting and non-interacting participants, and those viewing the control prototype.

6.7.4 Discussion

Both the comprehension achieved, and attention exhibited, by interacting participants were significantly higher than those of participants viewing the control prototype. The finding that differences existed between interacting and control participants, rather than between interacting and non-interacting participants, supports the theory that the interaction caused a change in participants' cognitive responses and was not a result of pre-existing differences.

It is interesting to note that both comprehension and attention are significantly higher for interacting participants compared with those in the control condition for this prototype. The literature suggests that increases in both attention and comprehension reflect both an increase in the difficulty of the material, and in the viewer's understanding of it (Anderson & Lorch, 1983). The task of collecting cards, performed by interacting participants, was a highly visual one, requiring participants to visually attend to the prototype more closely than would otherwise be required. This task required additional effort from the interacting participant throughout the prototype, and the child was also rewarded each time they interacted. Given the design of this prototype, it is argued that Salomon's invested mental effort theory best accounts for the findings (Salomon, 1984). It is suggested that the comprehension and attention of interacting participants was greater than that exhibited by non-interacting participants and those viewing *Hi-5* Control because these participants invested greater effort in their viewing of the prototype. Crawley and colleagues have also attributed increased comprehension of episodes of *Blue's Clues* compared with other preschool prototypes to the increased mental effort this prototype requires (1999).

It is interesting to note that interacting participants exhibited significantly higher comprehension and attention, but did not report higher enjoyment than non-interacting participants and those viewing the control prototype. This finding may suggest that enjoyment of television prototypes in young children is not related to the effort invested in the prototype. Alternatively, this method of measuring enjoyment may lack utility with this age group. For all of the prototypes, the enjoyment reported by interacting, non-interacting and control-viewing participants has been high (four or higher on a five-point scale). It is suggested that this measure lacks sensitivity and is not useful in making distinctions between participants.

6.8 Comparing *Play School* Theme Repetition with *Play School* Control

6.8.1 Defining the interactive segments for *Play School* Theme Repetition

The interactive segment for this prototype is the segment containing a song about a dog. Presenter Andrew appears at the end of the first dog song and invites the child to watch another dog song by pressing the red button. The child had 14 seconds to press the red button, and if the child pressed the red button, another dog song was viewed. The prototype then resumed as in *Play School* Control, except that a subsequent segment was omitted to preserve the prototype length. As occurred in *Hi-5* Segment Repetition, this was a creative decision taken by the prototype designer to replicate the constraints of live broadcast television. If the viewer did not press the red button within the allocated time, the prototype resumed exactly as it would in the control prototype. Participants viewing the control prototype view the first dog song and all the remaining segments without having any option to view the additional dog song.

The interactive segment is considered to be both of the dog song segments for participants repeating in Segment Repetition. For non-repeating participants, and those viewing the control prototype, the interactive period is considered to be the first (and only) dog song segment. The first dog song segment was 1minute and 29 seconds in duration, and the second was 1 minute and 40 seconds in duration. For the purposes of the following analyses, these portions of the prototypes are referred to as the interactive segments.

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Play School,* question 4, specifically refers to the interactive segment (see Appendix F). Therefore, the scores of repeating and non-repeating participants, and participants viewing the control prototype, can be compared for question 4. The raw scores for question 4, with a possible range of 0 to 4, were converted to percentages for analysis.

The attention of participants during the interactive segment was compared for a random subset of repeating participants, comparing the attention during the first and second viewings of the dog song segments (17 participants). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as a percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

The omission of a subsequent segment to maintain the length or the prototype for repeating participants meant that the period after the interactive segments was not comparable for repeating, non-repeating, and the control prototype viewers. For this reason, comprehension and attention were not calculated for the period after the interactive segments. Finally, comprehension, attention and enjoyment were compared for the whole prototypes.

6.8.2 Comprehension

Table 6.14 presents the results of the comprehension comparisons made between participants who did and did not repeat the segment in *Play School* Theme Repetition, and participants viewing the control prototype. One-way ANOVAs were used to compare the comprehension scores achieved by participants during the interactive segments, and for the whole prototypes. Comprehension scores were not compared for the period after the interactive segments, as discussed above.

Table 6.14: Comprehension for *Play School* Theme Repetition.
One-way ANOVAs comparing comprehension scores for participants viewing *Play School* Control with those who did and did not repeat the segment in *Play School* Theme Repetition. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Theme Repetition**						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Repeated			**Did not repeat**						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
42	29.17	32.63	43	46.51	28.13	6	37.50	34.46	.416	2, 88	3.397	.038
Whole prototypes												
42	40.24	20.48	43	48.35	15.60	6	39.61	22.48	.299	2, 88	2.238	.113

As seen in Table 6.14, there were significant differences in the comprehension scores achieved by participants during the interactive segment. A Tukey HSD test found that participants repeating the segment achieved significantly higher comprehension for the interactive segment than those viewing the control prototype ($p < .05$). However, Table 6.14 also shows that this effect was not observed for the duration of the whole prototypes, with no significant differences in comprehension found for this period.

6.8.3 Attention and enjoyment

Tables 6.15 and 6.16 present the results of the attention and enjoyment comparisons made between repeating and non-repeating participants viewing Segment Repetition, and participants viewing the control prototype. A Wilcoxon Signed Ranks test was used to compare the attention observed for repeating participants during their first and second viewings of the segment. The results are presented in Table 6.15.

Table 6.15: Wilcoxon Signed Ranks tests comparing the attention exhibited by participants repeating the segment in *Play School* Theme Repetition during their first and second viewings. Attention is reported as the percentage of time participants were looking toward the television.

First segment				Second segment					
N	Mean	Mean Rank	Sum of Ranks	*N*	Mean	Mean Rank	Sum of Ranks	*Z*	*Sig.*
17	81.63	11.06	199.00	17	66.28	10.67	32.00	-2.902	.004

As shown in Table 6.15, the attention observed for repeating participants was significantly higher for the first viewing of the segment compared with the second viewing.

In Table 6.16, the results of two Kruskal-Wallis tests are presented comparing the attention observed and enjoyment reported by participants who did and did not repeat the segment in Theme Repetition, and those viewing the control prototype. A Kruskal-Wallis test was used to compare the percentage of attention shown by participants for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by participants for the whole prototypes.

Table 6.16: Attention and enjoyment for *Play School* Theme Repetition.
Kruskal-Wallis tests comparing attention and enjoyment for participants viewing *Play School* Control with those who did and did not interact with *Play School* Theme Repetition. Attention is reported as the percentage of time participants were looking toward the prototype, and enjoyment is reported on a one to five scale. Attention and enjoyment are compared for the whole prototypes.

***Play School* Control**			***Play School* Theme Repetition**								
			Repeated			**Did not repeat**			Chi-square	*df*	*Sig.*
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
Attention											
42	78.29	45.74	43	80.27	45.56	6	81.04	51.00	.231	2	.891
Enjoyment											
42	4.26	45.49	43	4.24	46.40	6	4.50	46.75	.038	2	.981

As seen in Table 6.16, participants who repeated, did not repeat, and viewed the control prototype, did not exhibit any differences in attention for the whole prototypes. Similarly, these groups did not report differences in their enjoyment of the prototypes.

6.8.4 Discussion

Significant differences in comprehension were observed during the interactive segments between repeating participants and those viewing the control prototype. This finding is consistent with the expectation that repeating segment themes would aid comprehension. It is reasonable to expect that participants who had seen two dog-themed segments could recall more about this theme than participants who had viewed only the first of these segments. The finding that the difference in comprehension was limited to the interactive segments, however, suggests that the effect of repeating the segment theme may be time limited.

The literature suggests that while comprehension increases with repetition, attention often decreases (Crawley et al., 1999). This decrease in attention reflects the child's increased understanding of the content and therefore their diminished requirement to attend to as much of the prototype as they previously required in order to understand it (Crawley et al., 1999). Therefore, it was consistent with expectations to find that participants exhibited significantly lower attention on their viewing of the second dog segment. It is suggested that the participants' comprehensional schema would be activated when they opted to view another dog segment. Consequently, significantly less attention was required to understand the segment content.

6.9 Comparing *Play School* Story Choice with *Play School* Control

6.9.1 Defining the interactive segments for *Play School* Story Choice

The interactive segment of this prototype begins when presenter Andrew invites the child to select which of two stories they would like to view. The interactive segment is considered to end at the conclusion of the selected cat or dog story. The cat story was 2 minutes and 59 seconds in duration, and the dog story was 3 minutes and 24 seconds in duration. For the purposes of the following analyses, these portions of the prototypes are referred to as the interactive segments.

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Play School,* question 2, specifically refers to the story segment (see Appendix F). Therefore, the scores of interacting and non-interacting participants, and participants viewing the control prototype, can be compared for question 2. The raw scores for question 2, with a possible range of 0 to 4, were converted to percentages for analysis. The attention of participants during this segment was compared for a random subset of participants (16 in the control prototype and 12 in Story Choice). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as a percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

Comprehension and attention can also be isolated for the period after the interactive segments. The period of time remaining in the prototype after the interactive segments was 4 minutes and 50 seconds. Comprehension for this period was assessed by examining the responses to comprehension questions 3 and 5. These questions relate specifically to segments occurring after the interactive segments. The summed raw scores for questions 3 and 5, with a possible range of 0 to 8, were converted to percentages for analysis. Attention for the period after the interaction was also calculated for the same subset of participants. Finally, comprehension, attention and enjoyment were compared for the whole prototypes.

6.9.2 Comprehension

Table 6.17 presents the results of the comprehension comparisons made between participants who did and did not interact with Story Choice, and participants viewing the control prototype. One-way ANOVAs were used to compare the comprehension scores of participants during the interactive segments, for the period after the interactive segments, and for the whole prototypes.

Table 6.17: Comprehension during *Play School* Story Choice.
One-way ANOVAs comparing comprehension scores for participants viewing *Play School* Control with those who did and did not interact with *Play School* Story Choice. Interacting participants were able to choose a cat story or dog story. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Story Choice**												
			Interacted – Cat story			**Interacted – Dog story**			**Did not interact – Default to Dog story**			Levene's test *(sig.)*	*df*	*F*	*Sig.*
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments															
42	22.02	34.13	8	34.38	39.95	15	16.67	30.86	11	20.45	31.26	.545	3, 72	.491	.690
After the interactive segments															
42	39.58	26.18	8	35.94	30.94	15	35.83	25.82	11	47.73	27.85	.853	3, 72	.484	.694
Whole prototypes															
42	40.24	20.47	8	44.89	17.47	15	36.80	16.78	11	40.00	16.20	.758	3, 72	.322	.809

As seen in Table 6.17, participants who interacted, did not interact, or viewed the control prototype did not show any differences in the comprehension scores achieved during the interactive segments, after the interactive segments, or for the whole prototypes.

6.9.3 Attention and enjoyment

Table 6.18 presents the results of the attention and enjoyment comparisons made between interacting and non-interacting participants viewing Story Choice, and participants viewing the control prototype. Three Kruskal-Wallis tests were used to compare the percentage of attention observed for participants during the interactive segments, after the interactive segments, and for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by participants for the whole prototypes.

Table 6.18: Attention and enjoyment for *Play School* Story Choice.
Kruskal-Wallis tests were used to compare attention and enjoyment for participants viewing *Play School* Control with those who did and did not interact with *Play School* Story Choice. Interacting participants were able to choose a cat or dog story. Attention is reported as the percentage of time participants are looking toward the television, and is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using a Kruskal-Wallis test.

***Play School* Control**			***Play School* Story Choice**											
			Interacted – Cat story			**Interacted – Dog story**			**Did not interact – Default to dog story**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments														
16	75.34	13.50	2	76.46	10.00	9	87.83	18.44	1	46.89	4.00	4.534	3	.209
Attention after the interactive segments														
16	73.61	14.81	2	65.77	10.50	9	77.55	16.33	1	38.65	1.00	3.637	3	.303
Attention for the whole prototypes														
42	78.29	37.21	8	81.50	38.88	15	83.24	41.27	11	79.23	39.36	.397	3	.941
Enjoyment														
42	4.26	39.05	8	4.88	52.13	15	4.03	31.67	11	4.18	35.82	5.660	3	.129

As shown in Table 6.18, interacting and non-interacting participants, and those viewing the control prototype, did not exhibit any differences in attention during the interactive segments. Similarly, no differences were found between these groups for the period after the interactive segments, or for the whole prototypes. It is also shown in Table 6.18 that interacting, non-interacting and control prototype viewers did not report any differences in their enjoyment of the prototypes.

6.9.4 Discussion

Given that there were no differences in comprehension, attention, or enjoyment between interacting, non-interacting and control prototype viewers, it is clear that offering participants a choice of which story to see did not produce an effect. It was expected that providing participants with a choice of two familiar story subjects (dogs and cats) would be interesting and enjoyable. However, the findings did not support this expectation. It is not likely that a ceiling effect accounts for the lack of variation between the responses of interacting, non-interacting and control participants. The percentage of attention observed, and level of enjoyment reported by participants are not higher than those found for other prototypes where significant differences were detected. The comprehension scores of participants during the interactive segments were particularly low for this prototype, discounting the possibility of a ceiling effect.

6.10 Comparing *Play School* Control with *Play School* Task Participation

6.10.1 Defining the interactive segments for *Play School* Task Participation

The interactive segment of this prototype is the duration of the Justine segment. In this segment, presenter Justine matches a series of people with their bags. For the purposes of the following analyses, the 3 minute and 38 second Justine segment in *Play School* Task Participation, and the 2 minute and 45 second Justine segment in *Play School* Control are referred to as the interactive segments. (The segment is 53 seconds longer in Task Participation than in the control prototype because the instructions from Andrew lengthen the segment).

Comprehension and attention can be isolated for the period of the interactive segments. One of the comprehension questions for *Play School,* question 3, specifically refers to this segment (see Appendix F). Therefore, the scores of interacting and non-interacting participants, and participants viewing the control prototype, can be compared for question 3. The raw scores for question 3, with a possible range of 0 to 4, were converted to percentages for analysis. The attention of participants during this segment was compared for a random subset of participants (16 in the control prototype and 20 in Task Participation). (This subset was analysed rather than the entire sample due to budgetary constraints.) Attention was calculated as a percentage of time the participant's gaze was oriented toward the television, as described in Chapter 4.

Comprehension and attention can also be isolated for the period after the interactive segments. The period of time remaining in the prototype after the interactive segments was 2 minutes and 4 seconds. Comprehension for this period was assessed by examining the responses to comprehension question 5. This question relates specifically to a segment occurring after the interactive segments. The raw scores for question 5, with a possible range of 0 to 4, were converted to percentages for analysis. Attention for the period after the interaction was also calculated for the same subset of participants. Finally, comprehension, attention and enjoyment were compared for the whole prototypes.

6.10.2 Comprehension

Table 6.19 presents the results of the comprehension comparisons made between interacting and non-interacting participants viewing Task Participation, and participants viewing the control prototype. One-way ANOVAs were used to compare the comprehension scores achieved by participants during the interactive segments, after the interactive segments, and for the whole prototypes.

Table 6.19: Comprehension for *Play School* Active Participation.
One-way ANOVAs comparing comprehension scores for participants viewing *Play School* Control with those who did and did not interact with *Play School* Active Participation. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Active Participation**						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Interacted			**Did not interact**						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
42	48.81	40.93	38	65.79	33.10	5	65.00	37.91	.032	2, 82	2.162	.122
After the interactive segments												
42	30.36	23.77	38	25.66	17.90	5	30.00	20.91	.205	2, 82	.510	.603
Whole prototype												
42	40.24	20.47	38	43.46	13.80	5	37.60	10.43	.040	2, 81	.471	.626

As shown in Table 6.19, no differences were found in the comprehension scores achieved by interacting, non-interacting and control prototype viewers during the interactive segments. However, a Levene's test found that the homogeneity of variance assumption had been violated for this comparison. Therefore, a nonparametric comparison was conducted. The results of a Kruskal-Wallis test confirmed that the difference in the comprehension scores achieved during the interactive segments were not significant (χ^2 (2) = 3.110; p > .05).

There were also no differences in the comprehension scores achieved by interacting, non-interacting and control prototype viewers for the period after the interactive segments, or for the whole prototypes. A Levene's test found that the homogeneity of variance assumption was also violated for the comprehension comparison for the whole prototypes. Therefore, a nonparametric comparison was made, and the results of a Kruskal-Wallis test confirmed that the differences between the groups were not significant (χ^2 (2) = 2.152; p > .05).

6.10.3 Attention and enjoyment

Table 6.20 presents the results of the attention and enjoyment comparisons made between interacting and non-interacting participants and participants viewing the control prototype. Three Kruskal-Wallis tests were used to compare the attention exhibited by participants during the interactive segments, after the interactive segments, and for the whole prototypes. A Kruskal-Wallis test was also used to compare the enjoyment reported by participants for the whole prototypes.

Table 6.20: Attention and enjoyment for *Play School* Active Participation.
Kruskal-Wallis tests were used to compare the attention and enjoyment of participants viewing *Play School* Control with those who did and did not interact with *Play School* Active Participation. Attention is reported as the percentage of time participants were looking toward the television, and is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes. Enjoyment is reported on a one to five scale, and is compared for the whole prototypes using a Kruskal-Wallis test.

***Play School* Control**			***Play School* Active Participation**								
			Interacted			**Did not interact**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments											
16	75.17	13.38	18	82.52	23.06	2	89.73	18.50	7.151	2	.028
Attention after the interactive segments											
16	55.44	16.75	18	56.83	20.22	2	65.12	17.00	.963	2	.618
Attention for the whole prototypes											
42	78.29	40.45	38	83.25	45.84	5	80.38	42.80	.952	2	.621
Enjoyment											
42	4.26	41.62	38	4.42	44.08	5	4.60	46.40	.381	2	.827

As shown in Table 6.20, there was a significant difference in the attention observed during the interactive segment for interacting, non-interacting, and control prototype viewers. Post-hoc analysis found that interacting participants showed significantly higher attention during the interactive segment than participants viewing the control prototype (Mann-Whitney U = 64.00; $p < .01$).

Table 6.20 shows that attention did not differ between interacting, non-interacting and control prototype viewers for the period after the interactive segments, or for the whole prototypes. It is also shown in Table 6.20 that there were no significant differences in enjoyment reported by participants who did or did not interact and those viewing the control prototype.

6.10.4 Discussion

It was found that participants interacting with this prototype did not show any differences in comprehension compared with non-interacting and control prototype viewers. They did, however, exhibit significantly higher attention than non-interacting and control prototype viewers. The higher attention shown by interacting participants might reflect either the novelty or difficulty of the task.

Given that assisting in a matching task is a novel attribute of television, it might be expected that additional attention would be directed toward the interactive segments. Alternatively, it is consistent with the Salomon's effort investment theory (Salomon, 1983; Salomon, 1984) that additional attention was directed toward the interactive segments because assisting with the matching task was more difficult than simply watching the segment without participating.

In either case, it is clear that interacting with this prototype did not aid comprehension, given that comprehension scores were not higher for interacting participants and that the attention shown by these participants was higher. It is suggested that assisting with the matching task was peripheral to an understanding of what was taking place during the segment. The findings also demonstrate that the higher attention observed for interacting participants is not associated with higher enjoyment.

