Cartoons Beyond Clipart: A Computer Tool for Storyboarding and Storywriting

by

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Abstract

The concept of a text in English teaching has become greatly generalised; moving image 'texts' as resources which learners may interpret and produce, in similar ways to traditional print texts, find an increasingly emphasised place in the English curriculum. This Thesis seeks to identify how computers currently fit into work which connects moving image media with English teaching, and how they may further contribute to educational practice After the educational context is established and recent practice described, four stages of research are undertaken

First, the state-of-the-art of visual storytelling is assessed through an analysis of a representative range of software. The target age range covers England and Wales' Key Stage 2, from 7 to 11 years, and the software is drawn from both research and commercial sources. The assessment concludes that there is significant scope for further development of such software.

Secondly, a concrete proposal for new software is developed by building on the findings of the assessment.

Thirdly, two pilot studies using early-stage implementations of the proposal are described; these serve to verify the proposal's feasibility and provide pointers for user interface refinements.

Fourthly, a main study, using software which incorporates these refinements, is carried out This finds that the software has the same effect on written stories, when it is used to visualise a story in preparation for writing, as two alternative preparation processes, one asking participants to draw pencil-and-paper cartoons and the other following the practice of a teacher involved in the study. However, the software cartoons show substantial differences to their pencil-and-paper counterparts, including a greater variety of character poses, a greater number of depictions of actions and interactions, and a much greater proportion of finished cartoons The conclusion is drawn that the software enables its users to create more expressive cartoons than pencil and paper.

Finally, the contribution of these four research stages is reviewed and further research directions are identified

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Chapter 1

Introduction

This Thesis presents research on the motivation, design, development and testing of a novel computer tool for cartoon storytelling, and its impact on narrative storywriting when used by children in England and Wales' Key Stage 2, which covers children aged from 7 to 11 years

1.1 Educational Context

In 2002, the Department for Education and Skills (DfES) initiated a four-year research project whose results paint a picture of the developing role of Information and Communications Technology (ICT) in primary and secondary schools in England (National Centre for Social Research, 2006). Although the research project was aimed specifically at assessing the impact of the DfES-funded Curriculum Online website (`www.curriculumonline.gov.uk`), a significant number of its findings shed light on the current context surrounding educational ICT.

In particular, a sample of schools was surveyed three times over the four years, and the changes in their teachers' attitudes towards ICT, their use of ICT, and the schools' spending on ICT were recorded. The full findings are presented by the National Centre for Social Research; however, it suffices here to note that primary schools' use of ICT in lessons and their spending on it have increased markedly, and teachers' attitudes towards ICT have become

more and more positive. Most saliently, in 2005, 89% of respondents rated ICT as having an important place in English teaching

However, there remains a perceived need to develop new approaches and tools for the teaching of subject areas the 2005 annual report of the Office for Standards in Education (Ofsted, 2005), states that, concerning primary schools, "In general, there is scope to extend the breadth of the curriculum in English, including more imaginative work using drama, moving image texts and ICT".

As the next chapter shall show, moving image texts are becoming increasingly linked with English teaching and particularly with fiction writing, visualisation and storytelling. Given too the growing prominence of ICT's role in classrooms, it is suggested that the time is especially ripe to consider new ways to extend approaches to English teaching by *combining* aspects of moving image texts and ICT. Developing one such new approach, and assessing its effect, comprises the research described in this Thesis

1.2 Aims and Objectives

The Thesis aims to identify the scope for the development of a new story visualisation tool which uses concepts of moving image literacy, and to develop such a tool and test its impact on writing, by:

1. Obtaining a precise definition of the term 'moving image literacy' and establishing how it relates to the theories and practice of written composition, and specifically fiction writing;

2. Surveying existing visual-story-making software, and identifying gaps in its provision;

3 Identifying specific research questions which may be asked concerning the relationships between ICT, visual storytelling activities, and story-writing, and specifying and developing a new software tool to be used in answering those research questions;

4. Designing and carrying out formative experiments to answer the research questions.

1.3 Overview of Work Carried Out in the Project

The work performed followed the lead of the objectives above to accomplish the overall aims. First, significant theories of writing were identified. The meaning of moving image literacy was investigated and clarified, examples of its possible effects on conventional literacy collected, and links to the earlier writing theory made.

