Toddler Techies: A Study of Young Children’s Interaction with Computers

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This article describes an ethnographic study of children’s behavioural interaction with multimedia within a familiar context. The rationale for such a study was to provide data and evaluation of the capabilities of young children in an expressly modified multimedia environment and to determine the usefulness of employing technology as an adjunct to young children’s play. However, hermeneutic and interpretivist concerns for the study of human action and social practice in the use of technology also informs both the structural, procedural, and evaluative management of the study. Using customised children’s software, observation focused on time spent using the computer, the attitude toward the computer, the reaction to the interface, their use and adaptation of the mouse, and adult interventions. Significantly, the results differ appreciably from previous research and possible grounds for this variation is explored.

THE TELEVISION METAPHOR (TVM) SOFTWARE

TVM was designed specifically for two and three year old children (Ellis, 2002) in response to the dearth of appropriate multimedia applications for very young children. The program is comprised of nine activities, each
designed to incrementally introduce various computing skills, intensifying in
complexity and each carefully considered for its age-appropriate skill level
and familiarity to the child user. As the product was custom designed and
implemented, a number of features were included specifically to assist in re-
search such as timers and log files of the user’s actions. A systemic meta-
phor exploiting the familiarity of the user group with television was em-
ployed, incorporating nine channels, a volume control facility and a power
switch. A “teddy” was also included on the lower right hand side to provide
assistance to the child user. TVM as an exemplar of interfaces for two- and
three-year old children, it was designed to meet the needs of this unique au-
dience (Ellis & Blashki, 2003) (Figure 1).

![Figure 1. A screen shot of the TVM Colouring book](image)

**Description of the Range of Activities Offered**

The following describes the interfaces with which the child interacts
while using TVM. Each activity was purposefully selected from a range of
familiar nondigital play environments, in which a young child would have
transferable and experiential knowledge.

**Balloon popping.** A screen is offered to the user covered with balloons.
Simple movement of the mouse over a balloon causes it to pop. The action
of popping the balloons reveals the outline of a picture. When all balloons
are popped the picture is coloured and provides movement. This activity in-
troduces children to manipulation of a mouse without the need to depress the
mouse button. Using a drill-style of learning this activity also introduces the child to interaction with a computer.

**Peekaboo.** The screen depicts a beach scene. Meaningful movement of the mouse over objects in the picture causes the creatures hiding within to respond, popping out and saying “peekaboo.” This activity extends the child’s skills in manipulation of the mouse and reinforces cause and effect.

**Old Mac Donald.** A screen displaying a series of farm animals is accompanied with the vocals and music of “Old Mac Donald had a farm.” Clicking on any one of the farm animals causes it to be the focus of the song. The child user learns to control this activity using a simple single mouse click on a large area.

**Felt pictures.** “Felt shapes” are located around the perimeter of a felt board. Clicking on a piece of felt picks it up enabling the user to move it with the mouse, clicking again deposits the felt wherever the cursor is placed. In this way a picture is created. This activity introduces mouse skills and encourages creativity.

**Sing along.** This activity displays video footage of a person singing a number of songs with actions. The child user is actively encouraged to sing along and to copy the actions. Tangible interaction with the computer and the virtual presenter is expected which will engage and stimulate the child intellectually, emotionally, and physically. This activity was also designed to provide physical activity that will alleviate any tension created from the concentration required while engaged in other activities.

**Colouring book.** The colouring book provides the child user with a variety of drawings. Clicking the mouse on a small image enables the enlargement of that image to the screen size. The user then colours the pictures by clicking on a colour and then clicking on an area in the picture. Single mouse clicks further enable the child to express their creativity.

**Three-part book.** A book divided into three parts is displayed, with text on one side and a corresponding image on the other. Each of the three sections of the book has both a backward and forward function. Once pages have been “turned” by the child user, the three parts do not necessarily correspond. Clicking on the “lips” enables the text to be read out aloud with each section changing colour as it is read. Thus the child user creates their own “stories” by using different combinations of pictures.
**Ball sort.** Four boxes, each of a different colour, and several balls are displayed on the screen. Clicking on a ball will pick it up enabling it to move with the mouse. Clicking again, will put the ball down. When a ball is placed on/near a box of the same colour the ball is “sucked” into the box with an accompanying animation. When a ball does not correspond to the same colour as the box, the ball is “sucked” in and then thrown back into the centre of the screen. When all the balls have been placed in their corresponding boxes, an animation occurs and the screen is reset. Children can choose to place the balls in the boxes or they can create patterns or pictures with the balls.