CHAPTER 7 – RESULTS: MODELS OF INTERACTIVITY

7.1 Introduction

Chapter 6 compared participants' responses to the interactive prototypes and control prototypes. Participants' comprehension, attention and enjoyment were compared for each prototype and its control for the period during the interactive segment, after the interactive segment, and for the whole prototype. The analyses presented in Chapter 6 focused on the choices made by interacting (and non-interacting) participants, and the responses of participants to the content subsequently viewed. In prototypes where participants had a choice of two options, such as the dragon or flowers pathway in *Dora the Explorer* Major Narrative Choice, responses to the content following each of these choices were analysed separately. For example, the analyses presented in Chapter 6 compared the responses of four groups of participants; those selecting the dragon, those selecting the giant flowers, those who did not interact, and those viewing *Dora the Explorer* Control.

This approach to the analyses presented two difficulties with data interpretation. While there were approximately 40 participants viewing each of the control and interactive prototypes, the groups compared in much of the analyses were not equal in size. This occurred because participants self-selected to the 'interacting' and 'non-interacting' categories based on their remote control use. As discussed in Chapter 5, approximately two thirds of participants assigned to interactive prototypes interacted with them while the remaining third did not. Consequently, the number of participants in the control, interacting, and non-interacting groups for any comparison were uneven. Where two choices were available to participants, the interacting participants self-selected to one of two groups based on their choice. In most instances, this resulted in uneven interacting participant cell sizes. For example, in *Dora the Explorer* Major Narrative Choice, 17 participants selected the giant flowers segment while only nine selected the dragon segment. The inequity in cell sizes may have influenced the parametric comparisons made for many of the prototypes, as parametric tests assume equivalent cell sizes (Coakes & Steed, 1999). This limitation in interpreting the data also applies to prototypes where the participant has only one choice, such as whether to interact in *Dora the Explorer* Character Assistance. However, the unequal cell sizes are spread over three comparison groups (the interacting, non-interacting, and control participants) rather than four comparison groups (participants interacting by selecting option one, participants selecting option 2, non-interacting, and control participants) for these prototypes.

The other difficulty with analysing the data in the manner set out in Chapter 6 was that significant differences sometimes emerged for one of interactive choices available, but not the other. This pattern was observed for *Dora the Explorer* Minor Narrative Choice (significant differences were found between participants selecting the blue wagon and other participant groups, but not between participants selecting the yellow wagon and other participant groups), *Dora the Explorer* Major Narrative Choice (significant differences were found between participants selecting the dragon and other participant groups, but not between participants selecting the giant flowers and other participant groups), and *Hi-5* Presenter Choice (significant differences were found between participants selecting Nathan and other participant groups, but not between participants selecting Tim and other participant groups). It is difficult to meaningfully account for why effects would be found for some of these choices but not others. Using this approach to the analyses, the interactive prototypes were viewed as discrete, and it was difficult to meaningfully interpret the patterns occurring across the prototypes.

After completing this approach to the analyses, as presented in Chapter 6, another approach to the analyses was developed. Rather than analysing participant responses according to the specific content viewed, responses were compared based on the kind of interactivity provided. Although the prototype designer had an individual rationale for each of the prototypes, it is argued that there are commonalities between some prototypes from the perspective of the participants.

The nine interactive prototypes examined four general approaches to, or models of, interactivity. As discussed previously, both *Dora the Explorer* Minor Narrative Choice and *Dora the Explorer* Major Narrative Choice investigated ways of providing the participant with choices about narrative structure. *Hi-5* Presenter Choice and *Play School* Story Choice explored ways of allowing the viewer to customise the prototype by selecting a segment matching their interests. *Hi-5* Segment Repetition and *Play School* Theme Repetition explored two different models of utilising repetition within a program. Finally, *Dora the Explorer* Character Assistance, *Hi-5* Collecting Cards and *Play School* Task Participation each explored ways to increase viewer participation with the program.

In this chapter, the results are presented in a new format. First, interacting participants are grouped together for all comparisons, rather than being separated by the specific choices they made. Consequently, participants interacting with prototypes that offered two choices were grouped together rather than separately. Therefore, participants viewing *Dora the Explorer* Minor Narrative Choice, *Dora the Explorer* Major Narrative Choice, *Hi-5* Presenter Choice, and *Play School* Story Choice were categorised only as 'interacting' or 'non-interacting'. The purpose of grouping interacting participants together was to determine the effect of each model of interactivity, rather than determining the effect of viewing specific content following interactivity. Although this distinction may appear to be subtle, it is important to distinguish between the effect of making a major narrative choice, for example, and the effect of the selecting the dragon segment. The prototypes providing only one interactive choice; *Dora the Explorer* Character Assistance, *Hi-5* Segment Repetition, *Hi-5* Collecting Cards, *Play School* Theme Repetition, and *Play School* Task Participation, were analysed in the same manner as in Chapter 6 given that these participants were already grouped as interacting or non-interacting.

The other difference in the presentation of results is that the data are presented in a different order than in Chapter 6. Rather than presenting results for nine discrete prototypes, the data for each interactive model are grouped together to allow greater comparison. This presentation format better illustrates the trends occurring across prototypes.

7.2 Narrative Choice

Both *Dora the Explorer* Minor Narrative Choice and *Dora the Explorer* Major Narrative Choice provided the opportunity to make a choice about the prototype's narrative structure. It is argued that these two interactive prototypes are comparable because they both explored ways of providing narrative choice in an interactive context. As discussed in Chapter 5, *Dora the Explorer* Character Assistance was not classified as a narrative choice despite the interactivity having implications for a program event. Given that the interactivity in Character Assistance was presented as a way to help Dora rather than as a choice of two different options this prototype was classified as, and analysed with, prototypes facilitating participation.

7.2.1 Comprehension

The comprehension scores of participants viewing *Dora the Explorer* Minor Narrative Choice, *Dora the Explorer* Major Narrative Choice, and *Dora the Explorer* Control are compared in Table 7.1.

Table 7.1: Comparing the comprehension scores achieved during *Dora the Explorer* Minor Narrative Choice, *Dora the Explorer* Major Narrative Choice, and *Dora the Explorer* Control. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes using one-way ANOVAs.

Control			Prototype						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Interacted			Did not interact						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
Dora the Explorer Minor Narrative Choice												
42	21.43	21.79	25	23.00	21.55	16	9.38	15.48	.478	2, 80	2.458	.092
Dora the Explorer Major Narrative Choice												
42	50.60	26.18	26	53.85	27.10	16	46.88	27.20	.441	2, 81	.344	.710
After the interactive segments												
Dora the Explorer Minor Narrative Choice												
42	41.67	16.26	25	38.00	21.49	16	26.56	22.76	3.66	2, 80	3.566	.033
Whole prototypes												
Dora the Explorer Minor Narrative Choice												
42	41.81	9.96	25	44.96	11.96	16	30.50	14.38	2.078	2, 80	8.182	.001
Dora the Explorer Major Narrative Choice												
42	41.81	9.96	26	45.85	10.92	16	38.25	11.40	.300	2, 81	2.694	.074

NB: Comprehension for the period after the interactive segment in *Dora the Explorer* Major Narrative Choice was not calculated as no comprehension questions related specifically to this portion of the prototype.

As shown in Table 7.1, the comprehension scores of interacting, non-interacting, and control participants during the interactive segments follow similar patterns for both Minor Narrative Choice and Major Narrative Choice. For both prototypes, similar comprehension scores were achieved during the interactive segment for interacting participants and those viewing the control prototype, and markedly lower (but non-significant) comprehension scores were achieved by non-interacting participants.

These findings are more easily interpreted than those reported in Chapter 6. Similar results were obtained for Major Narrative Choice in the previous chapter (narrative choices did not affect comprehension during the interactive segment). However, using the previous method of analysis, different and less interpretable results were found for Minor Narrative Choice. It was previously found that participants selecting the blue wagon had significantly lower comprehension during the interactive segment than non-interacting participants. However, participants selecting the yellow wagon did not have different comprehension scores compared to the other groups. With this method of analysis, the findings demonstrate that narrative choice did not affect comprehension scores during the interactive segment.

For the period after the interactive segment, the highest comprehension scores were found for interacting participants and those viewing the control prototype. In this case, the differences between the groups were significant for Minor Narrative Choice. A Tukey's HSD test found that the comprehension scores of non-interacting participants were significantly lower than for control participants during this period ($p < .05$). This trend was also apparent in the previous chapter, but the difference in the comprehension scores of non-interacting and control participants did not reach significance. Examination of the current findings suggests that narrative choice has a negative effect on the comprehension scores of non-interacting participants for the period after the interactive segment.

Comprehension analysis for the whole prototypes found that the lowest scores were obtained by non-interacting participants. A Tukey's HSD test found that non-interacting participants viewing Minor Narrative Choice had significantly lower comprehension scores than interacting participants ($p < .01$), and control participants ($p < .01$). Non-interacting participants viewing Major Narrative Choice also had lower comprehension scores than interacting participants, with this difference approaching significance ($p < .07$). The comprehension analysis for the whole prototypes is also more easily interpreted using this approach. As discussed in Chapter 6, effects found for the blue wagon and dragon choices but not the yellow wagon and giant flowers choices, made it difficult to draw conclusions about the effect of narrative choice. The current analysis contributes toward a more parsimonious understanding of the impact of narrative choice on comprehension.

Table 7.1 demonstrates that narrative choices are not associated with increases in comprehension. Participants interacting with the narrative choice prototypes did not obtain higher comprehension scores than participants viewing the control prototype. In contrast, lower comprehension was found for non-interacting participants. Possible explanations for these findings are discussed in conjunction with the attention and enjoyment data in section 7.2.3.

7.2.2 Attention and enjoyment

The attention exhibited and enjoyment reported by participants viewing *Dora the Explorer* Minor Narrative Choice, *Dora the Explorer* Major Narrative Choice, and *Dora the Explorer* Control are compared in Table 7.2.

As shown in Table 7.2, no differences in attention were found between interacting and non-interacting Minor Narrative Choice participants and control participants, for any of the comparison periods. However, attention differences were found in comparisons of Major Narrative Choice and control participants. During the interactive segments, interacting participants were significantly less attentive than non-interacting participants

(Mann-Whitney U = 22.00; p < .05), and control participants (Mann-Whitney U = 79.00; p < .01). After the interactive segments, interacting participants were also significantly less attentive than non-interacting participants (Mann-Whitney U = 15.00; p < .01). Analysis of attention for the whole of Major Narrative Choice showed that there were no differences between interacting, non-interacting and control participants. The current method of analysis allows a clearer interpretation of the impact of narrative choice on attention. It is apparent from Table 7.2 that the minor narrative choices did not affect the attention of participants. The major narrative choices, however, resulted in reduced attention for the interacting participants.

Table 7.2: Comparing attention and enjoyment for *Dora the Explorer* Minor Narrative Choice, *Dora the Explorer* Major Narrative Choice, and *Dora the Explorer* Control. Attention is reported as a percentage of the time the participant is looking toward the television, and is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes using Kruskal-Wallis tests. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using a Kruskal-Wallis test.

Control			Prototype						Chi-square	*df*	*Sig.*
			Interacted			Did not interact					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments											
Dora the Explorer Minor Narrative Choice											
25	89.28	30.88	16	83.76	22.19	12	78.68	25.33	3.279	2	.194
Dora the Explorer Major Narrative Choice											
25	92.36	27.52	14	86.35	14.71	7	92.99	26.71	8.644	2	.013
Attention after the interactive segments											
Dora the Explorer Minor Narrative Choice											
25	89.44	26.36	16	88.57	24.00	12	87.86	32.33	2.078	2	.354
Dora the Explorer Major Narrative Choice											
25	89.55	24.22	14	84.02	17.61	7	95.91	32.71	6.069	2	.048
Attention during the whole prototypes											
Dora the Explorer Minor Narrative Choice											
42	88.43	42.19	25	86.80	39.84	16	86.15	44.88	.431	2	.806
Dora the Explorer Major Narrative Choice											
42	88.43	43.93	26	86.15	34.88	16	91.85	51.13	4.679	2	.096
Enjoyment											
Dora the Explorer Minor Narrative Choice											
41	4.66	47.32	25	4.16	38.84	16	3.88	30.75	8.022	2	.018
Dora the Explorer Major Narrative Choice											
42	4.66	44.74	26	4.04	36.33	16	4.53	41.60	2.884	2	.236

Finally, Table 7.2 shows that non-interacting participants viewing Minor Narrative Choice reported lower enjoyment than interacting or control participants. Post-hoc analysis confirmed that this difference was significant (Mann-Whitney U = 189.35, $p < .01$). Table 7.2 shows that the major narrative choice had no effect on participants' enjoyment. However, participants who did not interact when presented with a minor narrative choice reported significantly lower enjoyment than those who interacted or viewed the control prototype.

7.2.3 Discussion

In summary, it was found that narrative choices did not affect the comprehension of participants during the interactive segment. For the period after the interactive segment and for the whole prototype, however, significantly lower comprehension was found by non-interacting participants. The enjoyment reported by non-interacting participants was also significantly lower. In addition, the attention exhibited by participants making a major narrative choice was significantly lower during and after the interactive segment. There are two explanations for this pattern of findings.

As suggested in Chapter 6, there may have been pre-existing differences between the non-interacting participants, and the other groups, such as their level of media literacy, which accounts for both the tendency to interact with the prototypes and the comprehension of prototype content. After the analysis of results for Minor Narrative Choice and Major Narrative Choice presented in this chapter, the evidence does not support this explanation. It is unlikely that a systematic difference (such as media literacy) would separate the *non-interacting* participants from the other groups in Minor Narrative Choice, and the *interacting* participants from the other groups in Major Narrative Choice. This explanation of the results also appears unlikely because the differences between groups were not observed during all points throughout the prototypes. If a pre-existing factor was affecting the viewing behaviour of participants, it is reasonable to expect that these effects would be found for the whole prototype as well as the periods during and after the interactive segment.

An alternative explanation for the results is that interacting with narrative programs and being presented with a narrative choice impacts on children’s information processing differently than when children simply watch a narrative program. The different information processing demands of the narrative choices may account for the reduced attention noted in major narrative choice interactors and the decreased comprehension of minor narrative choice non-interactors. It is suggested that the calls to action in the narrative choice prototypes many have interrupted the flow of the prototypes, particularly as experienced by the non-interacting participants.

During Minor Narrative Choice, the prototype narrative was interrupted to present participants with a choice between a blue and yellow wagon. While comprehension of the interactive segment was not affected by the presentation of this choice, comprehension for the period after the interactive segment, and for the whole prototype, was lower for non-interacting participants. Interacting participants appeared to have been less distracted by the narrative choice, possibly because making a choice assisted them in re-entering the narrative flow. For participants who did not respond to the narrative choice offered, the flow of the narrative was disrupted and, consequently, comprehension was lower for the remainder of the prototype. This disruption of the narrative would also account for the significantly lower enjoyment reported by non-interacting participants.

During Major Narrative Choice, the prototype narrative was interrupted to present participants with a choice between passing the dragon or giant flowers. Participants who made a choice were significantly less attentive to the interactive segment and the remainder of the prototype. This reduction in attention is consistent with the theory that the choice disrupted participants, making it more difficult to comprehend the remaining content. Young children have been shown to direct decreased attention to difficult content (Anderson & Lorch, 1983). It is not clear why the non-interacting participants were not distracted by the major narrative choice as much as they were by the minor narrative choice. However, it is clear that providing narrative choices to viewers of this age has the potential to negatively impact on comprehension and enjoyment. It is also clear that there is no benefit in offering narrative choices, as no increases in either comprehension or enjoyment were observed for participants viewing the interactive prototypes compared to the control prototypes.

7.3 Customisation

Both *Hi-5* Presenter Choice and *Play School* Story Choice provided the opportunity to customise the prototype by selecting the segment with the greatest interest or appeal. It is argued that these prototypes are comparable because they both explored ways of providing customisation within an interactive context.

7.3.1 Comprehension

The comprehension scores achieved by participants viewing *Hi-5* Presenter Choice, *Play School* Story Choice, and the relevant control prototypes are compared in Table 7.3.

As shown in Table 7.3, a similar pattern of results were found for both of the customisation prototypes. For both Presenter Choice and Story Choice, comprehension comparisons for the period of the interactive segment showed no differences between interacting, non-interacting, and control participants. Likewise, no comprehension differences were found for the periods after the interactive segments, or for the whole prototypes, between interacting, non-interacting, and control participants. These findings allow a simpler interpretation than the findings presented in Chapter 6. (In the previous analyses, participants selecting the Nathan segment had significantly higher comprehension than control participants, with no comparable difference found between participants selecting the Tim segment).

Table 7.3: Comparing the comprehension scores achieved during *Hi-5* Presenter Choice and *Play School* Story Choice with the control prototypes. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes using one-way ANOVAs.

Control			Prototype						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Interacted			Did not interact						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
Hi-5 Presenter Choice												
44	22.73	23.07	27	31.48	35.76	13	15.38	24.01	.024	2, 81	1.627	.203
Play School Story Choice												
42	20.02	34.13	23	22.83	34.47	11	20.45	31.26	.773	2, 73	.018	.982
After the interactive segments												
Hi-5 Presenter Choice												
44	30.68	28.97	27	37.96	32.79	13	32.69	27.74	.232	2, 81	.494	.612
Play School Story Choice												
42	39.58	26.18	23	35.87	27.00	11	47.73	27.85	.944	2, 73	.736	.482
Whole prototypes												
Hi-5 Presenter Choice												
44	34.27	15.39	27	42.37	16.09	13	36.00	16.41	.668	2, 81	2.246	.112
Play School Story Choice												
42	40.24	20.47	23	39.62	17.08	11	40.00	16.20	.687	2, 73	.008	.992

It is clear from the results presented in Table 7.3 that the customisation prototypes were not associated with any changes in comprehension. Irrespective of whether participants interacted when the choices were presented to them, no differences in comprehension scores were achieved as compared with viewers of the control prototypes.

7.3.2 Attention and enjoyment

The attention exhibited and enjoyment reported by participants viewing *Hi-5* Presenter Choice, *Play School* Story Choice, and the relevant control prototypes are compared in Table 7.4.

Table 7.4: Comparing attention and enjoyment for *Hi-5* Presenter Choice and *Play School* Story Choice and the control prototypes. Attention is reported as a percentage of the time the participant is looking toward the television, and is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using Kruskal-Wallis tests.

Control			Prototype								
			Interacted			Did not interact			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments											
Hi-5 Presenter Choice											
20	85.08	20.50	13	84.50	19.54	5	80.80	15.40	.843	2	.656
Play School Story Choice											
16	75.34	13.50	11	85.76	16.91	1	46.89	4.00	2.809	2	.245
Attention after the interactive segments											
Hi-5 Presenter Choice											
20	82.42	19.27	13	88.04	21.96	5	81.14	14.00	1.871	2	.392
Play School Story Choice											
16	73.61	14.81	11	75.40	15.27	1	38.65	1	2.814	2	.245
Attention during the whole prototypes											
Hi-5 Presenter Choice											
44	81.13	41.48	27	84.94	43.85	13	81.21	43.15	.170	2	.919
Play School Story Choice											
42	78.29	37.21	23	81.63	40.43	11	79.23	39.36	.336	2	.845
Enjoyment											
Hi-5 Presenter Choice											
44	4.39	42.41	27	4.54	44.70	13	4.23	38.23	.772	2	.680
Play School Story Choice											
42	4.26	39.05	23	4.33	38.78	11	4.18	35.82	.232	2	.890

The results shown in Table 7.4 are consistent with those reported in Chapter 6. For both Presenter Choice and Story Choice, attention comparisons for the period of the interactive segment showed no differences between interacting, non-interacting, and control participants. It was also found that there were no attention differences between interacting, non-interacting, and control participants for the periods after the interactive segments, or for the whole prototypes. Likewise, no enjoyment differences were found between interacting and non-interacting participants viewing the customisation prototypes and the control prototypes.

7.3.3 Discussion

In summary, it was found that providing the opportunity to customise aspects of the prototype did not affect the comprehension, attention, or enjoyment of participants. Both Presenter Choice and Story Choice provided viewers the opportunity to choose content that most appealed to them. It was reasonable to expect that the ability to select the more appealing and interesting content would enhance the participants' involvement with the content, and possibly alter their comprehension, attention and enjoyment.

For both of these prototypes, participants were given a choice between two aspects that were highly familiar and presumably salient to them. *Hi-5*, for example, is a character-driven program and anecdotal experience suggests that children often have a favourite presenter they enjoy watching. It was expected, therefore, that the opportunity to select a preferred presenter to see next during the program would have been an interesting and enjoyable choice for young children. Similarly, children are typically accustomed to choosing which story they would like, and it was expected that having the opportunity to see a dog or cat story in *Play School* would also be an interesting and enjoyable choice. In spite of these expectations, no differences in comprehension, attention or enjoyment were observed during either of these prototypes. In contrast to the present findings, previous studies have found that providing children with choices about computer content increases their interest in and enjoyment of computer activities (Calvert et al., 2005; Cordova & Lepper, 1996).

It is suggested that no effects were found for either customisation prototypes because the available choices resulted in material that was familiar. It may be that the content viewed by interacting participants was so similar to the usual television experience of participants that no differences in comprehension, attention, or enjoyment were warranted. As discussed in Chapter 4, participants were assigned to view versions of programs they were familiar with, and so the participants interacting with Presenter Choice and Story Choice would have been accustomed to the type of content presented in these prototypes. The findings suggest that the act of simply making a choice was not particularly interesting or enjoyable for participants. If choice in itself were interesting and enjoyable, the responses of interacting participants would have differed from those of the other groups.

It is important to note that no decreases in comprehension or enjoyment were observed for the customisation prototypes. There were simply no potential benefits found from providing participants with the ability to customise the prototypes.

7.4 Repetition

In both *Hi-5* Segment Repetition and *Play School* Theme Repetition, participants had the opportunity to repeat content. An entire segment could be repeated in Segment Repetition, and content based on a particular theme could by repeated in Theme Repetition. It is argued that these two prototypes are comparable because they both explore ways of repeating content in an interactive context.

7.4.1 Comprehension

The comprehension scores of participants viewing *Hi-5* Segment Repetition, Play School Theme Repetition, and the relevant control prototypes are compared in Table 7.5.

Table 7.5: Comparing the comprehension scores achieved during *Hi-5* Segment Repetition and *Play School* Theme Repetition and the control prototypes. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes using one-way ANOVAs.

Control			**Prototype**						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Repeated			**Did not repeat**						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
Hi-5 Segment Repetition												
44	23.30	23.75	28	28.57	20.09	13	26.92	23.85	.934	2, 82	.492	.613
Play School Theme Repetition												
42	29.17	32.63	43	46.51	28.13	6	37.50	34.46	.416	2, 88	3.397	.038
Whole prototypes												
Hi-5 Segment Repetition												
44	34.27	15.39	28	44.90	15.19	13	41.14	22.31	.240	2, 82	3.687	.029
Play School Theme Repetition												
42	40.24	20.48	43	48.35	15.60	6	39.61	22.48	.299	2, 88	2.238	.113

NB: No comparisons were made for the period after the interactive segment for either of these prototypes because participants repeating the interactive segment did not see identical material to the non-repeating and control participants after the interaction.

Table 7.5 presents the same comprehension analyses as were shown in Chapter 6. However, presenting the comprehension results for the two repetition prototypes together illustrates some trends that were not evident previously. As shown in Table 7.5, comprehension for both repetition prototypes was highest for participants repeating content. A Tukey's HSD test found that participants repeating content in Theme Repetition obtained significantly higher comprehension scores during the interactive segment than control participants ($p < .05$). In contrast, a Tukey's HSD test found that participants repeating content in Segment Repetition obtained significantly higher comprehension scores for the whole prototype compared with control participants ($p < .05$).

It is apparent from Table 7.5 that providing the opportunity for repetition can increase the comprehension of participants. It is noted that the effect of repetition on comprehension scores was limited to the interactive segment in *Play School*. However, the effect of repetition on comprehension scores was found across the whole prototype in *Hi-5*.

7.4.2 Attention and enjoyment

The attention exhibited by repeating participants during their first and second viewings of the interactive segments of Segment Repetition and Theme Repetition are compared in Table 7.6.

Table 7.6: Comparing attention for the first and second viewings of the repeated segments in *Hi-5* Segment Repetition and *Play School* Theme Repetition. Attention is reported as a percentage of the time the participant is looking toward the television, and is compared for participants repeating the interactive segment using Wilcoxon Signed Ranks tests.

First viewing				Second viewing					
N	Mean	Mean Rank	Sum of Ranks	*N*	Mean	Mean Rank	Sum of Ranks	*Z*	*Sig.*
Hi-5 Segment Repetition									
11	77.40	6.50	52.00	11	69.92	4.70	14.00	-1.689	.091
Play School Theme Repetition									
17	81.63	11.06	199.00	17	66.28	10.67	32.00	-2.902	.004

As shown in Table 7.6, repeating participants were more attentive during the first viewing of the segment than they were during the second viewing. This pattern of results is consistent with reports in the literature that children direct less attention to television when content is familiar or repetitive (Anderson & Lorch, 1983; Huston et al., 1990). Table 7.6 shows that that while the difference in attention directed toward to the first and second viewings of the repeated segment approached significance for Segment Repetition, it was significant for Theme Repetition.

The enjoyment reported by participants viewing Segment Repetition, Theme Repetition, and the relevant controls are presented in Table, which also shows the attention directed toward the whole of these prototypes.

Table 7.7: Comparing attention and enjoyment for *Hi-5* Segment Repetition and *Play School* Theme Repetition and the control prototypes. Attention is reported as a percentage of the time the participant is looking toward the television, and is compared for the whole prototypes using Kruskal-Wallis tests. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using Kruskal-Wallis tests.

Control			**Prototype**						Chi-square	*df*	*Sig.*
			Repeated			**Did not repeated**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the whole prototypes											
Hi-5 Segment Repetition											
44	84.13	42.00	28	83.48	41.46	13	87.52	49.69	1.136	2	.567
Play School Theme Repetition											
42	78.29	45.74	43	80.27	45.56	6	81.04	51.00	.231	2	.891
Enjoyment											
Hi-5 Segment Repetition											
44	4.39	43.06	27	4.11	38.24	12	4.38	46.58	1.447	2	.485
Play School Theme Repetition											
42	4.24	45.49	43	4.24	46.40	6	4.50	46.75	.038	2	.981

As shown in Table 7.7, there were no differences in the attention exhibited by repeating, non-repeating, or control participants for either Segment Repetition or Theme Repetition. In conjunction with the findings reported in Table 7.6, these findings suggests that the decreased attention observed in participants during the repeated segment does not influence the attention directed toward the remainder of the program. The advantage of presenting the attention and enjoyment results for both repetition prototypes together is that the emerging trends are more easily identified. It can be seen from Table 7.7 that providing participants with the opportunity to repeat portions of the program does not influence their enjoyment of the prototypes.

7.4.3 Discussion

In summary, it was found that participants repeating segments in both repetition prototypes achieved significantly higher comprehension scores. It was also found that repeating participants directed less attention toward the repeated segment, but that this reduction in attention did not continue for the remainder of the program. These findings are consistent with the research literature on young children and repetition. Crawley and colleagues point out that “almost any theory of comprehension would predict children’s comprehension of television increasing with repetition” (1999, p. 630). Given that comprehension increased with repetition, it is unsurprising to note that attention decreased during the repeated segments.

It was interesting to note that the comprehension benefit of Segment Repetition was observed for the whole prototype, while the comprehension benefit of Theme Repetition was limited to the interactive segment. It may be that the effect of exactly repeating a segment is cumulative; while the effect of repeating themes is time-limited. Alternatively, it may be that the application of repetition generally in *Hi-5* compared with *Play School* accounts for this difference.

7.5 Participation

Dora the Explorer Character Assistance, *Hi-5* Collecting Cards, and *Play School* Task Participation allowed viewers to participate with the prototype in a way that did not alter the prototype content. Rather than making choices about content, the viewer was able to participate in a prototype activity. It is argued that this element of participation, rather than choice, makes these three prototypes comparable.

7.5.1 Comprehension

The comprehension scores obtained by participants viewing *Dora the Explorer* Character Assistance, *Hi-5* Collecting Cards, *Play School* Task Participation, and the relevant control prototypes are compared in Table 7.8.

Table 7.8: Comparing the comprehension scores achieved during *Dora the Explorer* Character Assistance, *Play School* Task Participation, *Hi-5* Collecting Cards, and the control prototypes. Comprehension scores represent the number of points for correct responses achieved by participants as a percentage of the maximum possible points. Comprehension scores are compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes using one-way ANOVAs.

Control			Prototype						Levene's test *(sig.)*	*df*	*F*	*Sig.*
			Interacted			Did not interact						
N	Mean	sd	*N*	Mean	sd	*N*	Mean	sd				
During the interactive segments												
Dora the Explorer Character Assistance												
42	32.74	17.01	32	25.78	23.32	5	25.00	0.00	1.02	2, 76	1.302	.278
Play School Task Participation												
42	48.81	40.93	38	65.79	33.10	5	65.00	37.91	.032	2, 82	2.162	.122
After the interactive segments												
Dora the Explorer Character Assistance												
42	50.60	26.18	32	50.78	29.43	5	70.00	32.60	.630	2, 76	1.123	.331
Play School Task Participation												
42	30.36	23.77	38	25.66	17.90	5	30.00	20.91	.205	2, 82	.510	.603
Whole prototypes												
Dora the Explorer Character Assistance												
42	41.81	9.96	32	45.00	11.94	5	48.80	4.38	.070	2, 76	1.475	.235
Play School Task Participation												
42	40.24	20.47	38	43.46	13.80	5	37.60	10.43	.040	2, 81	.471	.626
Hi-5 Collecting Cards												
44	34.27	15.39	28	43.14	18.51	14	32.57	11.83	.139	2, 83	3.234	.044

NB: Comparisons are not made for the period during or after the interactive segment of Collecting Cards because the interactive opportunities occurred throughout the prototype.

As shown in Table 7.8, a similar pattern of results were found for Character Assistance and Task Participation. For both of these participation prototypes, no comprehension differences were found between interacting, non-interacting, and control participants for any of the comparison periods. However, significant differences were found between

Collecting Cards and *Hi-5* Control viewers. A Tukey's HSD test found participants interacting with Collecting Cards obtained higher comprehension scores than control viewers ($p < .07$).

It is interesting that significant differences in comprehension were observed for only one of the participation prototypes (Collecting Cards) and not for the other two (Character Assistance and Task Participation). As discussed previously, Collecting Cards provided the viewer with five opportunities to interact throughout the program. Consequently, the viewer had the opportunity to participate with this prototype in a more extensive way than was possible with the other participation prototypes.

7.5.2 Attention and enjoyment

The attention directed toward, and reported enjoyment of, *Dora the Explorer* Character Assistance, *Hi-5* Collecting Cards, *Play School* Task Participation, and the relevant control prototypes are compared in Table 7.9.

As shown in Table 7.9, comparisons of participants viewing Character Assistance and *Dora the Explorer* Control found that there were no attention differences between interacting, non-interacting, and control participants for any of the comparison periods. As discussed in Chapter 6, a ceiling effect appears to have affected the attention exhibited by viewers of *Dora the Explorer* Character Assistance, and this effect makes meaningful interpretation of the results difficult.

Table 7.9: Comparing attention and enjoyment for *Dora the Explorer* Character Assistance, *Play School* Task Participation, *Hi-5* Collecting Cards, and the control prototypes. Attention is reported as a percentage of the time the participant is looking toward the television, and is compared for the period during the interactive segments, after the interactive segments, and for the whole prototypes using Kruskal-Wallis tests. Enjoyment is reported on a one to five scale and is compared for the whole prototypes using Kruskal-Wallis tests.

Control			Prototype						Chi-square	*df*	*Sig.*
			Interacted			Did not interact					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Attention during the interactive segments											
Dora the Explorer Character Assistance											
26	89.29	23.62	18	96.66	22.47	2	99.80	31.25	.843	2	.656
Play School Task Participation											
16	75.17	13.38	18	82.52	23.06	2	89.73	18.50	7.151	2	.028
Attention after the interactive segments											
Dora the Explorer Character Assistance											
26	90.21	22.81	18	89.35	24.50	2	85.09	23.50	.169	2	.919
Play School Task Participation											
16	55.44	16.75	18	56.83	20.22	2	65.12	17.00	.963	2	.618
Attention during the whole prototypes											
Dora the Explorer Character Assistance											
42	88.43	39.10	32	87.86	40.38	5	91.58	45.20	.331	2	.848
Play School Task Participation											
42	78.29	40.45	38	83.25	45.84	5	80.38	42.80	.952	2	.621
Hi-5 Collecting Cards											
44	81.13	37.43	28	91.77	54.02	14	88.44	41.54	7.653	2	.022
Enjoyment											
Dora the Explorer Character Assistance											
41	4.55	42.27	32	4.53	36.19	5	4.60	38.00	1.906	2	.386
Play School Task Participation											
42	4.26	41.62	38	4.42	44.08	5	4.60	46.40	.381	2	.827
Hi-5 Collecting Cards											
44	4.39	41.89	28	4.45	44.86	14	4.50	45.86	.508	2	.776

NB: Comparisons are not made for the period during or after the interactive segment of the control prototype and *Hi-5* Collecting Cards because the interactive opportunities occur throughout this prototype. Therefore, comparisons are only made for the whole prototypes.

Attention differences were found, however, in comparisons of attention during Task Participation and *Play School* Control. During the interactive segment, attention was significantly higher for viewers interacting with Task Participation compared to the attention of control viewers (Mann-Whitney U = 64.00; $p < .01$). This effect was not observed for the period after the interactive segment of Task Participation however, nor was it found for the prototype as a whole. It was found that there were significant attention differences between viewers of Collecting Cards and Hi-5 Control. Post-hoc analysis found that viewers interacting with Collecting Cards directed more of their attention to the prototype than control viewers (Mann-Whitney U = 389.00; $p < .01$), and the non-interacting viewers (Mann-Whitney U = 125.50; $p < .08$).

Of the three participation prototypes, heightened attention was observed during the interactive segment of Task Participation, and for the whole of Collecting Cards. As discussed, the multiple opportunities to interact throughout *Hi-5* Collecting Cards may account for why this was the only participation prototype where whole prototype effects were observed. These findings suggest that participation models can influence participant attention, but that multiple interactive opportunities may be required to elicit this effect.

Finally, Table 7.9 shows no differences in the enjoyment reported by interacting, non-interacting, and control viewers in any of the participation prototypes. It is surprising to note that no differences in enjoyment were observed for the participation prototypes; and particularly for Collecting Cards, given that significant differences in both comprehension and attention were observed. Again, it is suggested that the measure of enjoyment used may not have been sufficiently sensitive to reflect changes in the enjoyment of participants.

7.5.3 Discussion

The final model of interactivity explored in this study was participation. Three prototypes, *Dora the Explorer* Character Assistance, *Hi-5* Collecting Cards, and *Play*

School Task Participation, explored different ways of allowing the viewer to participate in program activities. As reported, findings for these three prototypes varied.

Participants interacting with Character Assistance did not exhibit any differences in comprehension or attention during the interactive segment compared with participants viewing the control prototype. As discussed in Chapter 6, the interpretation of this finding is made more difficult because comprehension and attention were particularly high during the interactive segment in the control prototype. The enjoyment reported by participants viewing the control prototype was also extremely high. It is possible that there was a ceiling effect associated with *Dora the Explorer* Control, preventing any increases in attention and enjoyment from being found. However, this effect was less pronounced for the portion of the program after the interactive segment and for the program as a whole. It is clear that any effect that may have occurred during the interactive segment was not present for the rest of the program. If there was an effect masked by the ceiling effect during the interactive segment, it was short-acting. It is important to note however that there were no detrimental effects associated with this prototype, with high attention, comprehension and enjoyment observed for both interacting and non-interacting participants.

Participants interacting with Task Participation directed significantly more attention toward the interactive segment than did control viewers. As discussed previously, this effect was limited to the interactive segment. This pattern is similar to that noted during Theme Repetition, where the higher comprehension observed for interacting participants was limited to the interactive segment. It is suggested that the effects associated with interactivity are time-limited and diminish rapidly after the interaction has occurred.

There were multiple opportunities to interact during Collecting Cards, and analysis was subsequently limited to comparisons between whole programs. It was found that participants interacting with this prototype had significantly higher comprehension and attention compared to participants viewing the control prototype. The increased attention associated with this prototype is expected given that participants needed to watch the program to identify new cards when they appeared. However, it is interesting to note that comprehension was significantly higher for interacting participants given that they did not view any additional content compared with the control condition. It is argued that increased involvement with the program, and a sense of greater investment from the viewer, may account for the higher comprehension observed.

Given these findings, it is suggested that participation-based interactivity can be effective for young children. No detrimental effects, such as lower comprehension or enjoyment, were observed for any of the participation-based prototypes. As discussed, particularly positive outcomes were observed for participants interacting with Collecting Cards.

CHAPTER 8: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

8.1 Overview

The work reported in this thesis formed part of a larger multidisciplinary project. Chapter 1 discussed the nature and scope of the project, and the contributions of the partners. In Chapter 2, research assessing young children's responses toward television was discussed, and the impact of individual differences on viewing responses was examined. Chapter 3 was concerned with the existing literature examining children's use of interactive television and other interactive media, and some theoretical support for the use of interactivity in children's television was discussed. The methodological design for the prototype evaluations was outlined in Chapter 4, with the results discussed in Chapters 5, 6 and 7. Chapters 6 and 7 presented two different approaches to the data analyses, and it was argued that the later chapter provided more parsimonious and interpretable data. The present chapter focuses on the implications of the findings for program makers and future researchers, and the strengths and limitations of this research.

8.2 Implications for Interactive Television

The analysis presented in Chapter 7 explored the impact of four different models of interactive television for young children. The models examined were narrative choice, customisation, repetition, and participation. Although the design of the study prohibited true inferences from being drawn across programs, some general patterns emerged that warrant discussion.

8.2.1 Narrative choices

Providing the viewer with narrative choices is a seemingly obvious application for interactive television. After comparing children's responses to *Dora the Explorer* Control with responses to *Dora the Explorer* Minor Narrative Choice and *Dora the Explorer* Major Narrative Choice, it is apparent that there are caveats around this kind of interactivity. Narrative choices were not associated with higher comprehension or enjoyment for interacting participants compared with non-interacting and control participants. In fact, participants who did not interact when presented with a minor narrative choice obtained lower comprehension and enjoyment than control viewers, who were not presented with choice. Participants who interacted when presented with a major narrative choice directed less attention to the interactive segment, and the remainder of the prototype, than non-interacting and control viewers. This suggests that interacting with the prototype may have reduced participants' understanding of, or interest in, the prototype.