**Shape sort.** The screen displays a container that accepts shapes surrounded by a number of coloured shapes. When a shape is clicked upon, it is picked up and moves with the mouse. Clicking again will place the shape. If a coloured shape is placed on the corresponding container shape then it is “dropped” into the container. An incorrect placement of shape will result in it remaining in the place of origin.

**PARTICIPANTS IN THE STUDY**

This study was undertaken in the suburbs of the city of Melbourne, Australia. Fourteen children and their parents (known to one of the authors) were solicited to participate in the study. Nine mothers responded and agreed to participate with their children. Of the nine participating children, eight were female and one male. The average age of the children was 2 years 5 months 5 days. The youngest child was 1 year 11 months 11 days and the oldest child was 2 years 10 months 21 days (Table 1).

<table>
<thead>
<tr>
<th>Age</th>
<th>Age in Days</th>
<th>Gender</th>
<th>Home Computer</th>
<th>Used a computer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child 1</td>
<td>2y4m21d</td>
<td>873</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>Child 2</td>
<td>2y5m18d</td>
<td>900</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>Child 3</td>
<td>2y3m30d</td>
<td>851</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>Child 4</td>
<td>2y7m11d</td>
<td>954</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>Child 5</td>
<td>2y5m29d</td>
<td>911</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>Child 6</td>
<td>2y5m14d</td>
<td>896</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>Child 7</td>
<td>2y3m13d</td>
<td>834</td>
<td>Female</td>
<td>No</td>
</tr>
<tr>
<td>Child 8</td>
<td>2y10m21d</td>
<td>1055</td>
<td>Female</td>
<td>Yes</td>
</tr>
<tr>
<td>Child 9</td>
<td>1y11m11d</td>
<td>710</td>
<td>Male</td>
<td>No</td>
</tr>
</tbody>
</table>
Of the nine children, seven lived in a home with computer equipment and just over 50% had experienced contact with a computer. This contact however, in all cases, was confined to limited practices such as touching the mouse or keyboard a few times. Three children had played games and other children had typed their name on the screen.

**PROCEDURE**

An observer attended each child’s home on a day and time that was convenient to both parties and varied for each child. A laptop computer was set up on a purpose built small children’s table complemented by two small chairs. The child sat in the chair placed directly in front of the computer and the adult “helper” sat to the side of the child. The observer sat behind and to the side of the child to enable uninterrupted vision of the child’s interactions without interfering with or distracting the child’s activity. A custom built box covered the keyboard and the mouse was placed on top of the box. This placement facilitated the child’s use of the mouse without distraction by the keyboard. A guard protected the screen of the laptop so that the child was not tempted to touch the screen. The laptop was equipped with built in speakers to enable playing of sounds associated with the program. Each child was permitted free and unrestricted use of the computer for the time they remained at the screen. During the study an observation sheet assisted the researcher in noting the child’s responses and prompted the monitoring of particular interactions.

**RESULTS**

While positivist in the search for both internal and external validity and reliability of the research, the premise of the evaluation is inherently post-positivist in its acceptance that results are more than likely to reflect a “reality” or “truth” of multiple variables inherently dependant on the particular environment from which individual participant’s emerge. Thus, such results are inevitably paradigmatic of the interpretativist canon that “reality is constructed.” The ensuing outcomes are consequently founded upon a mélange of both empirical and intepretativist analyses.

Acknowledged as a given is thus the acceptance that the “representative” group of children is neither representative nor objectively selected. By employing a variety of methods for the collection of data, the foundation of
methods triangulation, a widely accepted level of validity can be achieved (Guba, 1990; Gorman & Clayton, 1997; Denzin & Lincoln, 1998; Janesick, 1998; Williamson et al., 2000). In addition to the researcher’s notes collected during observation of each child, other sources of information included tracking features purpose-built into the software program and a questionnaire completed by the parents of each child that provided information on the child’s prior computer use.

**Duration of Attention**

The mean time expended at the computer was 44.74 minutes. The maximum time a child spent at a computer was 79.67 minutes and the minimum time a child spent at the computer 6.38 minutes. The average time on any individual activity was 12.59 minutes and the maximum was 75.52 minutes. The average number of activities attempted was 8.44 with a minimum of 1 and a maximum of 17 (Table 2, Figure 2).