As discussed in Chapter 5, some participants were able to explain the interactivity in terms of making narrative choices (such as "Choosing which way to go"). In fact, participants were able to articulate their use of the remote control, and the outcome of their use, at higher rates for the narrative choice prototypes than for many of the other interactive models. Given these patterns, it is suggested that the participants viewing these prototypes understood the nature of the choices provided to them. However, the findings demonstrate that providing narrative choices to young children, whether those choices involve minor or major aspects of the narrative, can act to decrease program comprehension and enjoyment. It may be that offering narrative choices within a program acts to distract the viewer. Successful narratives engage the viewer in the 'flow' of the story, and this flow appears to have been disrupted by presenting the viewer with narrative choices. As a result, participants' comprehension and enjoyment were reduced.

Given these findings, it is suggested that narrative choices are not an effective model of interactivity for young children. Providing narrative choices offered no advantages to participants and potentially provided a less comprehensible and enjoyable viewing experience compared with the traditional program format. It appears that narrative choices are risky to implement and may disrupt the flow of the narrative. Despite narrative choices being an obvious application for interactivity, it is recommended that program makers be wary of implementing them. Providing the opportunity for narrative choice is an expensive interactive application, requiring the production of additional content that will not seen by all viewers. Given the cost of employing this model of interactivity, the benefits for viewers would need to be substantial. This is clearly not the case. As discussed in Chapter 1, viewer enjoyment is a priority for the makers of *Dora the Explorer, Hi-5* and *Play School*. Therefore, any interactive application with the potential to significantly decrease the enjoyment of viewers would be unacceptable to the partners.

8.2.2 Customisation

The second model of interactivity investigated in this study was customisation. The rationale underlying both *Hi-5* Presenter Choice and *Play School* Story Choice was that providing children with the opportunity to select content that appealed to them would enhance their involvement and interest with the content, presumably impacting on their comprehension, attention and enjoyment. Previous studies have demonstrated that giving children control over aspects of a computer task increases their interest and performance (Calvert et al., 2005; Cordova & Lepper, 1996). It was found, however, that young children did not respond in this manner when presented with choices about television content. As discussed in Chapter 7, neither of the customisation prototypes had a significant impact on participants' comprehension, attention, or enjoyment.

For both of these prototypes, participants were able to choose between two familiar and (presumably) salient alternatives. *Hi-5*, for example, is a character-driven program and anecdotal experience suggests that children often have a favourite presenter they enjoy seeing (H. Harris, personal communication, June 17, 2003). It was expected, therefore, that the opportunity to select a preferred presenter would have been an interesting and meaningful choice for young children. Similarly, children are typically accustomed to selecting a preferred story, and it was expected that having the choice between a dog or cat story in *Play School* would also be interesting and meaningful. In spite of these expectations, no differences in comprehension, attention or enjoyment were observed during either of these prototypes. It may have been that despite the familiarity and presumed appeal of the alternatives available to participants, the ability to customise content within a television program was not salient to children of this age. Participants interacting with the customisation prototypes appeared to have understood the choices they were making (see Chapter 5). However, it appears that making a choice in itself was not particularly relevant or meaningful to participants. Consequently, little change in comprehension, attention or enjoyment followed. In contrast to this finding, Calvert and colleagues reported that young children given control of a computer mouse, which essentially gave them the ability to make choices throughout their session, exhibited significantly higher attention to the computer storybook than children without access to this control. They concluded that control acts as a determinant of interest and engagement. It is interesting that the control provided to participants in the customisation prototypes did not elicit the same effects. Perhaps the choice (and control) given to participants in the present study was too inconsequential or brief to elicit higher attention.

Alternatively, it is possible that the choices themselves were salient and interesting to participants, but that the subsequent material viewed was so similar to the *Hi-5* and *Play School* experiences they were familiar with, that no differences in viewing behaviour occurred. Perhaps the same kinds of choices followed by more varied content, or content in a less familiar format, might have resulted in different participant responses. In either case, it appears that using archive program material to offer customised content within a program is not an effective model of interactivity for this age group. Unlike the narrative choice model, there were no decreases in comprehension or attention associated with offering customisation. It is clear, however, that there was no comprehension or enjoyment advantage to providing these kinds of choices. Given these findings, it is unlikely that program makers would invest their resources in developing interactive models of this kind.

8.2.3 Repetition

The literature suggests that the repetition of television content increases young children's comprehension (Crawley et al., 1999), and two of the prototypes examined different models of repetition-based interactivity. *Hi-5* Segment Repetition provided participants with the opportunity to exactly repeat the content of a segment while *Play School* Theme Repetition provided the opportunity to view a segment containing a similar theme. Interestingly, *Play School* Theme Repetition had the highest interaction rate of all the prototypes, with 88% of participants choosing to view another dog song.

For both repetition prototypes, significantly higher comprehension was obtained by the participants who repeated content. Interestingly, this difference in comprehension did not occur during the interactive segment in Segment Repetition, but was found for the whole prototype. Conversely, higher comprehension was observed during the interactive segment of Theme Repetition but the effect was not observed for the period after the interactive segment or for the prototype as a whole. For both repetition prototypes, attention was lower during the repeated segment than it was during the first viewing. This finding is consistent with those reported in the literature (Crawley et al., 1999). As discussed in Chapter 7, it is consistent with expectations of decreased attention directed at the repeated content given that it was familiar to participants.

The findings suggest that repetition-based models of interactivity are effective for this age group. In an interactive television context, repetition functions in the same way as in other contexts; by increasing participant comprehension and requiring less attention. Of course, repetition can be, and is, used within and across linear television programming. However, the advantage of using repetition in interactive television is that children can choose whether they would like to repeat content or not. This allows repetition of content for those children who would enjoy, and benefit from, repeating content to do so. Given the findings of Crawley and colleagues, it is likely that younger children, and those less experienced with television, would most benefit from repetition (1999). However, older and more experienced children may become bored with repetition (Crawley et al., 2002), and may elect not to re-view content. Given the advantages of interactive repetition, it is suggested that program makers explore ways to incorporate repetition-based interactions in their programming. For a program such as *Play School,* where the primary aim of the program makers is to provide children with a comprehensible experience, and the maintenance of high attention is not considered important, repetition applications are particularly well suited.

8.2.4 Participation

The final model of interactivity explored in the present study was participation. Three prototypes, *Dora the Explorer* Character Assistance, *Hi-5* Collecting Cards, and *Play School* Task Participation, explored different ways of encouraging viewer participation with particular tasks. The findings for the three participation prototypes were varied.

Participants interacting with Character Assistance did not show any differences in comprehension or attention during the interactive segment compared with participants viewing the control prototype. As discussed in Chapter 6, the interpretation of this finding was difficult given that comprehension and attention were particularly high during the interactive portion of the control prototype. The enjoyment reported by participants viewing the control prototype was also extremely high. A ceiling effect may have occurred with the control prototype, preventing any increases in attention and enjoyment from being found. However, this effect was less pronounced for the portion of the prototype after the interactive segment and for the prototype as a whole. It was clear that any effect that may have occurred during the interactive segment was not present for the rest of the program. If there was a difference masked by a ceiling effect during the interactive segment, it was short-lived. It is important to note however that there were no detrimental findings associated with this prototype, as very high attention, comprehension and enjoyment were observed for both interacting and non-interacting participants.

Participants interacting with Task Participation directed significantly more attention toward the television during the interactive segment than control viewers, and as discussed previously, this effect was limited to the interactive segment. (This pattern is similar to that noted during Theme Repetition, where the higher comprehension scores observed for interacting participants were limited to the interactive segment.) It is suggested that some effects associated with interactivity are time-limited, diminishing rapidly after the interaction has occurred. The high proportion of attention directed toward the interactive segment in Task Participation suggests that interacting participants found the segment more enjoyable and possibly more demanding than non-interacting and control viewers. The visual nature of the matching task may have required additional attention and concentration from viewers.

There were multiple opportunities to interact during Collecting Cards, and analysis was subsequently limited to comparisons between whole prototypes. It was found that participants interacting with this prototype obtained significantly higher comprehension scores and directed more attention to the prototype than control viewers. The increased attention associated with this prototype is explicable given that participants needed to attend to the program in order to identify the appearance of new cards. It is interesting, however, that comprehension was significantly higher for interacting participants given that they did not view any additional content. It is likely that this occurred because viewers experienced a greater sense of involvement and investment (Salomon, 1984).

Given the findings for the participation prototypes, it is apparent that participation-based interactivity can be effective for young children. No detrimental effects, such as reductions in comprehension or enjoyment, were observed for any of the participation prototypes. Particularly positive outcomes were observed for participants interacting with Collecting Cards. It is suggested that participation-based interactivity could be effectively used within *Dora the Explorer, Hi-5,* and *Play School*. As discussed in Chapter 1, engagement and participation are high priorities for the makers of these programs. Participation applications are also considerably cheaper to implement than narrative or customisation applications, which require considerable additional production.

There is another reason why participation appeared to be more effective in *Hi-5* and *Play School* than it did in *Dora the Explorer*. As discussed in Chapter 1, extensive formative testing takes place for each episode of *Dora the Explorer*. Each episode is tested and refined until it elicits high levels of comprehension and attention from young children (C. Ricci, personal communication, May 29, 2003). In contrast, no formal testing takes place for episodes of *Hi-5* (H. Harris, personal communication, June 17, 2003) or *Play School* (J. Buckingham, personal communication, June 2, 2003). As seen throughout Chapter 6, the control prototype for *Dora the Explorer* elicited notably higher attention than the control prototypes of *Hi-5* or *Play School* (88.43% compared with 81.13% and 78.29% respectively). Similarly, higher comprehension scores were obtained by viewers of the *Dora the Explorer* control prototype compared with participants viewing the control prototypes of *Hi-5* or *Play School* (41.81% compared with 34.29% and 40.24% respectively). The lower baseline levels of attention and comprehension for *Hi-5* may explain why participation was effective in *Hi-5* but not *Dora the Explorer*. It may be that interactivity could not ‘improve’ *Dora the Explorer* in any measurable way because the program is extensively tailored to maximise the enjoyment, comprehension and attention of participants. With *Hi-5* and *Play School*, no such tailoring has taken place, leaving some room for interactivity to impact on viewing behaviour.

8.2.5 Frequency of interactivity

The greatest benefits for viewer comprehension and attention were found for participants interacting with Collecting Cards. Although potential explanations for this finding have been discussed, such as increased investment and the reinforcement provided by the collection of each card, it is also important to note that this was the only prototype offering multiple opportunities to interact throughout the program. It may have been that the one interactive opportunity presented in the other eight interactive prototypes was less effective in engaging viewers. It is recommended that future research examine the duration of interactive effects and the optimum amount of interactivity for young children. The effect of providing different numbers of interactions throughout a program deserves further examination. It may be that there are an optimum number of interactions for different applications, or for different demographic groups.

8.2.6 Persistence of interactive effects

Where possible, the comprehension and attention of participants were compared for the periods during the interactive segment, after the interactive segment, and for the whole prototypes. While significant changes in comprehension and attention were found during the interactive segments of some prototypes, very few of these effects were seen in the period after the interaction or for the program as a whole. This pattern was noted for Theme Repetition and Task Participation, where significantly higher attention or comprehension was observed only during the interactive portion of the prototypes. This may indicate that the effects of interactivity, or particular types of interactivity, do not persist across the duration of the program. If particular interactive effects are brief in duration, this would also provide a rationale for including multiple interactions across the duration of a program.

8.3 Limitations and Recommendations for Future Research

This thesis focuses on the evaluation of children's responses to interactive programs which were designed in the context of a broader project. The interpretability and generalisability of the data were constrained by several factors, which can be classified as pertaining to the prototypes, method of participant recruitment, and measures used. The limitations associated with each of these factors will be discussed, and suggestions are made for avoiding these difficulties in future studies.

8.3.1 Prototype design

The interactive prototypes used in this study were designed and produced by others, and as such this thesis is written from the perspective of a program evaluation (Miller & Salkind, 2002). Given that the rationale and design of the prototypes were not developed within a psychological experimental framework, this work did not seek evidence for a series of hypotheses. Instead, the study aimed to understand how young children might respond to different models of interactivity within existing television programs. The prototypes tested in this study were designed by a postgraduate student working toward a PhD in Media Production. As such, the prototypes were designed with a production focus, and with creative and aesthetic priorities rather than experimental ones. As a consequence of this design focus, the experimental aspect of the study was constrained in several ways. This discussion is not intended as a criticism of the creative or production aspects of the prototypes. However, the experimental difficulties arising from aspects of the prototype design need to be identified insomuch as the interpretability of the data are limited.

For each of the partners' programs, *Dora the Explorer*, *Hi-5* and *Play School*, three interactive prototypes were created. Consequently, the experimental design involved the comparison of nine experimental and three control conditions. While this work examined young children's responses to different interactive applications, the lack of a unitary control condition meant that inferences could only be confidently drawn about children's responses to each interactive prototype compared with that prototype's control. It could not be concluded, for example, that an interactive application (such as the use of Segment Repetition) would function the same way in *Play School* as it did in *Hi-5*. It would have been useful to directly compare the responses of participants viewing *Hi-5* Segment Repetition with those of participants viewing *Play School* Theme Repetition. Such a comparison would have provided information on any differing effects between these two repetition applications. As the study was designed, however, the repetition application used was confounded by the use of two different programs. The current study did not employ a truly factorial design, and so the inferences that can be drawn across programs are limited.

The exploratory and collaborative nature of this research prevented optimal experimental methods from being implemented. Tentative implications have been made about the research findings, but further research employing fully factorial designs and one control condition are required. This may be best achieved by testing interactive applications within an original program, rather than imbedded in an existing program.

The method of analysis presented in Chapter 6 is constrained by several factors. For four of the nine interactive prototypes, participants were given a choice between two alternatives. With the exception of *Hi-5* Presenter Choice, where content from both alternatives featured in the control prototype, the other prototypes offered the chance to view a segment that was not part of the control prototype. For example, participants viewing *Dora the Explorer* Major Narrative Choice could choose between the dragon and giant flowers pathway. Participants viewing *Dora the Explorer* Control, however, saw only the giant flowers segment. As a result, there was no control comparison available for the dragon segment. Similarly, the non-interacting participants viewing these prototypes defaulted to only one of the two alternatives. This created a situation in *Dora the Explorer* Major Narrative Choice where non-interacting participants viewed content that was not part of the control prototype. Therefore, in some conditions, interacting participants did not view identical content to that viewed by non-interacting or control participants. In these instances, statistical comparisons could not be made, and there were difficulties in interpreting the data.

For some of the prototypes, the two alternatives available to participants varied considerably in terms of content and length. For example, the dog story featured in *Play School* Story Choice had the characteristics of a typical 'story', as the presenter read from a book while the story was acted out. The cat story, however, did not resemble a typical story, as it was a song about a cat and her kittens. This story format may have been less identifiable to young children as 'a story', and their response to the comprehension question "What happened in the story today" may have been affected by this. As it was, there was no effect found for *Play School* Story Choice. However, if there had been a difference between those viewing the cat and dog stories, these differences in content may have limited the interpretability of the finding. The cat story in *Play School* Story Choice was 2 minutes and 59 seconds in duration, compared with the dog story which was 3 minutes and 24 seconds in duration. Given that children's attention can be influenced by the duration of the material they view (Anderson & Lorch, 1983), it could be argued that it is problematic to compare the attention exhibited during these two segments.

A variation on this limitation is that the alternatives provided to viewers were not designed with equivalent formal features in mind. It is well established that particular formal features are associated with increased or decreased attention in young children (Huston & Wright, 1983; Van Evra, 2004). If the alternative content differed in the formal features it contained, interpretation of the attention data becomes difficult. These difficulties were minimised using the method of analysis presented in Chapter 7. By comparing participant responses based on the model of interactivity used, rather than the specific choice made, results for prototypes with two interactive choices were aggregated.

Some modifications are recommended for future research where interactive applications feature content choices. It is recommended that non-interacting participants be randomly assigned to view each of the alternatives as a default. In the current study, all non-interacting participants defaulted to only one alternative, and this prevented direct comparisons being made between interacting, non-interacting, and control participants in some prototypes. It is also suggested that the content provided in choice applications be consistent in terms of their formal features, content, and duration. These factors would then be eliminated as potential confounds impacting on the viewing behaviour of participants.

Experimental comparisons were also restricted for the two repetition prototypes; *Hi-5* Segment Repetition and *Play School* Theme Repetition. In order to maintain the length of these prototypes, the prototype designer omitted a segment subsequent to the interaction for repeating participants. Participants were not aware that they had missed the opportunity to view a segment by repeating content, and the prototype they viewed was similar in total duration to that seen by non-repeating participants. However, the consequence of omitting a segment was that comprehension and attention comparisons for the period after the interaction were not possible. In future research, this design feature could be changed. Of course, this would create another experimental difficulty, as the repeating participants would then view a substantially longer program than non-interacting participants. By their nature, interactive applications featuring repetition will be difficult to experimentally compare with control programs.

Because the rationale for the interactive prototypes was based on the interests of the prototype designer, multidisciplinary team, and the partners rather than being theory-driven, clear hypotheses about the interactive prototypes were not formed and tested in this thesis. Instead, this work sought to evaluate children's responses to the interactive and control prototypes wherever comparisons could reasonably be made. Consequently, the analysis and interpretation of the findings was challenging.

Some technological constraints influenced the prototypes' design. There is no conventional platform for interactive television at present and many modes of delivering interactive content are possible (Carey, 1997; Srivastava, 2002). For example, interactive content could be delivered using high-speed cable, satellite, broadband internet or a combination of these. Viewer choices might be relayed to broadcasters via any of these modes, or with a phone line (Srivastava, 2002). In the present study, limited technology and resources were available. In order to have the interactive programs working in both a mobile laboratory and home setting, the interactive prototypes operated from a combination of DVD and computer. These technologies limited the kinds of interactions that could be created. The combination of DVD and computer technology also made it difficult to recreate participants' interactive experience with the DVD's in Appendix D. [4]

8.3.2 Participant sample

It is acknowledged that there are limitations associated with aspects of the participant sample and the assignment of participants to the different conditions. Demographic information about each participant was collected via a parent questionnaire distributed between August and September 2004. In this questionnaire, parents were asked to indicate their children's familiarity with the different television programs being tested, and their experience with the television remote control. Participant testing took place between October 2004 and March 2005. For the participants tested in 2004, the information collected was recent and likely to give a good indication of each participant's experience with different television programs and remote controlled devices. The information provided for participants tested in 2005, however, was less recent and may not have accurately reflected each participant's current experience.

A further limitation with the sample is that 16 of the participants assigned to view *Dora the Explorer* were not familiar with the program. As discussed in Chapter 5, it was decided that children would be assigned to view programs they were familiar with, because so few participants were unfamiliar with *Play School* and *Hi-5*. Unfortunately, there were insufficient participants who were familiar with *Dora the Explorer* to view the four *Dora the Explorer* prototypes. Therefore, 16 participants who were familiar with *Blue's Clues* were assigned to the *Dora the Explorer* cells. While there are clear

[4] Although these DVD's contain all the possible content available to participants, the order in which content was viewed is not always maintained on the DVD. The icons appearing during the calls to action also do not appear on the DVD's. Consequently, simulations of the interactive segments are attached as Appendix E.

differences between *Blue's Clues* and *Dora the Explorer*, both are Nickelodeon animations designed for three to five-year olds. Both programs have an emphasis on active viewing and encourage the viewer to overtly participate in the program by answering questions and performing physical actions (Crawley et al., 1999; Gifford et al., 2002). *Dora the Explorer* head researcher, Christine Ricci, explained that children who were already familiar with *Blue's Clues* had no difficulty understanding the participation in *Dora the Explorer* (C. Ricci, personal communication, May 29, 2003). Therefore, participants familiar with *Blue's Clues* were considered suitable substitutes for *Dora the Explorer* viewers. Of course, it is possible that the 16 *Blue's Clues* viewers responded in slightly different ways to the four *Dora the Explorer* prototypes, and that this may have influenced the results.

The participants assigned to view the *Dora the Explorer* prototypes differed from the *Play School* and *Hi-5* viewers in that fewer of them attended Independent schools. Of the three Independent schools participating in the study, two were Evangelical Christian schools. As discussed in Chapter 4, the Principals from these schools agreed to participate on the condition that their students did not view content inconsistent with the schools' ethos. The magical content contained in the *Dora the Explorer* prototypes was of concern to these schools, and consequently no children from these two schools were assigned to view the *Dora the Explorer* prototypes. While it is considered unlikely that the different ratio of Independent school children across the prototypes influenced the results, this possibility cannot be eliminated.

8.3.3 Measurement of dependent variables

As discussed in Chapter 5, there were difficulties with the analysis and interpretation of some variables measured in the present study. Consequently the verbal engagement, nonverbal engagement, and observed enjoyment data analysed were not interpreted or discussed. It was found that most participants did not exhibit any verbal or nonverbal engagement behaviours (the modal score was 0), and that power transformations of such data would make the data difficult to meaningfully interpret (Emerson & Stoto, 2000). It was unfortunate that these data were not more normally distributed, as the engagement and observed enjoyment behaviours may have provided additional insight into children's responses to the interactive prototypes. Measures similar to the engagement measures used in this study were reported by Anderson and colleagues (1981), and by Crawley and colleagues (2002; 1999). In each of these studies, the authors acknowledge that these behaviours occurred infrequently, however sufficient data were collected for analysis. It is likely that the more conservative measure of partial-interval recording used in the present study was not as sensitive as the continuous method of recording used in the abovementioned studies (Sulzer-Azaroff & Maher, 1977). In addition, laughter was included as a nonverbal engagement measure in these studies but was categorised as an enjoyment behaviour in the present study. This may also account for the higher incidence of behaviours reported previously. Although some researchers discuss measuring enjoyment observationally (Fisch & Bernstein, 2001; Read et al., 2002), no comparable data to the present observed enjoyment measure have been reported. In future research, it is recommended that measures of behaviours be recorded continuously, rather than with partial-interval recording in order to maximise the likelihood of recording all the relevant behaviours. Similarly, it is recommended that enjoyment behaviours (particularly laughter) be recorded in conjunction with engagement behaviours to maximise the likelihood of identifying differences between conditions.

As discussed in Chapter 5, children rated their enjoyment of the program using a five-point face scale. Similar scales have been used to assess young children's enjoyment in other studies (Read et al., 2002; Salomon, 1977), and have produced data suitable for statistical analysis. In the present study, very few significant differences were found using the reported enjoyment measure. This may indicate that the measure was unsuitable or insufficiently sensitive to detect differences. Alternatively, Read and colleagues have suggested that children consistently report very high enjoyment irrespective of the material they have experienced (Read et al., 2006), and this may have occurred irrespective of the enjoyment measure used. However, it is also possible that participants may have genuinely experienced high levels of enjoyment for all of the prototypes. Given that all of the prototypes were based on programs designed to entertain young children, this explanation is quite plausible. While little differentiation in enjoyment reports was found between groups of participants, two significant differences in program enjoyment were detected. As reported previously, children living in less affluent suburbs reported higher program enjoyment than more affluent participants. Non-interacting participants viewing *Dora the Explorer* Minor Narrative Choice also reported lower program enjoyment than control participants. Both of these findings can be reasonably accounted for, and the fact that significant differences were detected using this measure suggests that it was sufficiently sensitive to detect meaningful differences in the enjoyment of participants.

The dependent variables used in this evaluation were originally designed to measure children's responses across the entire duration of the prototypes, and not for discrete portions within the prototypes. At the commencement of this study, the multi-disciplinary team, and the Researcher, anticipated that large differences in attention and comprehension would be found between conditions. At this time, we were operating on the common assumption, referred to by Wartella and colleagues (2002), that 'interactivity' in itself would have a powerful impact on young children. When the data collection was designed, it was anticipated that only whole-prototype comparisons would be made. Specifically, the comprehension questions were not designed to assess children's understandings of specific segments in addition to the whole prototype. As a result, comprehension for some prototype periods (such as the period after the interactive segment in *Dora the Explorer* Major Narrative Choice) could not be assessed because none of the questions related specifically to these portions of the prototypes. Similarly, reported enjoyment was measured as a global rating and could not be isolated for specific portions of the prototypes.

The most significant difficulty in assessing viewing behaviour during portions of the prototypes was measuring attention. Attention was initially recorded as a continuous measure for all participants. Because it was anticipated that only whole-program comparisons would be required, the computer program developed for calculating percentage attention was only able to generate data for the duration of the prototype. In order to assess participants' attention during specific portions of the prototypes, the coding of attention from participant video recordings had to be re-done. Continuous coding is extremely time consuming, and the project allowed neither sufficient funds nor time to re-calculate attention for all 498 participants. Therefore, it was decided that the Researcher would re-calculate attention for half of the dataset, selected at random. It was thought that analysing the attention of a random subset of participants would provide a reliable indication of all participants' attention; however, this cannot be determined conclusively. In future research, a method of calculating continuous data which allows both whole-program and segment-specific analysis is strongly recommended. Such a design would afford a considerable time saving. It is also recommended that comprehension questions be designed to allow both segment-based and whole-program comparisons.

8.3.4 Test environment

Miller and Salkind (2002) note that there is often a trade-off between internal and external validity in experimental research. Internal validity refers to the extent to which any differences observed between participants in the experimental and control groups can be confidently attributed to the independent variable rather than another factor. External validity refers to the extent to which any observed effects can be generalised to other populations or settings. It has been suggested that aspects of design which increase internal validity may also serve to reduce external validity, and vice versa (Miller & Salkind, 2002).

Several steps were taken to ensure that the present study had high internal validity. For example, all participants viewed the prototypes in an individual viewing environment and in the same context (in the Research Centre located at the child's school during school hours). The sample was stratified so that each prototype was viewed by children with a similar composition of gender, age, school type, and experience with remote controls. This method of assigning participants eliminated the possibility that one of these demographic factors was responsible for differences between prototype viewers independent of the prototype content. It is argued that the data have not been confounded by any systematic differences between participants viewing the 12 prototypes.

A further step taken to strengthen the internal validity of the study was the decision to test participants individually. Although it would have been substantially faster to have children view the prototypes in pairs or small groups (Fisch & Bernstein, 2001) children are known to influence the viewing behaviour of co-viewers (Anderson et al., 1981). Having each child view individually ensured that their responses were not influenced by other children. This allowed any differences in comprehension, attention or enjoyment found between participants viewing the interactive and control prototypes to be attributed to the interaction.

While many of these steps strengthened the internal validity of the study, they may also have reduced the study's external validity. If children's interactive television was developed and broadcast, young children would mostly view such content in their homes. There are several key differences between viewing in a home and laboratory environment, and these differences may limit the generalisability of the results. For example, children viewing at home might typically share the company of a sibling or parent, eat and drink, and be involved with the goings-on of the household. In the home context, viewing television may also be one of many available leisure options. This creates a very different viewing environment to the Research Centre, where children viewed alone surrounded by unfamiliar décor. In the Research Centre, participants did not have access to any activities other than the prototype and the distracter toys. Another key difference in the Research Centre is that children were brought out of their classrooms to watch television. This may have afforded the prototypes with particular salience compared to programming viewed at home. It is also known that children (and adults) often behave differently when they are aware of being observed (Sharman, Cross, & Vennis, 2004). Therefore, it is possible that the Researcher's presence during data collection may have influenced participants' viewing behaviour. Consequently, it is not clear how indicative the current findings are of the way children would have viewed the interactive prototypes in their homes. However, the controlled nature of the

Research Centre provided an environment in which the differences between prototypes were more likely to be observed. In a home environment, with more background activity and measurement error, it is likely that fewer effects would have been observed. While it is acknowledged that the findings from the present study may not be highly generalisable to children viewing in naturalistic settings, the study does provide the optimum conditions for identifying what effects the interactive prototypes might have on viewers.

8.3.5 Statistical approach

The analyses presented in Chapters 5, 6, and 7 used t-tests and one-way ANOVAs to examine the effects of demographic and treatment variables on viewing behaviour. Ideally, it would have been desirable to conduct factorial analyses to examine interactions between these variables. It was decided that this approach would not be pursued, however, due to the size of the sample. Although the total sample includes data from 498 children, each condition contained approximately 40 children. Once interacting and non-interacting participants were separated, the cell sizes were correspondingly smaller. It was decided that dividing these small cells according to demographic factors would be untenable.

8.3.6 Recommended strategies for future research on interactive programming

Throughout this chapter, the study's limitations have been discussed and recommendations for avoiding these difficulties in the future have been made. Given these individual recommendations, the following combined strategy is proposed to assist future researchers in this area.

1) Design interactive models based on developmentally-grounded theory. While some conclusions can be drawn from evaluative research, basing interactive models on a

theoretical framework and testing theoretically derived hypotheses would allow a richer understanding of the effects arising from an interactive model. Wartella and colleagues (2000) have also suggested that more theory-based research be conducted examining children's interactive media. They argue that without such an approach, research tends not to be additive, and is not as easily accessed across disciplines. Given the limited research examining the impact of interactive television on young children, cumulative and cross-disciplinary research is required. 2) Develop multiple interactive prototypes to test variations of the interactive model, using the same base program. By examining an interactive concept across variations applications or prototypes, a clearer understanding of the specific circumstance in which an effect occurs can be gained. It is suggested that these variations be examined based on the same program, so that the differing effects of the models can be confidently attributed to the precise nature of the application rather than the program in which it is featured. 3) Examine the impact of interactivity developed in the context of an original program rather than placing interactive components within existing programs. Using programs designed around interactive components ensures that the interactivity does not appear 'tacked-on', or create a sense of disruption and discontinuity for the viewer. It is suggested that examining interactivity within original programming provides the best test of the potential impact of interactive applications. 4) Ensure that adequate controls are used. While the nature of interactivity inherently means that viewers may have one of several different viewing experiences, it is essential that each of the interactive options available has a suitable control. For example, if participants in the interactive condition have the choice of two options within a program, the two content variations need also to be viewed by control participants, but without the choice. This may be ensured by having control participants randomly assigned to viewing one of the two program variations, or by having two control groups for comparison with the interactive prototype. It is also suggested that the interactive and control prototypes be matched, where possible, according to length and the use of formal features. This may be best achieved by the use of original programming, rather than modified versions of existing programs. A research strategy such as this would provide a sound basis for making conclusions about the mechanisms underlying interactivity, and the circumstances in which particular effects occur. These findings would also allow additive research across disciplinary boundaries.

8.4 Conclusions

Wartella and colleagues (2002) point out that 'interactivity' in and of itself is often assumed to influence children's processing of media. Despite this common belief in interactivity's inherent benefits, the present study has demonstrated that some models of interactivity do not elicit any differences in children's viewing behaviour than traditional television. Of the interactive models examined, only prototypes within the participation and repetition models were associated with increases in comprehension or attention. The customisation applications examined were not associated with any differences in children's comprehension, attention, or enjoyment compared with the control prototypes. In addition, the narrative choice applications were associated with reduced attention for those interacting with Major Narrative Choice, and reduced comprehension and enjoyment for those not interacting with Minor Narrative Choice. These findings suggest that offering choices within a narrative program may impact children's ability to process the content.

It would appear that design features effective in traditional children's television are also likely to be effective in children's interactive television. As has been demonstrated in successful traditional television programs, such as *Blues' Clues*, successful interactive programs facilitate content repetition, and encourage overt participation from the viewer (Crawley et al., 1999). The present study suggests that participation and repetition are the most promising of the interactive applications examined.

This study was exploratory and evaluative in nature. From the findings, several research questions and hypotheses have emerged about children's understandings of interactive television. Specific recommendations have been given. Further research is required to establish the conditions under which interactivity can enhance young children's television programs.

REFERENCES

Airey, S., Plowman, L., Connolly, D., & Luckin, R. (2002). *Rating children's enjoyment of toys, games and media.* Paper presented at the 3rd World Congress of the International Toy Research Association on Toys, Games and Media, London.

Aisbett, N. (2006, August 19). TV or not TV? *The West Australian,* pp. 4-5.

Alvarez, M., Huston, A. C., Wright, J., & Kerkman, D. (1988). Gender differences in visual attention to television form and content. *Journal of Applied Developmental Psychology, 9*, 459-475.

Alwitt, L. F., Anderson, D. R., Lorch, E. P., & Levin, S. R. (1980). Preschool children's visual attention to attributes of television. *Human Communication Research, 7*, 52-67.

American Academy of Pediatrics Committee on Public Education. (1999). Media education. *Pediatrics, 104*, 341-343.

Anastasi, A. (1958). *Differential psychology* (3rd ed.). New York: Macmillan.

Anderson, D. R. (1998). Educational television is not an oxymoron. *Annals of the American Academy of Political and Social Science, 557*, 24-38.

Anderson, D. R., Choi, H. P., & Lorch, E. P. (1987). Attentional inertia reduces distractibility during young children's TV viewing. *Child Development, 58*, 798-806.

Anderson, D. R., Field, D. E., Collins, P. A., Lorch, E. P., & Nathan, J. G. (1985). Estimates of young children's time with television: A methodological comparison of parents reports with time-lapse video home observation. *Child Development, 56*, 1345-1357.

Anderson, D. R., & Levin, S. R. (1976). Young children's attention to *Sesame Street*. *Child Development, 47*, 806-811.

Anderson, D. R., & Lorch, E. P. (1983). Looking at television: Action or reaction? In J. Bryant & D. R. Anderson (Eds.), *Children's understandings of television: Research on attention and comprehension.* (pp. 1-33). New York: Academic Press.

Anderson, D. R., Lorch, E. P., Field, D. E., Collins, P. A., & Nathan, J. G. (1986). Television viewing at home: Age trends in visual attention and time with TV. *Child Development, 57*, 1024-1033.

Anderson, D. R., Lorch, E. P., Smith, R., Bradford, R., & Levin, S. R. (1981). The effects of peer presence on preschool children's television viewing behavior. *Developmental Psychology, 17*, 446-453.

Australian Broadcasting Corporation. (2002). *Editorial policies.* Sydney: Australian Broadcasting Corporation.

Australian Broadcasting Corporation. (2006). About the ABC: History of the ABC. Retrieved 28th August 2006: http://www.abc.net.au/corp/history/hist1.htm

Baldwin, H. (2006, 27th March). *Concept Development: CiTV enhancements.* Paper presented at the Final iTV Forum, Sydney, Australia.

Bianchi, S. M., & Robinson, J. (1997). What did you do today? Children's use of time, family composition, and acquisition of social capital. *Journal of Marriage and the Family, 59*, 332-344.

Brain Gym International. (2006). About *Brain Gym*. Retrieved 28 August 2006: http://www.braingym.org/about.html

Brunsdon, C. (1997). *Screen tastes: Soap opera to satellite dishes.* London: Routledge.

Bundell, G. (2006, 15th July 2006). Stories to tell. *The Australian,* p. 2.

Burdette, H. L., & Whitaker, R. C. (2005). A national study of neighbourhood safety, outdoor play, television viewing, and obesity in preschool children. *Pediatrics, 116*, 657-663.

Busching, L. (2000). Kids market research: Thumbscale replaces smiley. Retrieved 1st September, 2004: http://www.iris-net.org/whatsnew/default.asp?aID= 889

Calvert, S., Strong, B. L., & Gallagher, L. (2005). Control as an engagement feature for young children's attention to and learning of computer content. *American Behavioral Scientist, 48*, 578-589.

Calvert, S. L., Huston, A. C., Watkins, B. A., & Wright, J. C. (1982). The relation between selective attention to television forms and children's comprehension of content. *Child Development, 53*, 601-610.

Campbell, T. A., Wright, J. C., & Huston, A. C. (1987). Form cues and content difficulty as determinants of children's cognitive processing of televised educational messages. *Journal of Experimental Child Psychology, 43*, 311-327.

Carey, J. (1996). *Winky Dink to Stargazer: Five decades of interactive television.* Paper presented at the UnivEd Conference, Edinburgh.

Carey, J. (1997). Interactive television trials and marketplace experience. *Multimedia Tools and Applications, 5*, 207-216.

Christakis, D. A., Zimmerman, F. J., DiGiuseppe, D. L., & McCarty, C. A. (2004). Early television exposure and subsequent attentional problems in children. *Pediatrics, 113*, 708-713.

Christakis, D. A., Zimmerman, F. J., DiGiuseppe, D. L., & McCarty, C. A. (2004). Early television exposure and subsequent attentional problems in children. *Pediatrics, 113*, 708-713.

Clancy-Hepburn, K., Hickey, A., & Nevill, G. (1974). Children's behavior responses to TV food advertisements. *Journal of Nutrition Education, 6*, 93-96.

Coakes, S. J., & Steed, L. G. (1999). *SPSS: Analysis without anguish.* Brisbane: John Wiley & Sons Australia.

Cohen, A. A., & Salomon, G. (1979). Children' literate television viewing: Surprises and possibilities. *Journal of Communication, 29*(3), 156-163.

Cole, C. F., Richman, B. A., & McCann Brown, S. K. (2001). The world of *Sesame Street* research. In S. M. Fisch & R. Truglio (Eds.), *"G" is for growing: Thirty years of research on children and Sesame Street* (pp. 147-180). Mahwah: Lawrence Erlbaum Associates.

Collins, W. A. (1979). Children's comprehension of television content. In E. Wartella (Ed.), *Children communicating: Media and development of thought, speech, understanding* (Vol. 7). Beverly Hills: Sage.

Comstock, G., & Paik, H. (1991). *Television and the American child.* San Diego: CA: Academic Press.

Condry, J. (1989). *The psychology of television*. Hillsdale, NJ: Erlbaum.

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualisation, personalization, and choice. *Journal of Educational Psychology, 88*, 715-730.

Crawley, A. M., Anderson, D. R., Santomero, A., Wilder, A., Williams, M., Evans, M. K., et al. (2002). Do children learn how to watch television? The impact of extensive experience with *Blue's Clues* on preschool children's television viewing behavior. *Journal of Communication, 52*, 264-280.

Crawley, A. M., Anderson, D. R., Wilder, A., Williams, M., & Santomero, A. (1999). Effects of repeated exposures to a single episode of the television program Blue's Clues on the viewing behaviors and comprehension of preschool children. *Journal of Educational Psychology, 91*, 630-637.

Dennison, B. A., Russo, T. J., Burdick, P. A., & Jenkins, P. L. (2004). An intervention to reduce television viewing by preschool children. *Archives of Pediatrics & Adolescent Medicine, 158*, 170-176.