**Table 2**

Details of Participating Children

<table>
<thead>
<tr>
<th>Child</th>
<th>Time Spent on Program</th>
<th>Number of Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child 1</td>
<td>56.24</td>
<td>10</td>
</tr>
<tr>
<td>Child 2</td>
<td>70.05</td>
<td>14</td>
</tr>
<tr>
<td>Child 3</td>
<td>39.57</td>
<td>17</td>
</tr>
<tr>
<td>Child 4</td>
<td>19.78</td>
<td>5</td>
</tr>
<tr>
<td>Child 5</td>
<td>79.67</td>
<td>14</td>
</tr>
<tr>
<td>Child 6</td>
<td>6.38</td>
<td>1</td>
</tr>
<tr>
<td>Child 7</td>
<td>44.73</td>
<td>6</td>
</tr>
<tr>
<td>Child 8</td>
<td>75.52</td>
<td>1</td>
</tr>
<tr>
<td>Child 9</td>
<td>10.71</td>
<td>8</td>
</tr>
</tbody>
</table>

**Figure 2.** Graph of time children spent on activities
As can be discerned, a large variation was observed in both time spent at the computer and the number of activities attempted. The interactive behaviour of the children can be categorised into four main types: single activity for a long time (over 20 minutes) = one child; single activity for a short time (under 20 minutes) = one child; multiple activities for a long time = five children and multiple activities for a short time = two children (Figure 3).

Figure 3. Grouped time and number of activities graph

A number of studies have attempted to establish numerical values for an optimum length of time for a child’s use of the computer. Anselmo and Zinck (1987) found that 4- and 5-year-olds chose to spend 22 minutes on average using a computer, and 5- and 6-year-olds 29 minutes. When given an indeterminate length of time, Jones and Liu (1997) found that two year olds used a computer program for between 1 and 14 minutes, and that not surprisingly the children were easily distracted by other children in the room. In the light of such studies, Harbeck and Sherman (1999) recommended that young children use a computer for between 15 and 20 minutes.

Williams and Beeson (1986-87) found that 24 to 69 month old children, when given the choice, used the computer for between 0 and 121 minutes out of a possible 600 minutes. King and Alloway (1992) found that four-year old children used a computer for 16 ½ minutes on average for their
first visit to the computer. The children’s interest peaked at 28 minutes, and by the end of the study children were using the computer for an average of 13 minutes. Haugland and Shade (1994) conducted research with preschool children and found that they chose to use a computer for an average of 14 minutes in each 1 hour session of free play.

In this study the average amount of time for which the children played the game was 44.74 minutes, significantly longer than that encountered by previous studies. There are three contributing factors to these results: The first is, given the interpretativist premise of the study, the individual differences in the children have been considered when analysing the results, and clearly the sample size is too small for this study to be representative of all children in this age bracket. The second factor concerns adult intervention and the nature of the software. As the TVM software provided a variety of activities, as the child’s interest in one activity waned they were asked if they wished to try another activity. As this process was repeated several times, this ensured that when the child’s interest was waning and they may have left the computer, they were encouraged to remain by introducing another activity. The third factor contributing to the children’s time spent using the software was that the child user was able to locate their favourite real world activity within the virtual world of the computer. As an example, child five spent 29 minutes interacting with the fourth activity as the colouring book was the child’s favourite real world activity.

**Activity Repetition**

*Children often repeated the same activity multiple times.* Every child played the balloon popping activity between one and four times. The children popped all of the balloons without changing activities between 1 and 50 times, with the average clearing the screen of balloons 6 times without changing activity.

While the available research focuses on the duration of time a child will spend at the computer, little is known of the propensity of young children to repeat the same activity continuously without changing activity.

Children in this study repeated the same activity for a variety of observable reasons; they clearly enjoyed the activity, the child enjoyed the activity for similar duration in a non-digital environment, the child was attempting to gain a mastery of the particular skill, the child was “playing” by trying to repeat the activity faster or with more precision, and because successful repetition is comforting and reassuring. Child eight exhibited significant
perseverance and gradual improvement in skill level by repeating the balloon popping activity 50 times for over an hour. In light of this data a worthwhile modification to the TVM software would be create a random series of “reward” animations in the balloon popping activity to ensure an extra element of interest for multiple repetition. Child five revealed similar persistence in repeating one activity by spending 29 minutes on the colouring book and completing nine pictures. This activity has variations built in with five possible pictures to colour.

**Attitude to the computer**

All of the participants were fascinated by the computer and did not require any encouragement from the accompanying parent to interact with the computer. A number of the children were very interested giving the computer their undivided attention. They demonstrated enthusiasm for activities on the screen by laughing, clapping, and jumping up and down. Other signs of intense interest included vocalising in excitement and pointing at the screen.

All participating children sat at the child’s chair provided for at least some of the session. Other positions adopted during the session were standing and kneeling on the floor. The children appeared to readily accept the technology, gazing at the screen, listening to the audio and interacting with the mouse through the guidance of the adult helper. One child was fascinated by the source of the music, walked around to the back of the computer several times pointing and declaring, “it is singing.”

According to Pardeck and Murphy (1989), Jones and Liu (1997) and Shade and Watson (1989), at the age of two, children are able to use a computer with some degree of competence. They claim the software appropriate for two-year-old children comprises drill and practice style applications with colour animations requiring little skill to manipulate. Other software may be introduced later, once higher order skills have been acquired. According to Clements (1987) the aim of a two year old’s interaction with a computer should be to gain familiarity with the concepts, skills and types of interaction required to use a computer and to instil positive attitudes towards computing. All the children participating in this study exhibited a positive attitude to the computer and readily interacted with the computer in meaningful ways. Regardless of age, children tend to approach computers with confidence and a desire to explore and learn (Shade & Watson, 1989). Clements, Nastasi and Swaminathan (1993) suggested that, “Even two-year-olds can work proficiently on the computer using age-appropriate software that requires only
simple keypresses or pointing with a mouse. Preschoolers can easily start a computer, load disks, type on the keyboard, and understand pictorial cues (p. 63)."

Crook (1991) also found that children from three years of age had little difficulty using a basic paint program controlled by a mouse. Clements (1987) suggested that while young children may take longer to learn a particular skill they are quite capable of meaningful and effective interactions. Bowman and Beyer (1994) suggested that confidence and ability exhibited by young children in learning new technologies is observed in their rapid mastery of the telephone, stereo, computerised toy and video games. The authors have observed isolated incidents involving a 17-month-old child turning on a computer and moving a mouse while watching the cursor move on the screen. Thus, the age that it is possible for a child to use a computer may be dependent on the child’s exposure to computers. Children who have a computer in their home and see adults using them, may mimic their parents and try to use computers at a very young age. Meaningful interaction can occur when the child feels comfortable, however initial assistance from an adult will usually be required.

The configuration of the equipment also effects the child’s interactions with the computer. The chairs and table were designed and built at the correct height to enable a child to stand or sit while using the computer and facilitating movement otherwise impossible at a conventional adult desk. Covering the keyboard ensured that the children were not distracted by the keyboard and could therefore direct their interactions to manipulation of the mouse. An appropriate arrangement of the computer and accompanying equipment has the potential to enhance the child’s interaction with the computer.

**Reaction to the Teddy**

The “teddy” functions as guide and mediator to the young child user providing simple spoken instructions on the use of each activity. The teddy “speaks” with a gentle high-pitched voice in an attempt to create a nonintimidating environment. The teddy also plays the role of a transitional object, providing emotional support for the child as they move from using the computer with the assistance of an adult to independent interactions.

Seven out of the nine children responded to the teddy on the screen. When the program was started the first response of five of the children was to smile and talk about the teddy and the balloons, often pointing to the teddy while vocalising and looking to the parent. Four of the children clicked
on the teddy and of these four children, three clicked on the teddy multiple times to evoke the same response (Figure 4).

![Response to Teddy](image)

**Figure 4.** Number of children that responded to teddy and the type of responses

The use of attachment or transitional objects has been documented by a number of researchers, although not in the context of computer usage. Bowlby (1970) discussed that children can become attached to inanimate objects such as a cloth, blanket or cuddly toy. The object becomes a substitute to comfort the child when a familiar adult is unavailable. These attachments to inanimate objects are not uncommon. A study by Schaffer and Emerson (as cited in Bowlby, 1970) where 11 out of 28 Scottish children age 18 months had at some stage, an attachment to a cuddly object. Bowlby also recognised that the attachment object has particular importance when the child is tired, ill, or encountering a new situation. The use of a transitional object when introducing young children to computers theoretically should be appropriate as the children’s age makes them developmentally predisposed to relationships of this type. The attachment to these objects is usually relinquished prior to starting school, so the use of cuddly objects would become inappropriate for children at this later stage of development.