Emerson, J. D., & Stoto, M. A. (2000). Transforming data. In D. C. Hoaglin, F. Mosteller & J. W. Tukey (Eds.), *Understanding robust and exploratory data analysis* (pp. 97-128). New York: John Wiley & Sons.

Fetler, M. (1984). Television viewing and school achievement. *Journal of Communication, 34*(2), 104-118.

Field, D. E., & Anderson, D. R. (1985). Instruction and modality effects on children's television attention and comprehension. *Journal of Educational Psychology, 77*, 91-100.

Fisch, S. M., & Bernstein, L. (2001). Formative research revealed: Methodological and process issues in formative research. In S. M. Fisch & R. T. Truglio (Eds.), *"G" is for growing: Thirty years of research on children and Sesame Street* (pp. 39-60). Mahwah, N. J.: Lawrence Erlbaum Associates.

Fisch, S. M., & Truglio, R. (Eds.). (2001). *"G" is for growing: Thirty years of research on children and Sesame Street*. Mahwah: Lawrence Erlbaum Associates.

Galst, J., & White, M. (1976). The unhealthy persuader: The reinforcing value of television and children's purchase-influencing attempts at the supermarket. *Child Development, 47*, 1089-1094.

Gambell, T. J., & Hunter, D. M. (1999). Rethinking gender differences in literacy. *Canadian Journal of Education, 24*, 1-18.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic Books.

Geiger, S., & Reeves, B. (1993). The effects of scene changes and semantic relatedness on attention to television. *Communication Research, 20*, 155-175.

Gifford, C., Walsh, V., & Weiner, E. (2002). Meet Dora's Creators.   Retrieved 7 September, 2004: http://www.nickjr.com/home/shows/dora/meet_the_creators.jhtlm

Ginsberg, H. P., & Opper, S. (1988). *Piaget's theory of intellectual development* (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.

Given, J. (2003). *Turning off the television: Broadcasting's uncertain future*. Sydney: UNSW Press.

Glenstrup, A. J. (1995). *Eye controlled media: Present and future state.* Unpublished Bachelor, University of Copenhagen, Denmark.

Gunter, B., Furnam, A., & Lineton, Z. (1995). Watching people watching television: What goes on in front of the TV set. *Journal of Educational Television, 21*, 165-191.

Hallman, D. M. (2000). "If we're so smart,...": a response to Trevor Gambell and Darryl Hunter. *Canadian Journal of Education, 25*, 62.

Halpern, D. F. (1986). *Sex differences in cognitive abilities*. Hillsdale, NJ: Erlbaum.

Hanna, L., Risden, K., & Alexander, K. J. (1997). Guidelines for usability testing with children. *Interactions, 5*, 9-14.

Hawkins, R. P., Kim, Y., & Pingree, S. (1991). The ups and downs of attention to television. *Communication Research, 18*, 53-76.

Hawkins, R. P., Tapper, J., Bruce, L., & Pingree, S. (1995). Strategic and nonstrategic explanations for attentional inertia. *Communication Research, 22*, 188-206.

Hayes, D. S., & Birnbaum, D. W. (1980). Preschooler's retention of televised events: Is a picture worth a thousand words? *Developmental Psychology, 16*, 410-416.

Hayes, D. S., Kelly, S. R., & Mandel, M. (1986). Media differences in children's story synopses: Radio and television contrasted. *Journal of Educational Psychology, 78*, 341-346.

Heeter, C. (2000). Gender differences in viewing styles. In C. Heeter & B. Greenberg (Eds.), *Cableviewing*. Norwood, NJ: Albex Press.

Huston, A. C., Anderson, D. R., Wright, J., Linebarger, D. L., & Schmitt, K. L. (2001). Sesame Street viewers as adolescents: The recontact study. In S. M. Fisch & R. Truglio (Eds.), *"G" is for growing: Thirty years of research on children and Sesame Street* (pp. 131-142). Mahwah: Lawrence Erlbaum Associates.

Huston, A. C., & Wright, J. C. (1983). Children's processing of television: The informative functions of formal features. In J. Bryant & D. R. Anderson (Eds.), *Children's understandings of television: Research on attention and comprehension.* (pp. 35-68). New York: Academic Press.

Huston, A. C., & Wright, J. C. (1996). Television and socialization of young children. In T. M. MacBeth (Ed.), *Tuning in to young viewers: Social science perspectives on television.* (pp. 37-60).

Huston, A. C., Wright, J. C., Marquis, J., & Green, S. B. (1999). How young children spend their time: Television and other activities. *Developmental Psychology, 35*, 912-925.

Huston, A. C., Wright, J. C., Rice, M. L., Kerkman, D., & St. Peters, M. (1990). Development of television viewing patterns in early childhood: A longitudinal investigation. *Developmental Psychology, 26*, 409-420.

Huston, A. C., Wright, J. C., Wartella, E., Rice, M. L., Watkins, B., Campbell, T., et al. (1981). Communicating more than content: Formal features of children's television programs. *Journal of Communication, 31*(3), 32-48.

Hyde, J. S., & Linn, M. C. (1988). Gender differences in verbal ability: A meta-analysis. *Psychological Bulletin, 104*, 53-69.

informitv.com. (2004). Disney uses Ensequence for Kids Awards. Retrieved 27th July, 2004: http://informitv.com/articles/2004/09/28/disneyusesensequence/

Kids Like Us. (1999). About Hi-5. Retrieved 7 September, 2004, from Kids Like Us: http://ninemsn.com.au/kids/hi5/abouthf.asp

Kids Like Us. (2004). The Hi-5 Fan Website. Retrieved 7 September, 2004: http://www.Hi5America.com

Krull, R. (1983). Children learning to watch television. In J. Bryant & D. R. Anderson (Eds.), *Children's understandings of television: Research on attention and comprehension.* (pp. 103-123). New York: Academic Press.

Landers, S. J. (2004). Kids, TV a weighty blend of trouble. *American Medical News, 47*, 26-27.

Leal, O. F. (1990). Popular taste and erudite repertoire: The place and space of television in Brazil. *Cultural Studies, 4*, 19-29.

Lees, N. (2004). Nick Jr Australia to relaunch and up its preschool programming budget. *KidScreen*, 20.

Lesser, H. (1977). *Television and the preschool child*. New York: Academic Press.

Levin, S. R., & Anderson, D. R. (1976). The development of attention. *Journal of Communication, 26*, 126-135.

Lewis, A., Maras, P., & Simonds, L. (2000). Young school children working together: A measure of individualism/collectivism. *Child: Care, Health and Development, 26*, 229.

Loncar, T., Fairbrother, P., & Daiziel, J. (2005). *Digital Media in Australian Homes.* Sydney: Australian Communications and Media Authority.

Lorch, E. P., Anderson, D. R., & Levin, S. R. (1979). The relationship between visual attention and children's comprehension of television. *Child Development, 50*, 722-727.

Lorch, E. P., & Castle, V. J. (1997). Preschool children's attention to television: Visual attention and probe response times. *Journal of Experimental Child Psychology, 66*, 111-127.

Lull, J. (1980). Family communication patterns and the social uses of television. *Communication Research, 7*, 319-334.

Lumby, C., & Fine, D. (2006). *Why TV is good for kids.* Sydney: PanMacmillan.

MacBeth, T. M. (1996). Indirect effects of television: Creativity, persistence, school achievement, and participation in other activities. In T. M. MacBeth (Ed.), *Tuning in to young viewers: Social science perspectives on television.* (pp. 149-219). Thousand Oaks: Sage.

Maccoby, E. E. (1966). Sex differences in intellectual functioning. In E. E. Maccoby (Ed.), *The development of sex differences.* (pp. 25-55). Stanford, CA: Stanford University Press.

Maccoby, E. E. (1990). Gender and relationships: A developmental account. *American Psychologist, 45*, 513-520.

Maccoby, E. E., & Jacklin, C. N. (1974). *The psychology of sex differences*. Stanford, CA: Stanford University Press.

Maccoby, E. E., & Jacklin, C. N. (1987). Gender segregation in childhood. In H. W. Reese (Ed.), *Advances in child development and behavior* (pp. 239-288). New York: Academic Press.

Mander, J. (1978). *Four arguments for the elimination of television*. New York: Morrow.

Mares, M. (1996). *Positive effects of television on social behavior: A meta-analysis.* (No. 3): The Annenberg Public Policy Center of the University of Pennsylvania.

Miller, D. C., & Salkind, N. J. (2002). *Handbook of research design and social measurement* (6th ed.). Thousand Oaks, CA Sage.

Neilson. (1981). *Neilson Television Index: Child and teenage television viewing*. New York: Neilson Media Research.

Neville, L., Thomas, M., & Bauman, A. (2005). Food advertising on Australian television: The extent of children's exposure. *Health Promotion International., 20*(105-112).

Pediatric obesity: Kaiser Family Foundation releases report on role of media in childhood obesity. (2004). *Health & Medicine Week*.

Pingree, S. (1986). Children's activity and television comprehensibility. *Communication Research, 13*, 239-256.

Pinon, M. F., Huston, A. C., & Wright, J. C. (1989). Family ecology and child characteristics that predict young children's educational television viewing. *Child Development, 60*, 846-856.

Prior, M., Smart, D., Sanson, A., & Oberklaid, F. (1993). Sex differences in psychological adjustment from infancy to 8 years. *Journal of the American Academy of Child and Adolescent Psychiatry, 32*, 291-303.

Read, J. C., Kelly, S. R., & Birkett, S. (2006). How Satisfying is Gaze Tracking for Children? Retrieved 31 August 2006: www.amber-light.co.uk/CHI2006/gazeandkids_.pdf

Read, J. C., & MacFarlane, S. J. (2001). Expectations and endurability: Measuring fun. Retrieved 9 January, 2004: http://www.uclan.ac.uk/facs/destech/compute/staff/read/Publish/ChiCi/docs/Fun2001.pdf

Read, J. C., & MacFarlane, S. J. (2001). Measuring fun: Usability testing for children. Retrieved Spring: http://www.uclan.ac.uk/facs/destech/compute/staff/read/Publish/ChiCi/docs/FUN2000.pdf

Read, J. C., MacFarlane, S. J., & Casey, C. (2002). Endurability, engagement and expectations: Measuring children's fun. Retrieved 29 September, 2004:

REIWA. (2004). Median house price of established house sales in Perth. Retrieved 29th November, 2005: http://www.reiwa.com.au/res/res-salesgraph-display

Rice, M. L., Huston, A. C., Truglio, R., & Wright, J. C. (1990). Words from 'Sesame Street': Learning vocabulary while viewing. *Developmental Psychology, 26*, 421-428.

Robinson, T. N., Hammer, L. D., Killen, J. D., Kraemer, H. C., Wilson, D. M., Hayward, C., et al. (1993). Does television viewing increase obesity and reduce physical activity? Cross-sectional and longitudinal analyses among adolescent girls. *Pediatrics, 91*, 273-280.

Rolandelli, D. R., Wright, J. C., Huston, A. C., & Eakins, D. (1991). Children's auditory and visual processing of narrated and nonnaratted television programming. *Journal of Experimental Child Psychology, 51*, 90-122.

Ross, J. G., & Pate, R. R. (1987). The national children and youth fitness study II: A summary of findings. *Journal of Physical Education, Recreation and Dance, 1987*, 51-56.

Rothbart, M. (1989). Temperament and development. In G. A. Kohnstamm, J. E. Bates & M. K. Rothbart (Eds.), *Temperament in Childhood* (pp. 187-247). New York: John Wiley.

Salomon, G. (1977). Effects of encouraging Israeli mothers to co-observe 'Sesame Street' with their five-year-olds. *Child Development, 48*, 1146-1151.

Salomon, G. (1979). *Interaction of media, cognition, and learning: An exploration of how symbolic forms cultivate mental skills and affect knowledge acquisition.* San Francisco: Jossey-Bass Publishers.

Salomon, G. (1983). Television watching and mental effort: A social psychological view. In J. Bryant & D. R. Anderson (Eds.), *Children's understandings of television: Research on attention and comprehension.* (pp. 181-198). New York: Academic Press.

Salomon, G. (1984). Investing effort in television. In J. P. Murray & G. Salomon (Eds.), *The future of children's television.* (pp. 59-64). Boys Town, NE: Father Flanagan's Boys' Home.

Schmitt, K. L., Anderson, D. R., & Collins, P. A. (1999). Form and content: Looking at visual features of television. *Developmental Psychology, 35*, 1156-1167.

Shannon, B., Peacock, J., & Brown, M. J. (1991). Body fatness, television viewing and calorie intake of a sample of Pennsylvania sixth grade children. *Journal of Nutrition Education, 23*, 262-268.

Sharman, C., Cross, W., & Vennis, D. (2004). *Observing children: A practical guide* (3rd ed ed.). London: Continuum.

Singer, J. L. (1980). The power and limitations of television: A cognitive-affective analysis. In P. H. Tannenbaum & R. Abeles (Eds.), *The entertainment functions of television*. New Jersey: Erlbaum.

Smithson, M., & Verkuilen, J. (*in submission*). A Better Lemon-Squeezer? Maximum Likelihood Regression with Beta-Distributed Dependent Variables. *Psychological Methods*.

Srivastava, H. O. (2002). *Interactive TV: Technology and markets*. Boston: Artech House.

St. Peters, M., Fitch, M., Huston, A. C., Wright, J. C., & Eakins, D. J. (1991). Television and families: What do young children watch with their parents? *Child Development, 62*, 1409-1423.

Stifter, C. A., & Fox, N. A. (1986). Preschool children's ability to identify emotions. *Journal of Non-Verbal Behavior, 10*, 255-266.

Sulzer-Azaroff, B., & Maher, G. R. (1977). *Applying behavior-analysis procedures with children and youth.* New York: Holt, Rinehart and Winston.

Swann, P. (2000). *TV dot com: The future of interactive television*. New York: TV Books.

Taras, H. L., Sallis, J. F., Patterson, T. L., Nader, P. R., & Nelson, J. A. (1989). Television's influence on children's diet and physical activity. *Journal of Developmental and Behavioral Pediatrics, 10*, 176-180.

Truglio, R. T., Murphy, K. C., Oppenheimer, S., Huston, A. C., & Wright, J. C. (1996). Predictors of children's entertainment television viewing: Why are they tuning in? *Journal of Applied Developmental Psychology, 17*, 475-494.

Tucker, L. (1986). The relationship of television viewing to physical fitness and obesity. *Adolescence, 21*, 799-806.

TV-Watching By Young Children Linked To Later Attention Problems. (2004). *Child Health Alert,* pp. 1-3.

Van Evra, J. (2004). *Television and child development* (3rd ed.). New Jersey: Lawrence Erlbaum Associates.

Vgotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Ward, S., & Wackman, D. B. (1973). Children's information processing of television advertising. In P. Clarke (Ed.), *New models for mass communication research*. Beverly Hills, CA: Sage.

Wartella, E. (1979). The developmental perspective. In E. Wartella (Ed.), *Children communicating: Media and development of thought, speech, understanding* (Vol. 7, pp. 7-20). Beverly Hills: Sage.

Wartella, E., Lee, J. H., & Capolovitz, A. G. (2002, November 2002). Children and interactive media: Research compendium update. Retrieved November 6, 2005, from the Markle Foundation: http://www.markle.org/downloadable_assets/cimcomp_update.pdf

Wartella, E., O'Keefe, B., & Scantlin, R. (2000, May 2000). Children and interactive media: A compendium of current research and directions for the future. Retrieved November 6, 2005, from the Markle Foundation Website: http://www.markle.org/downloadable_assets/cimcompendium.pdf

Winn, M. (1977). *The plug-in drug*. New York: Viking Press.

Wong, D., & Baker, C. (1998). Pain in children: Comparison of assessment scales. *Pediatric Nursing, 14*, 9017.

Wong, D., & Baker, C. (2001). FACES pain rating scale. Retrieved 9 January, 2004: www3.us.elsevierhealth.com/WOW/faces.html

Wright, J. C., Huston, A. C., Ross, R. P., Calvert, S. L., Rolandelli, D., Weeks, L. A., et al. (1984). Pace and continuity of television programs: Effects on children's attention and comprehension. *Developmental Psychology, 20*, 653-666.

Wright, J. C., Huston, A. C., Scantlin, R., & Kotler, J. (2001). The Early Window Project: Sesame Street prepares children for school. In S. M. Fisch & R. Truglio (Eds.), *"G" is for growing: Thirty years of research on children and Sesame Street.* (pp. 97-114). Mahwah: Lawrence Erlbaum Associates.

Wright, J. C., St. Peters, M., & Huston, A. C. (1990). Family television use and its relation to children's cognitive skills and social behavior. In J. Bryant (Ed.), *Television and the American family*. Hillsdale, NJ: Lawrence Erlbaum Associates.

APPENDIX A: Information letter to school principals

interactive television research institute

Anna Hynd
Interactive Television Research Institute
Murdoch University
South Street, MURDOCH 6150
Phone: 0403 510 738
Email: a.hynd@murdoch.edu.au

Name of Principle
Name of School
Address
SUBURB

14th July, 2004

Dear ________,

I am writing to seek your participation in the project: **Enhancing the Content and Experience of Interactive Children's Television.**

The Interactive Television Research Institute (ITRI) at Murdoch University is investigating the use of interactive television by preschool children. Interactive television differs from regular television in that it allows the viewer to make choices that alter the content or experience of the program using the television remote control. In this way, interactive television allows the viewer to have a more engaging and participatory experience with the program than is possible with regular television. We anticipate that interactive television programs will stimulate greater enjoyment and comprehension of program content.

The project is funded for three years through an Australian Research Council Linkage Grant with the Australian Broadcasting Corporation, Nickelodeon, the Nine Network, and the Department of Education and Training, Western Australia as key industry partners.

We have developed several interactive versions of *Play School*, *Hi-5,* and *Dora the Explorer,* and are ready to evaluate them with kindergarten children. We will be seeking approval to evaluate the programs with children from Government, Catholic, and Independent schools.

With your approval, I would like to evaluate our interactive programs with kindergarten children from your school. Obviously, we will then seek permission from the parents of the kindergarten children.
We would like to have each child participate in one evaluation session, which will involve them viewing approximately 30 minutes of interactive television. The session will involve the observation of the child, to determine their level of attention, comprehension and enjoyment of the program. This evaluation would take place in our mobile laboratory which we would bring to your school. Overall, we anticipate that we would be at your school for less than one week, in term three.

Please find enclosed our approval letter from the Murdoch University Human Research Ethics Committee. We also have permission to approach you about this project from Pam Moss, Curriculum Director of the Western Australian Department of Education and Training, which is attached also.

The Interactive Television Research Institute will be donating a BenQ digital camera to schools participating in this project.

We are hoping to evaluate 300 kindergarten children from Government schools, and are approaching a number of schools in order to obtain this number. In the event that we obtain parental consent to evaluate more than 300 children, we may not need to conduct evaluations at all the schools we have approached. If this situation occurs, and you school is affected, we will contact you.

I would welcome any questions or the opportunity to discuss the project with you. Please don't hesitate to contact me as per the details at the top of this letter. Alternatively, I will contact you by telephone in the next week.

I look forward to discussing this with you further.

Yours sincerely,

Anna Hynd
encl.

APPENDIX B: Parent information letter and consent form

interactive television
research institute

Research Project: Enhancing the Content and Experience of Interactive Children's Television

Dear Parent,

The Interactive Television Research Institute (ITRI) at Murdoch University is carrying out a research project investigating the use of interactive television by preschool children. Interactive television differs from regular television in that it allows the viewer to make choices that alter the content or experience of the program using the television remote control. In this way, interactive television allows the viewer to have a more engaging and participatory experience with the program than is possible with regular television. We anticipate that interactive television programs will stimulate greater enjoyment and comprehension of program content.