Winnicott (1971) also discussed the importance of transitional objects, finding that they come in a variety of forms, and are vitally important to infants, particularly at special times. Winnicott was primarily working with younger children such as infants but he noted “patterns are set that persist
into childhood” (p. 5). Winnicott identified the transitional object as a method by which the young child moves towards independence; “It is not the object, of course, that is transitional. The object represents the infant’s transition from a state of being merged with the mother to a state of being in relation with the mother as something outside and separate” (p. 17).

Transitional objects can help the child to gain the confidence required to explore the world independently. More recently, teddy bears have been used as an emotional support for upper primary school aged aboriginal children who are separated from their community to attend boarding schools in larger regional centres (Potter, 2001). The project works by assigning a bear to a group of aboriginal children at a school: the children name the bear, take photos of the bear, and write stories about what the bear has been doing. This information is then made available to the children’s communities through the Internet. The project, known as “travelling bears” provides the means for the children to inform their communities about their lives while they are away at school. The teddy also acts as an emotional comfort as the children can use their teddy to express their feelings to their families. This project is an example of where a cuddly toy is used to mediate children’s interactions with a computer and to make the technology more tangible.

The teddy in TVM is placed there to act as a transitional object to ease young children’s introduction to using a computer. Children would be expected to use the TVM program at the computer with their adult carer for the first few sessions. The adult would gradually provide less support and the teddy would start to take over the role of emotional support and providing advice on how to use the activities. The teddy makes the computer less intimidating and “hard” by providing a “soft” friendly face. The teddy is there to reassure the child and to encourage them to explore the computer. The role of the teddy would decrease as the child’s confidence increases, eventually becoming obsolete.

**Mouse Movements**

Four children used their right hand only to control the mouse during the session. Three children initially used both hands together to manipulate the mouse, two reverted to right hand usage later in the session. Two children alternated right and left hands throughout the session and did not establish one particular preference.

Four of the children turned the mouse over to look at the underside. One child described the ball as the “bellybutton.” The other five children did not turn the mouse over.
Two of the children rotated the mouse 180° so that the cord was facing toward the child and the buttons were towards the screen.

Five out of the nine children lifted the mouse rather than dragging it along at some time during the session. Eight out of nine of the children had the cursor around the edge of the screen for considerable periods of time when they had overrun the object that they were aiming for and landed at the edge of the screen.

Five of the children exhibited some improvement in coordinating movement of the mouse from the beginning to the end of the session. Three of these children demonstrated considerable improvement from no previous experience of a mouse to sufficient control over the mouse to enable placement of the cursor in a desired position on the screen.

Existing Research on Input Devices

A significant body of research has examined different input devices and their effect on children’s interactions with computers (Jones, 1989; Revelle & Strommen, 1990; Scaife & Bond, 1991; Crook, 1992; King & Alloway, 1993; Morgan & Shade, 1994). The results of such research invariably recommend that the best input devices for young children are highly dependent on the type of activity being undertaken. Common to all input devices used in these studies was that children would press buttons or keys with no apparent purpose, or simply just to see what would happen. Thus, software targeted for young users must be designed to deal with these irrelevant key presses (Revelle & Strommen, 1990; Jones & Liu, 1997).

Research indicates that the mouse is a suitable input device for young children. The cursor easily moves around the screen, as movement is relative to the child’s hand position. King and Alloway (1993) noted that the advantage with this type of device is that,

… continuous movement devices offer children a direct relationship between the movement of their hand and the intended movement through space of the object selected for manipulation. Speed of movement on the object is also directly related to the speed of the hand movement. (p. 47)

The consistently most effective input devices, according to Lane and Ziviani (1997), were those where the hand movement directly resembles the on screen movement. Jones (1989) however determined that the time taken for a child to complete a task using a mouse did not appear to be affected by whether or not the child could see their hand.
Button pressing when using a mouse can prove difficult for young children to master, due to two major factors. The first is that the mouse relies on stasis for button press selection to occur and young children often have difficulty keeping the mouse completely still. The second reason is that mouse movement and button press are completed by the same hand and such dexterity can be difficult for young children to master. Even young children improve rapidly with practice in their use of a mouse and develop capabilities in response (Revelle & Strommen, 1990; Crook, 1992). Using a computer mouse is a worthwhile skill for a child to master as they can use this knowledge later to use “adult” systems.

To render the mouse easier to master, software should progress incrementally, beginning with the introduction of the movement of the mouse. Once the child has mastered moving the mouse, further development of this device should be introduced, such as a single button click. Button clicks require a sensitivity and tolerance to being held down as children may need practice to complete a single button press. “Dragging and dropping” of an object and “double button clicks” are quite complex skills to master; therefore should not be introduced too early, as such expectations inevitably cause frustration for the young child. TVM is an example of software that is designed to progressively introduce mouse actions, from the simplest activities such as the Balloon Popping and Peekaboo, which only require the mouse to be moved over the objects to evoke a response, to more complex interactions in the form of a single button press required for Old MacDonald and the Three Part Book. The other form of mouse usage requires a single button click to select an object to pick up and the next button click puts the object down. While this form of interaction introduces the concept of manipulating objects, it deliberately avoids the use of drag and drop mouse movements.

Age has a significant impact on a child’s effective use of a mouse, typically, older children find a mouse easier to use. Lane and Ziviani (1997) however determined that practice and exposure to the mouse, rather than the age of the user, was the single most powerful determinant in mastery of the mouse. Although children may have difficulty at first, they improve rapidly and no matter the age at which the mouse is introduced, a certain amount of practice will be required to master it. King and Alloway (1993) found that by the end of first grade (six years and seven months), children were as efficient with a mouse as grades two and three children (seven years and eight months and eight years and five months respectively), implying that children master the use of the mouse very rapidly, and then stabilise in their ability.

Much of the existing research fails to discuss the nature of the interactions enabled by use of a mouse, preferring to focus on comparison of possible input devices. Thus emphasis remains on device selection rather than
providing information on how to best implement the use of a mouse for young children’s interactions.

Two- and three-year old children seldom have an established hand preference, thus may still be experimenting to determine the hand that is more comfortable to use. The children reflected this transition in the constant alternation of hands during their use of the mouse.

Children are naturally curious about new objects when introduced, thus it would be expected that children will turn the computer mouse over to observe what it looks like and how it works.

The desire for the children to rotate the mouse 180° appears to emerge from the metaphor of the mouse. As one of the children explained; the tail should be away from the screen and the eyes should be towards the screen. Thus, these users are employing not only the precepts of logic, but also experiential knowledge to approach an unknown device. The “correct” way to use the mouse must thus be learned and accepted. Such adaptive behaviour is achieved with assistance and intervention from an adult and repeated use of the mouse in the “correct” direction. Alternatively, given the logic of the metaphorical implications, why is the user required to adopt and adapt to the technology? Adaptive actions to remedy the metaphorical mismatch of the technology should be explored by the manufacturers. As Norman (1998) consistently exhorts, the design of technology is obliged to mirror the operative and functional needs of the user.

The children consistently lifted the mouse off the board in an attempt to direct the cursor up the screen. This may be the result of difficulty in translating the horizontal plane of the mouse movement across to the vertical plane of the screen. Indeed this problem was exacerbated and reinforced by the parents’ use of the phrase “move the mouse up.” The child user raised their hand less when directions were given in relation to the mouse plane, e.g., “towards the screen” and were most effective with the reinforcement of pointing to the correct location on the board upon which the mouse was located.

Children have difficulty with the fine motor skills and control necessary to remain within the boundary of the screen, therefore the cursor often remains at the edge of the screen for a considerable length of time. The requisite control necessary to confine the cursor to the desired position is rapidly achieved with practice. Designers of software can assist by ensuring the cursor is large enough to ensure visibility and avoid items that “pop up” when the mouse is at the edge of the screen as it is difficult for young children to coordinate these interactions.

A successful strategy implemented by several children and parents was that the parent would move the mouse to the desired position, hold the
mouse steady and the child would press the button without any movement. This cooperative mouse usage was more successful in retaining the child’s attention than the parent moving and pressing the button with the child as a passive observer.