This project is being funded by an Australian Research Council grant, and involves the collaboration of the ABC, the Nine Network, and Nickelodeon. With the help of these industry partners, ITRI has developed several interactive versions of *Play School*, *Hi-5,* and *Dora the Explorer.*

ITRI is now ready to evaluate these interactive programs with children. ITRI is seeking kindergarten-aged participants to take part in the study by viewing one 15-minute program version of *Play School, Hi-5,* or *Dora the Explorer.* The evaluation session will involve the observation of each participant's level of engagement, enjoyment, and visual attention while watching the program. After viewing the program, a short series of questions will be asked to assess the child's comprehension of the program content. Children will also be asked to indicate how much they enjoyed watching the program. It is anticipated that the evaluation session will take approximately 30 minutes to complete. Sessions may be video and/or audio taped to assist with data collection. These materials will be stored securely, in accordance with the relevant university protocol.

School Principal __________ has agreed for us to conduct evaluations at ____________. The evaluation sessions will take place in ITRI's mobile laboratory, which will be located at your child's school. All evaluation sessions will take place during regular school hours.

As a parent of a kindergarten child, you can help in this research by giving your formal agreement to your child participating in an evaluation session, and by completing the attached questionnaire. The consent form and questionnaire need to be returned to your child's teacher.

All information given by you or your child during any of the research procedures is confidential and no names (or other information which might identify you or your child) will be used in any report or publication arising from the research. Feedback about the results of this phase of the research will be provided to participants.

If you are willing for your child and yourself to participate in this research project, please complete the details on the attached sheet.

If you have any questions about this project please contact Prof. Duane Varan (First Chief Investigator for the project) on 9360 6035. Alternatively you can contact the Murdoch University's Human Research Ethics Committee on 93606677.

Yours sincerely,

Anna Hynd
Interactive Television Research Institute

Consent Form: Enhancing the Content and Experience of Interactive Children's Television

I have read the information on the attached sheet. Any questions I have asked have been answered to my satisfaction. I agree for my child to take part in this phase of the research project, however, I know that I may change my mind and stop at any time.

I understand that all information provided is treated as confidential and will not be released by the investigators unless required to do so by law. I understand that my child may be videotaped to assist with data collection.

I agree that research data gathered for this study may be published provided my name (and that of my child), or other information which might identify my child, or me is not used.

Child’s Name: ....………

Parent Name: ....……..

Parent Signature: ....……

Date: ....

APPENDIX C: Parent questionnaire

Dear Parent,

We would appreciate if you could complete the following questionnaire and return it to your child's teacher by ________________________.

Please provide the following information about your child:

1. Date of birth ____/____/____
2. Gender
   Male Female
3. Postcode _________
4. School your child attends ___________________________________
5. Does your child have any siblings living at home?
   No
   Yes

   If yes, please state the age and gender of each sibling

   Age _____ Gender _____
   Age _____ Gender _____
   Age _____ Gender _____
   Age _____ Gender _____
6. Which national culture does your family most identify with?
   Australian
   Other (please indicate) _____________________
7. Main language spoken at home
   English

   Other (please indicate) ____________________

8. Please estimate how many hours *per day* your child usually spends watching television

Monday to Friday

Less than 1 hour	1-2 hours	2-3 hours	3-4 hours
4-5 hours	5-6 hours	6-7 hours	8 hours or more

Saturday and Sunday

Less than 1 hour	1-2 hours	2-3 hours	3-4 hours
4-5 hours	5-6 hours	6-7 hours	8 hours or more

8. Has your child ever viewed the following programs?

Play School

No
Yes

If yes, how often does your child watch *Play School*?

Most weekdays
Once or twice a week
Every few weeks
Has only seen *Play School* once or twice

Hi-5

No
Yes

If yes, how often does your child watch *Hi-5*?

Most weekdays
Once or twice a week
Every few weeks
Has only seen *Hi-5* once or twice

<u>Dora the Explorer</u>

No

Yes

If yes, how often does your child watch *Dora the Explorer*?

Most weekdays
Once or twice a week
Every few weeks
Has only seen *Dora the Explorer* once or twice

<u>Blue's Clues</u>

No

Yes

If yes, how often does your child watch *Blue's Clues*?

Most weekdays

Once or twice a week

Every few weeks

Has only seen *Blue's Clues* once or twice

<u>Where's Boo?</u>

No

Yes

If yes, how often does your child watch *Where's Boo*?

Most weekdays

Once or twice a week

Every few weeks

Has only seen *Where's Boo*? once or twice

9. Does your child use the remote control when watching television?

Yes

No

Only when supervised

10. Please indicate which of the following devices your child uses:

- Computer games
- Video games
- VCR
- DVD player
- Game boy
- CD-ROMs

Thank you for completing this questionnaire.
Your time is greatly appreciated.

APPENDIX F: Comprehension questions

Date: Condition:	Did the child interact with prototype? Y N
Participant ID:	Comprehension score:

DORA THE EXPLORER RESPONSE SHEET

1. Who did you see on *Dora the Explorer* today? (After they point to each card) What's his/her name?

   Name Name Name

2. Dora and Boots put Benny in a wagon today. What can you tell me about the wagon?

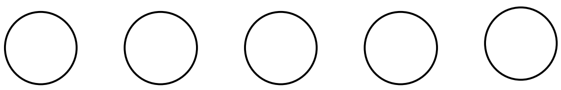
3. Can you tell me what did Swiper do today?

4. Something happened to Benny today; do you remember what happened to Benny?

5. Dora and Boots went to the Wizard's Castle today; can you tell me where they went on the way?

6. Did you use the remote control today? What did you do with it? How did you know to do that?

7. I've got some faces here to show you. These faces are people who have been watching *Dora the Explorer*. This person (point to face #5) thought that watching *Dora the Explorer* was really, really fun. But this person (point to face #1) thought that watching *Dora the Explorer* was really boring. This person (point to face #3) thought that watching *Dora the Explorer* was just ok. This person (point to face 4) thought that it was fun, but not as fun as this (point to face #5). And this person (point to face #2) thought that it was boring, but not as boring as this (point to face #1). So if you think about all those faces, which one is what you thought about watching *Dora the Explorer* today?"



5 4 3 2 1

Date: Condition:	Did the child interact with prototype? Y N
Participant ID:	Comprehension score:

HI-5 **RESPONSE SHEET**

1. Who did you see on *Hi-5* today? (After they point to each card)
   What's his/her name?

Name	Name	Name

2. What did Charli do today?

3. What did Nathan do today?

4. What did Tim do today?

5. Kathleen was cooking a pizza today. Can you tell me what the pizza was made of?

6. Did you use the remote control today? What did you do with it? How did you know to do that?

7. I've got some faces here to show you. These faces are people who have been watching *Hi-5*. This person (point to face #5) thought that watching *Hi-5* was really, really fun. But this person (point to face #1) thought that watching *Hi-5* was really boring. This person (point to face #3) thought that watching *Hi-5* was just ok. This person (point to face 4) thought that it was fun, but not as fun as this (point to face #5). And this person (point to face #2) thought that it was boring, but not as boring as this (point to face #1). So if you think about all those faces, which one is what you thought about watching *Hi-5* today?"

5 4 3 2 1

Date: Condition:	Did the child interact with prototype? Y N
Participant ID:	Comprehension score:

PLAY SCHOOL RESPONSE SHEET

1. Who did you see on *Play School* today? (After they point to each card) What's his/her name?

Name Name Name

2. There was a story on *Play School* today. What can you tell me about what happened in the story today?

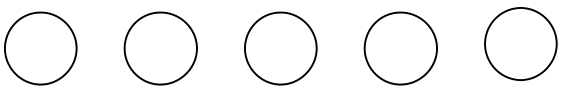
3. Justine was matching bags and people today; do you remember what people she was matching?

4. Someone in *Play School* was pretending to be a dog today; can you tell me what the dog did?

5. Andrew and Karen were diggers today; can you tell me what they were doing?

6. Did you use the remote control today? What did you do with it? How did you know to do that?

7. I've got some faces here to show you. These faces are people who have been watching *Play School*. This person (point to face #5) thought that watching *Play School* was really, really fun. But this person (point to face #1) thought that watching *Play School* was really boring. This person (point to face #3) thought that watching *Play School* was just ok. This person (point to face 4) thought that it was fun, but not as fun as this (point to face #5). And this person (point to face #2) thought that it was boring, but not as boring as this (point to face #1). So if you think about all those faces, which one is what you thought about watching *Play School* today?"



5 4 3 2 1

APPENDIX G: Criteria used to score responses to comprehension questions.

Dora the Explorer comprehension questions

1. Who did you see on *Dora the Explorer* today? (After they point to each card) What's his/her name?
    - One point for pointing to each of the three correct responses; Dora, Benny and Swiper
    - One point for naming each of the characters; Dora, Benny and Swiper
    - Maximum score six points

2. Dora and Boots put Benny in a wagon today. What can you tell me about the wagon?
    - One point each for any of the following responses:
        - Wagon colour (red, yellow, or blue depending on condition)
        - Other physical descriptions of wagon such as wheels, handle, shiny etc
        - Wagon used to carry Benny
        - Pulled by Dora
    - Maximum score four points

3. Can you tell me what did Swiper do today?
    - One point each for any of the following responses:
        - Hid in the bushes
        - Sneaks up on Dora/Boots/Benny
        - Said "Oh man"
        - Steals things/tries to steal things/stole Benny
        - Threw Benny in the bushes
        - Ran away
    - Maximum score four points

4. Something happened to Benny today; do you remember what happened to Benny?
    - One point each for any of the following responses:
        - Found a magic wand
        - Turned into a potato
        - Rode in the wagon
        - Was thrown into the bush
        - Went to Wizard's Castle
        - Turned back into a bull
        - Rode on unicorn
        - Went in the giant flowers
        - Went past the sleeping dragon
    - Maximum score four points

5. Dora and Boots went to the Wizard's Castle today; do you remember where they went on the way?
   - One point each for any of the following responses:
     - To the giant flowers/giant flowers
     - Past the sleeping dragon
     - To the golden gate
     - Checked the map
     - Rode on unicorn
     - Walked on a path/through the jungle
   - Maximum score four points

6. Did you use the remote control today? What did you do with it? How did you know to do that?
   - 1 point for correctly saying yes (for interacting participants) or no (for non-interacting and control participants)
   - 1 point for identifying the coloured button pressed (eg. yellow)
   - 1 point for providing detail about the choice made (eg. the sleeping dragon)
   - Maximum score three points

Total points for *Dora the Explorer* comprehension questions = 25 points

Hi-5 comprehension questions

1. Who did you see on *Hi-5* today? (After they point to each card) What's his/her name?
    - One point for pointing to each of the three correct responses; Charli, Nathan and Tim
    - One point for naming each of the characters; Charli, Nathan and Tim
    - Maximum score six points

2. What did Charli do today?
    - One point each for any of the following responses:
        - Sung a song/sung to teddy
        - Played a guitar
        - Rocked/held her teddy
        - Put teddy to bed
        - Woke up teddy
        - Sung song again
        - Danced
    - Maximum score four points

3. What did Nathan do today?
    - One point each for any of the following responses:
        - Had a banana
        - Had a coconut
        - Tried to open the coconut
        - Watched monkey open coconut
        - Watched monkey steal banana
        - Chased monkey
        - Danced
        - Sung a song
    - Maximum score four points

4. What did Tim do today?
    - One point each for any of the following responses:
        - Went camping
        - Put up a tent/hammered tent pegs
        - Sung a song
        - Watched/heard birds
        - Drove in the car
        - Left because it was noisy
        - Talked on the phone
    - Maximum score four points

5. Kathleen was cooking a pizza today. Can you tell me what the pizza was made of?
    - One point each for any of the following responses:
        - Dough
        - Sauce
        - Zucchini
        - Cheese/bocconcini/mozzarella
        - Salami/meat

- Maximum score four points

6. Did you use the remote control today? What did you do with it? How did you know to do that?
    - 1 point for correctly saying yes (for interacting participants) or no (for non-interacting and control participants)
    - 1 point for identifying the coloured button pressed (eg. yellow)
    - 1 point for providing detail about the choice made (eg. Tim)
    - Maximum score three points

Total points for *Hi-5* comprehension questions = 25 points

Play School comprehension questions

1. Who did you see on *Play School* today? (After they point to each card) What's his/her name?
    - One point for pointing to each of the three correct responses; Andrew, Karen and Justine
    - One point for naming each of the characters; Andrew, Karen and Justine
    - Maximum score six points

2. There was a story on *Play School* today. What can you tell me about what happened in the story today?
    - One point each for any of the following responses:
        - Story about a dog
        - Dog called Chelsea
        - Andrew told the story
        - Andrew asked Chelsea to fetch paper
        - Andrew asked Chelsea to fetch clothes
        - Chelsea went home
        - A woman took Chelsea home
        - Story about cats
        - Three little kittens
        - Andrew and Karen sung song
        - Kittens lost their mittens
        - Asked the other animals if they had found the mittens
        - Found their mittens
        - Went home for some pie
    - Maximum score four points

3. Justine was matching bags and people today; do you remember what people she was matching?
    - One point each for any of the following responses:
        - Pilot or travel bag
        - Cook/chef or icing bag
        - Surfer or beach bag
        - Builder/workman or tool bag
    - Maximum score four points

4. Someone in *Play School* was pretending to be a dog today; can you tell me what the dog did?
    - One point each for any of the following responses:
        - Andrew pretended to be a dog
        - Andrew wore ears and a tail
        - Andrew sat up/lay down/barked
        - Andrew mixed up the second verse/behaved like a cat
        - Karen pretended to be a dog
        - Karen sung a song
        - Karen barked/scratched
    - Was mixed-up for the second verse

5. Andrew and Karen were diggers today; do you remember what they were doing?
    - One point each for any of the following responses:
        - Did actions like a digger
        - Made holes in the garden
        - Made sounds like a digger
        - Sung a song
    - Maximum score four points

6. Did you use the remote control today? What did you do with it? How did you know to do that?
    - 1 point for correctly saying yes (for interacting participants) or no (for non-interacting and control participants)
    - 1 point for identifying the coloured button pressed (eg. red)
    - 1 point for providing detail about the choice made (eg. dog story)
    - Maximum score three points

Total points for *Play School* comprehension questions = 25 points

Appendix H: Partial interval recording sheet

Participant ID:

Verbal **1** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **2** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **3** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **4** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **5** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **6** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **7** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **8** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing
Verbal **9** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **10** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **11** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **12** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **13** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **14** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **15** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **16** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing
Verbal **17** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **18** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **19** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **20** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **21** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **22** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **23** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **24** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing
Verbal **25** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **26** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **27** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **28** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **29** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **30** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **31** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **32** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing

Verbal **33** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **34** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **35** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **36** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **37** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **38** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **39** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **40** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing
Verbal **41** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **42** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **43** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **44** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **45** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **46** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **47** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing	Verbal **48** Answers Repeating Instructions Comments Nonverbal Answers Imitations Enjoyment Smiling Laughing

Number of prototype: ___________
Total number of intervals containing:

Verbal Answers	_________	Nonverbal Answers	_________
Repeats	_________	Imitations	_________
Instructions	_________	Total	_________
Comments	_________		
Total	_________	Enjoyment Smiling	_________
		Laughter	_________
		Total	_________

APPENDIX I: Analysis of verbal engagement data

Table 1: Verbal engagement during *Dora the Explorer* Character Assistance.
Kruskal-Wallis tests comparing verbal engagement for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Character Assistance. Verbal engagement is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Verbal engagement is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Character Assistance**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
During the interactive segments											
42	14.29	42.40	32	7.81	38.09	5	0.00	32.00	2.653	2	.265
After the interactive segments											
42	8.18	40.75	32	7.88	39.78	5	6.09	35.10	.310	2	.857
Whole prototypes											
42	6.54	39.33	32	8.18	42.03	5	4.26	32.60	.876	2	.645

Table 2: Verbal engagement during *Dora the Explorer* Minor Narrative Choice.
Kruskal-Wallis tests comparing verbal engagement for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Minor Narrative Choice. Verbal engagement is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Verbal engagement is compared for the period of the prototype during the interactive segment, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Minor Narrative Choice**									Chi-square	*df*	*Sig.*
			Interacted – Blue Wagon			**Interacted – Yellow Wagon**			**Did not interact- Default to Blue Wagon**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	5.95	42.93	16	6.25	41.72	9	5.56	43.50	16	0.00	39.00	1.723	3	.632
After the interactive segments														
42	8.67	44.80	16	9.50	46.91	9	8.89	42.89	16	3.00	29.25	6.594	3	.086
Whole prototypes														
42	6.54	44.46	16	7.84	45.94	9	7.28	47.33	16	1.97	28.59	6.930	3	.074

Table 3: Verbal engagement during *Dora the Explorer* Major Narrative Choice.
Kruskal-Wallis tests comparing verbal engagement for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Major Narrative Choice. Verbal engagement is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Verbal engagement is compared for the period of the prototype during the interactive segment, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Major Narrative Choice**											
			Interacted – Giant flowers			**Interacted – Dragon**			**Did not interact- Default to Dragon**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	10.20	44.62	17	12.61	46.15	9	8.33	44.33	16	2.34	32.03	4.874	3	.181
After the interactive segments														
42	6.80	45.48	17	5.88	42.00	9	7.69	52.78	16	0.48	29.44	9.148	3	.027
Whole prototypes														
42	6.54	45.25	17	7.14	45.79	9	5.22	45.22	16	2.32	30.25	5.502	3	.139

Table 4: Wilcoxon Signed Ranks tests comparing verbal engagement for participants who repeated the song during *Hi-5* Segment Repetition for the first and second viewings.

First viewing			**Second viewing**			*Z*	*Sig.*
Mean	Mean Rank	Sum of ranks	Mean	Mean Rank	Sum of Ranks		
1.72	2.50	5.00	0.69	1.00	1.00	-1.089	.276

Table 5: Verbal engagement during *Hi-5* Segment Repetition.
Kruskal-Wallis tests comparing verbal engagement for participants viewing *Hi-5* Control with those who did and did not interact with *Hi-5* Segment Repetition. Verbal engagement is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Verbal engagement is compared for the period of the prototype after the interactive segments, and for the whole prototypes.

***Hi-5* Control**			***Hi-5* Segment Repetition**								
			Repeated			**Did not repeat**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
After the interactive segments											
44	1.22	44.85	28	0.27	41.48	13	0.00	40.00	2.769	2	.250
Whole prototypes											
44	0.77	41.90	28	0.90	45.41	13	0.56	41.54	.861	2	.650

Table 6: Verbal engagement during *Hi-5* Character Choice.
In *Hi-5* Presenter Choice, participants were able to select the Nathan or Tim segment. Mann-Whitney U tests were used to compare the verbal engagement of participants who interacted by selecting Nathan with that of participants viewing the Nathan segment in *Hi-5* Control. Kruskal-Wallis tests were used to compare the verbal engagement of participants who interacted by selecting Tim with those of participants who did not interact (and therefore defaulted to the Tim segment) and those who viewed the Tim segment in *Hi-5* Control. Verbal engagement, is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Verbal engagement is compared for the interactive segments, the period of the prototype after the interactive segments, and for the whole prototypes.