**Adult intervention**

Adult interventions during the study produced behaviour from the child user that could be broadly categorised as follows; (a) independent, (b) cooperative, and (c) dependant. Children who used the computer independently either had a parent who did not take control of the mouse or the children pushed their parent’s hand away when the parent tried to hold the mouse. Cooperative interactions often consisted of the parent guiding the mouse to the correct location and the child pressing the button. Dependent interactions comprised the child insisting the parent take control of the mouse while they observed. No amount of coaxing from the parent could encourage the child to take control of the interactions. Each participating child spent some time in most of the categories depending on which activity was in use.

Five children were consistently independent in their computer use, two were very cooperative with their parents and two consistently dependent on their parent’s assistance. Interestingly, the skill level of the child did not appear to be the contributing factor to dependence. Parents reported that existing behavioural patterns were more likely to contribute to the dependence and the researcher’s observations would concur with this (Figure 5).

![Children's dependence on adult intervention](image)

**Figure 5.** Children's varying levels of dependence on an adult
Much, if not most, of the research is in accord that adults are crucial to the success of children’s computer usage, (see, for example, Anselmo and Zinck, 1987; Clements, 1987; Lippert, 1995). Adults are essential to young children’s initial use of computers; Jones and Liu (1997) stated that “at the age of two, human interaction is of critical importance” (p. 340). Adults are often responsible for selecting software for children, and should select appropriate software for their children based on developmentally appropriate guidelines. Another role for an adult to take in a child’s computer use is the role of “helper.” As Anselmo & Zinck (1987) and Jones & Liu (1997) suggested, very young children will require assistance with the computer until their fine motor skills develop sufficiently to enable them to be independent. It is important for the adult to provide appropriate levels of assistance rather than arbitrary intervention. If the child is required to passively observe the superior skills of control and dexterity of the adult, they will inevitably get bored, feel powerless, become frustrated, and not have the opportunity to develop their own skills. Without sufficient assistance however, the child may feel frustrated in not being able to achieve what they want or they may feel inadequate and not want to use the computer in the future. Once young children have had initial assistance, it can be decreased progressively until the child is working competently with minimal supervision (Clements & Nastasi, 1993; Bredekamp & Rosegrant, 1994; Jones & Liu, 1997).

While the presence of an adult/parent was important to provide emotional support for the child, significantly the level of assistance required was less than expected. This may be attributed to the design of the TVM software, which was intended to introduce mouse skills gradually. The requirement for adult intervention may also be dependent on the motivation of the child to use the computer; the more motivated the child, the more determined the child was to use the software independently.

CONCLUSION

This study demonstrates significant levels of independent interaction exhibited by young children with a customised software program. As the testing and subsequent evaluation suggests, the results significantly diverge from previous studies, revealing that with expressly modified environments young children can successfully engage in the beginnings of self directed learning.
As the study demonstrated, the provision of a diverse selection of activities and those that appeal to children in traditional play environments may assist in maintaining the child’s interest. Similarly, the repetition of the same activity multiple times by the participants in this study also supports that designers need to provide interesting variations of the same activity to address this phenomenon.

The expected duration of attention proved in this study to be significantly longer than previous research has suggested. The authors do not believe that this is merely a symptom of an evolution in technological familiarity as most of these children had not previously used a computer. Rather, these results are the consequence of user-centric design principles in the creation of software specifically for young children.

The level of assistance required to interact meaningfully was also significantly reduced due to the design of the software.

As the study indicates, “adult” input devices may be successfully integrated into a child’s use of a computer with carefully designed programs. In TVM the motor skills required for mouse control were introduced incrementally and repeated for rehearsal. The improvement in their use of the mouse in one session was considerable, children of this age rapidly learn and refine their fine motor coordination and could gain independence in their mouse interactions in a few sessions. This includes the ability to guide the mouse to the correct position and to make a single mouse press at the required place on the screen.

The inclusion of a transition object in the digital environment for support and encouragement enabled greater independent use and less adult intervention.

The choice of object was pivotal to this success. A teddy is an object with which many two and three year old children are familiar. The provision of a teddy on the screen when the program starts instantly engages the children. The use of the teddy could be further integrated into the program by being more responsive, for example welcoming the children to the program.

As this study has indicated, technology can be a meaningful learning tool alongside/in conjunction with, the more traditional play such as the sand pit, water, reading, colouring, and so forth, and need not be feared as detrimental to the learning process of young children.

Reference