***Hi-5* Control – Nathan segment**			***Hi-5* Presenter Choice**						Mann-Whitney U	*Z*	*Sig.*
			Interacted – Nathan segment			**Did not interact**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
44	.032	27.11	11	6.49	31.55	N/A			203.00	-2.085	.037
After the interactive segments											
44	0.86	26.84	11	7.69	32.64	N/A			191.00	-1.983	.047
Whole prototypes											
44	0.77	27.72	11	5.22	29.14	N/A			229.50	-.908	.683
***Hi-5* Control – Tim segment**			***Hi-5* Presenter Choice**						Chi-square	*df*	*Sig.*
			Interacted – Tim segment			**Did not interact – Defaulted to Tim segment**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
44	.057	35.95	16	1.56	38.22	13	1.28	39.04	1.074	2	.585
After the interactive segments											
44	.086	35.59	16	1.92	39.81	13	1.18	38.31	1.785	2	.410
Whole prototypes											
44	35.27	.077	16	1.76	40.00	13	1.10	39.31	1.488	2	.475

Table 7: Verbal engagement during *Hi-5* Collecting Cards.
Kruskal-Wallis tests comparing verbal engagement for participants viewing *Hi-5* Control with those who did and did not interact with *Hi-5* Collecting Cards. Verbal engagement is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Nonverbal engagement is compared for the whole prototypes.

***Hi-5* Control**			***Hi-5* Collecting Cards**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Whole prototypes											
44	.77	38.33	28	4.34	50.79	14	1.07	45.18	6.936	2	.031

Table 8: Wilcoxon Signed Ranks tests comparing verbal engagement for participants who repeated the song during *Play School* Theme Repetition for the first and second viewings.							
First viewing			Second viewing			*Z*	*Sig.*
Mean	Mean Rank	Sum of ranks	Mean	Mean Rank	Sum of Ranks		
1.22	2.00	2.00	0.41	1.00	1.00	-.447	.655

Table 9: Verbal engagement during *Play School* Theme Repetition.
A Kruskal-Wallis test compared verbal engagement for participants viewing *Play School* Control with those who did and did not interact with *Play School* Theme Repetition. Verbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Verbal engagement is compared for the whole prototypes.

***Play School* Control**			***Play School* Segment Repetition**								
			Repeated			**Did not repeat**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Whole prototypes											
42	2.27	51.57	43	.85	41.88	6	0.00	36.50	7.311	2	.026

Table 10: Verbal engagement during *Play School* Story Choice.
Kruskal-Wallis tests comparing verbal engagement for participants viewing *Play School* Control with those who did and did not interact with *Play School* Story Choice. Verbal engagement is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Verbal engagement is compared for the period of the prototype during the interactive segment, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Story Choice**											
			Interacted – Dog story			**Interacted – Cat story**			**Did not interact- Default to Dog story**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	0.99	39.57	15	0.00	36.00	8	3.75	41.00	11	0.00	36.00	2.896	3	.408
After the interactive segments														
42	3.85	36.69	15	0.51	32.23	8	4.17	43.13	11	2.10	39.14	3.181	3	.364
Whole prototypes														
42	2.27	39.60	15	0.93	33.67	8	5.10	47.88	11	0.79	34.09	3.977	3	.264

Table 11: Verbal engagement during *Play School* Task Participation.
Kruskal-Wallis tests comparing verbal engagement for participants viewing *Play School* Control with those who did and did not interact with *Play School* Task Participation. Verbal engagement is reported as a percentage of prototype intervals where verbal engagement enjoyment behaviours were observed. Verbal engagement is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Task Participation**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
During the interactive segments											
42	3.90	45.26	38	1.91	41.42	5	0.00	36.00	2.186	2	.335
After the interactive segments											
42	1.79	43.54	38	0.66	42.61	5	0.00	41.50	.469	2	.791
Whole prototypes											
42	1.90	44.21	38	2.27	43.43	5	0.00	29.50	2.359	2	.307

APPENDIX J: Analysis of nonverbal engagement data

Table 12: Nonverbal engagement during *Dora the Explorer* Character Assistance.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Character Assistance. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Nonverbal engagement is compared for the period of the prototype during the interactive segment, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Character Assistance**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
During the interactive segments											
42	9.52	40.02	32	10.94	41.14	5	0.00	32.50	1.328	2	.515
After the interactive segments											
42	2.48	42.33	32	1.49	38.66	5	0.00	29.00	2.741	2	.254
Whole prototypes											
42	3.41	39.81	32	3.48	41.20	5	1.42	33.90	.511	2	.775

Table 13: Nonverbal engagement during *Dora the Explorer* Minor Narrative Choice.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Minor Narrative Choice. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Nonverbal engagement is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Minor Narrative Choice**									Chi-square	*df*	*Sig.*
			Interacted – Blue Wagon			**Interacted – Yellow Wagon**			**Did not interact- Default to Blue Wagon**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	4.76	41.95	16	0.00	38.00	9	5.56	42.61	16	9.38	45.78	3.216	3	.360
After the interactive segments														
42	2.86	40.35	16	2.75	40.34	9	5.78	50.56	16	3.25	43.19	1.815	3	.612
Whole prototypes														
42	6.54	41.51	16	7.84	40.97	9	7.28	51.72	16	1.97	38.84	2.074	3	.557

Table 14: Nonverbal engagement during *Dora the Explorer* Major Narrative Choice.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Major Narrative Choice. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Nonverbal engagement is compared for the period of the prototype during the interactive segment, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Major Narrative Choice**									Chi-square	*df*	*Sig.*
			Interacted – Giant flowers			**Interacted – Dragon**			**Did not interact- Default to Dragon**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	0.68	39.10	17	2.52	45.76	9	1.39	42.44	16	3.13	48.00	6.723	3	.081
After the interactive segments														
42	2.21	42.55	17	1.26	39.71	9	19.66	49.28	16	1.44	41.53	1.765	3	.623
Whole prototypes														
42	3.41	42.83	17	2.52	42.09	9	3.92	49.72	16	2.12	38.00	1.510	3	.680

Table 15: Wilcoxon Signed Ranks tests comparing nonverbal engagement for participants who repeated the song during *Hi-5* Segment Repetition for the first and second viewings.

First viewing			**Second viewing**			*Z*	*Sig.*
Mean	Mean Rank	Sum of ranks	Mean	Mean Rank	Sum of Ranks		
0.86	7.00	7.00	4.18	3.50	21.00	-.1265	.206

Table 16: Nonverbal engagement during *Hi-5 Segment* Repetition.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Hi-5* Control with those who did and did not interact with *Hi-5* Segment Repetition. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Nonverbal engagement is compared for the period of the prototype after the interactive segments, and for the whole prototypes.

***Hi-5* Control**			***Hi-5* Segment Repetition**						Chi-square	*df*	*Sig.*
			Repeated			**Did not repeat**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
After the interactive segments											
44	0.52	43.90	28	0.27	42.52	13	0.00	41.00	1.146	2	.564
Whole prototypes											
44	0.17	39.83	28	0.79	49.09	13	0.36	40.62	6.964	2	.031

Table 17: Nonverbal engagement during *Hi-5 Segment* Repetition.
In *Hi-5* Presenter Choice, participants were able to select the Nathan or Tim segment. Mann-Whitney U tests were used to compare the nonverbal engagement of participants who interacted by selecting Nathan with that of participants viewing the Nathan segment in *Hi-5* Control. Kruskal-Wallis tests were used to compare the nonverbal engagement of participants who interacted by selecting Tim with those of participants who did not interact (and therefore defaulted to the Tim segment) and those who viewed the Tim segment in *Hi-5* Control. Nonverbal engagement is reported as a percentage of prototype intervals where verbal engagement behaviours were observed. Nonverbal engagement is compared for the interactive segments, the period of the prototype after the interactive segments, and for the whole prototypes.

***Hi-5* Control – Nathan segment**			***Hi-5* Presenter Choice**						Mann-Whitney U	*Z*	*Sig.*
			Interacted – Nathan segment			**Did not interact**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
44	0.00	28.00	11	0.00	28.00	N/A			242.00	.000	1.00
After the interactive segments											
44	0.18	27.64	11	0.70	29.45	N/A			226.00	-1.038	.299
Whole prototypes											
44	0.17	27.84	11	0.43	28.64	N/A			235.00	-.327	.744

***Hi-5* Control – Tim segment**			***Hi-5* Presenter Choice**						Chi-square	*df*	*Sig.*
			Interacted – Tim segment			**Did not interact – Defaulted to Tim segment**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
44	0.00	36.50	16	0.00	36.50	13	0.64	39.31	4.615	2	.099
After the interactive segments											
44	0.18	37.33	16	0.00	36.50	13	0.00	36.50	.659	2	.719
Whole prototypes											
44	35.55	0.17	16	0.45	39.88	13	.036	38.38	1.891	2	.389

Table 18: Nonverbal engagement during *Hi-5* Collecting Cards.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Hi-5* Control with those who did and did not interact with *Hi-5* Collecting Cards. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Nonverbal engagement is compared for the whole prototypes.

***Hi-5* Control**			***Hi-5* Collecting Cards**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Whole prototypes											
44	1.67	42.99	28	0.26	44.63	14	0.17	42.86	.376	2	.829

Table 19: Wilcoxon Signed Ranks tests comparing nonverbal engagement for participants who repeated the song during *Play School* Theme Repetition for the first and second viewings.

First viewing			**Second viewing**			*Z*	*Sig.*
Mean	Mean Rank	Sum of ranks	Mean	Mean Rank	Sum of Ranks		
1.22	3.00	6.00	2.44	3.75	15.00	-.954	.340

Table 20: Nonverbal engagement during *Play School* Theme Repetition.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Play School* Control with those who did and did not interact with *Play School* Theme Repetition. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Nonverbal engagement is compared for the whole prototypes.

***Play School* Control**			***Play School* Segment Repetition**						Chi-square	*df*	*Sig.*
			Repeated			**Did not repeat**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Whole prototypes											
42	0.78	44.35	43	1.19	47.86	6	1.08	44.25	.743	2	.690

Table 21: Nonverbal engagement during *Play School* Story Choice.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Play School* Control with those who did and did not interact with *Play School* Story Choice. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement behaviours were observed. Nonverbal engagement is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Story Choice**									Chi-square	*df*	*Sig.*
			Interacted – Dog story			**Interacted – Cat story**			**Did not interact- Default to Dog story**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	0.20	35.88	15	.006	35.00	8	2.50	45.13	11	3.03	48.45	15.604	3	.001
After the interactive segments														
42	1.83	37.92	15	1.54	35.10	8	3.33	45.00	11	2.80	40.64	2.138	3	.544
Whole prototypes														
42	0.78	36.11	15	0.76	34.90	8	2.31	49.13	11	2.10	44.82	5.870	3	.118

Table 22: Nonverbal engagement during *Play School* Task Participation.
Kruskal-Wallis tests comparing nonverbal engagement for participants viewing *Play School* Control with those who did and did not interact with *Play School* Task Participation. Nonverbal engagement is reported as a percentage of prototype intervals where nonverbal engagement enjoyment behaviours were observed. Nonverbal engagement is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Task Participation**								
			Interacted			**Did not interact**			Chi-square	*df*	*Sig.*
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
During the interactive segments											
42	2.16	40.71	38	3.83	43.86	5	5.45	55.70	2.951	2	.229
After the interactive segments											
42	0.00	42.00	38	1.32	44.24	5	0.00	42.00	2.503	2	.286
Whole prototypes											
42	0.78	40.58	38	1.71	44.92	5	2.13	48.70	1.470	2	.479

APPENDIX K: Analysis of observed enjoyment data

Table 23: Observed enjoyment during *Dora the Explorer* Character Assistance.
Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Character Assistance. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Character Assistance**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
During the interactive segments											
42	10.71	40.99	32	9.38	39.72	5	0.00	33.50	1.168	2	.558
After the interactive segments											
42	3.00	38.27	32	4.35	42.25	5	2.61	40.10	.724	2	.696
Whole prototypes											
42	4.93	40.17	32	5.93	40.80	5	3.73	33.50	.481	2	.786

Table 24: Observed enjoyment during *Dora the Explorer* Minor Narrative Choice.
Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Minor Narrative Choice. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Minor Narrative Choice**									Chi-square	*df*	*Sig.*
			Interacted – Blue Wagon			**Interacted – Yellow Wagon**			**Did not interact- Default to Blue Wagon**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	4.76	43.45	16	0.00	39.50	9	5.56	44.11	16	0.00	39.50	3.331	3	.343
After the interactive segments														
42	3.90	41.79	16	5.00	44.88	9	7.11	56.17	16	1.50	31.72	8.198	3	.042
Whole prototypes														
42	4.93	45.13	16	4.99	42.03	9	7.58	51.50	16	1.86	28.41	8.363	3	.039

Table 25: Observed enjoyment during *Dora the Explorer* Major Narrative Choice.
Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Dora the Explorer* Control with those who did and did not interact with *Dora the Explorer* Major Narrative Choice. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the period of the prototype during the interactive segments, after the interactive segments, and for the whole prototypes.

***Dora the Explorer* Control**			***Dora the Explorer* Major Narrative Choice**									Chi-square	*df*	*Sig.*
			Interacted – Giant flowers			**Interacted – Dragon**			**Did not interact- Default to Dragon**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank			
During the interactive segments														
42	1.70	38.12	17	6.73	51.18	9	5.56	48.56	16	3.91	41.38	7.664	3	.054
After the interactive segments														
42	3.23	42.21	17	2.94	43.65	9	3.42	46.67	16	1.44	39.69	.899	3	.826
Whole prototypes														
42	4.93	44.40	17	4.77	44.53	9	4.95	46.17	16	2.74	33.28	3.110	3	.375

Table 26: Wilcoxon Signed Ranks tests comparing observed enjoyment for participants who repeated the song during *Hi-5* Segment Repetition for the first and second viewings.

First viewing			**Second viewing**			*Z*	*Sig.*
Mean	Mean Rank	Sum of ranks	Mean	Mean Rank	Sum of Ranks		
4.31	5.40	27.00	4.14	4.50	18.00	-.540	.589

Table 27: Observed enjoyment during *Hi-5 Segment* Repetition.
Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Hi-5* Control with those who did and did not interact with *Hi-5* Segment Repetition. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the period of the prototype after the interactive segments, and for the whole prototypes.

***Hi-5* Control**			***Hi-5* Segment Repetition**						Chi-square	*df*	*Sig.*
			Repeated			**Did not repeat**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
After the interactive segments											
44	2.10	41.00	28	4.40	47.27	13	2.37	40.58	2.362	2	.307
Whole prototypes											
44	4.60	41.17	28	3.30	44.09	13	4.11	46.85	.689	2	.708

Table 28: Observed enjoyment during *Hi-5 Segment* Repetition.
In *Hi-5* Presenter Choice, participants were able to select the Nathan or Tim segment. Mann-Whitney U tests were used to compare the observed enjoyment of participants who interacted by selecting Nathan with that of participants viewing the Nathan segment in *Hi-5* Control. Kruskal-Wallis tests were used to compare the observed enjoyment of participants who interacted by selecting Tim with those of participants who did not interact (and therefore defaulted to the Tim segment) and those who viewed the Tim segment in *Hi-5* Control. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the interactive segments, the period of the prototype after the interactive segments, and for the whole prototypes.

***Hi-5* Control – Nathan segment**			***Hi-5* Presenter Choice**						Mann-Whitney U	*Z*	*Sig.*
			Interacted – Nathan segment			**Did not interact**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
44	3.90	26.36	11	11.69	34.55	N/A			170.00	-.2101	.036
After the interactive segments											
44	1.41	26.61	11	5.59	33.55	N/A			181.00	-1.909	.056
Whole prototypes											
44	4.60	27.63	11	5.25	29.50	N/A			225.50	-.379	.704
***Hi-5* Control – Tim segment**			***Hi-5* Presenter Choice**						Chi-square	*df*	*Sig.*
			Interacted – Tim segment			**Did not interact – Defaulted to Tim segment**					
N	Mean	Mean Rank	*N*	Mean	Mean Rank	*N*	Mean	Mean Rank			
During the interactive segments											
44	3.41	34.81	16	5.73	40.38	13	7.05	40.27	2.164	2	.339
After the interactive segments											
44	1.41	33.82	16	4.81	39.97	13	4.14	44.12	5.053	2	.080
Whole prototypes											
44	35.63	4.60	16	5.16	35.97	13	6.09	42.92	1.421	2	.491

Table 29: Observed enjoyment during *Hi-5* Collecting Cards.
Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Hi-5* Control with those who did and did not interact with *Hi-5* Collecting Cards. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the whole prototypes.

***Hi-5* Control**			***Hi-5* Collecting Cards**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
Whole prototypes											
44	4.60	38.45	28	8.85	51.57	14	6.24	43.21	5.253	2	.072

Table 30: Wilcoxon Signed Ranks tests comparing observed enjoyment for participants who repeated the song during *Play School* Theme Repetition for the first and second viewings.

First viewing			Second viewing				
Mean	Mean Rank	Sum of ranks	Mean	Mean Rank	Sum of Ranks	*Z*	*Sig.*
11.59	9.81	127.50	2.85	2.83	8.50	-3.142	.002

Table 31: Observed enjoyment during *Play School* Theme Repetition. Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Play School* Control with those who did and did not interact with *Play School* Theme Repetition. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the whole prototypes.

***Play School* Control**			***Play School* Segment Repetition**								
			Repeated			**Did not repeat**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	Chi-square	*df*	*Sig.*
Whole prototypes											
42	5.85	43.73	43	7.11	49.36	6	3.11	37.83	1.686	2	.430

Table 32: Observed enjoyment during *Play School* Story Choice.
Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Play School* Control with those who did and did not interact with *Play School* Story Choice. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the period of the prototype during the interactive segment, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Story Choice**											
			Interacted – Dog story			**Interacted – Cat story**			**Did not interact-Default to Dog story**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank	N	Mean	Mean rank	Chi-square	*df*	*Sig.*
During the interactive segments														
42	2.60	38.17	15	1.67	37.00	8	1.67	46.00	11	1.52	36.36	2.087	3	.554
After the interactive segments														
42	4.95	39.31	15	1.54	33.00	8	5.00	40.06	11	6.99	41.77	1.875	3	.599
Whole prototypes														
42	5.85	39.14	15	4.30	36.17	8	6.26	39.75	11	6.39	38.32	.254	3	.968

Table 33: Observed enjoyment during *Play School* Task Participation.
Kruskal-Wallis tests comparing observed enjoyment for participants viewing *Play School* Control with those who did and did not interact with *Play School* Task Participation. Observed enjoyment is reported as a percentage of prototype intervals where enjoyment behaviours were observed. Observed enjoyment is compared for the period of the prototype during the interactive segment, after the interactive segments, and for the whole prototypes.

***Play School* Control**			***Play School* Task Participation**						Chi-square	*df*	*Sig.*
			Interacted			**Did not interact**					
N	Mean	Mean rank	*N*	Mean	Mean rank	*N*	Mean	Mean rank			
During the interactive segments											
42	4.54	42.95	38	4.78	42.59	5	5.45	46.50	.168	2	.919
After the interactive segments											
42	4.17	44.02	38	1.32	41.18	5	20.00	48.20	1.950	2	.377
Whole prototypes											
42	5.85	43.18	38	5.29	42.68	5	7.72	43.90	.016	2	.992