Following this, the current state of visual storytelling software was surveyed, and a wide range of tools for producing general visual stories were systematically analysed. The analysis highlighted opportunities for new software development, and a concrete proposal for such developments was made

This proposal resulted in the progressive development and testing of a new cartoon storytelling tool, used in an action research setting by school children over two pilot studies and one main study. The first, early-stage, pilot study verified that the proposal was realistic, and the second pilot study and main study provided data concerning the tool's effect on story visualisation and writing compared to other techniques In addition to appearing here, the survey of current visual storytelling software and the second pilot study are also presented in Madden et al (2006a), and the main study in Madden et al. (2006b).

1.4 Relevant Areas of Knowledge

The work described above contributes to two main areas:

- The relationship between moving image literacy, ICT and writing;
- Knowledge relating to the effect which ICT can have on story visualisation, and knowledge concerning the current state of educational visual

storytelling ICT; what characterises current software, what possibilities exist for new developments, and the shape which new developments can take.

The remainder of the Thesis is structured as follows. The first of the above areas is addressed in Chapter 2, beginning with theories of writing. Chapter 3 then turns to software, examining those programs which relate to the production of visual stories generally Limitations in current software are discerned; Chapter 4 develops the proposal aimed to address these and poses specific research questions to answer These are answered in Chapters 5 and 6, the former discussing the two pilot studies and the latter reporting the main study. Finally, Chapter 7 draws together the findings and contributions of the Thesis.

Chapter 2

Writing and the Moving Image

This chapter presents the first part of the context surrounding the Thesis; it connects moving image approaches to literacy with a theory of writing and writers' development. It begins by introducing two complementary models of writing central to that theory.

2.1 Two Models of Writing Processes

There is good evidence that proficient writers, for example those who have made writing their living or whose work has reached a wide readership of some kind, follow a qualitatively different process to that of less accomplished or novice writers. Hayes and Flower (1986) suggest that the writing process consists of interdependent phases of planning, sentence construction, and revision, both of the text and of the plan, and find that experts tend to devote a greater proportion of their writing time to revision. Bereiter and Scardamalia (1987) emphasise the way in which expert writers not only shape their text in accordance with their ideas, but also allow their ideas to be changed and extended by what they write In other words, these experts tend to use the writing activity as a means of developing their thought on a subject in addition to any other purpose for which their text may be intended

Bereiter and Scardamalia contrast a number of features which distinguish expert writers from novices, particularly children. They too find that experts

revise their text to a much greater extent than novices, with children almost entirely eschewing revision They also note the following apparent differences in process Upon being given a writing task, young writers.

- Seem to spend little time thinking before they begin actual text production;
- Do not produce separate plans or notes for writing, but instead plan by writing a sequential outline of points which is then fleshed out in more or less the same form as it was created;
- Describe themselves as following quite a linear process which involves choosing, then writing down, a succession of points which are considered relevant without much attempt to link or synthesize them. Bereiter and Scardamalia contrast this with professional writers' self-reports which suggest a non-linear, iterative process.

To account for these qualitative differences, they propose two models of how writers go about their task.

2.1.1 The Knowledge-Telling Model

The knowledge-telling model reflects the self-reports of young writers mentioned above In it, the writer looks at the writing theme, be it an opinion essay, a scary story, or anything else besides, and examines what s/he already knows about the topic. Such knowledge can represent actual content for inclusion, such as the author's opinions, but it can also concern the form a particular kind of writing should take, for instance how a scary story should start or what kind of words and phrases to use.

Each time the memory search brings up an item, the author applies some kind of test for appropriateness so as to decide whether to include whatever was thought of in the text. If the item is accepted, it joins the text in a form which more or less reflects how it is stored in the writer's memory. In other words, an author who follows the knowledge-telling process demonstrates a one-way interaction from his or her beliefs and intentions to what s/he

writes, and does not really modify these former things in light of the latter. The memory search continues in this fashion until the author feels s/he has completed the task.

Knowledge telling is a label for a writing process which can be exhibited at virtually any age, it is important to note that it is not something which is automatically outgrown While knowledge telling at the graduate level might consist of very much more sophisticated and elaborate memory searches, tests of appropriate content, awareness of audience and so on, Bereiter and Scardamalia suggest that a good case can be made for the overall process being much the same, and that it can be characterised by the notion of one-way interaction from belief to text.

2.1.2 The Knowledge-Transforming Model

To account for the apparently more complex writing process of experts, Bereiter and Scardamalia assimilate the knowledge-telling model into a larger process model which they label knowledge transforming. Its distinguishing feature is that, in addition to the transformations from ideas to text which take place within knowledge telling, there is a second interaction which runs from the author's text to affect their goals for it and their conception of it. Bereiter and Scardamalia envisage one's goals, ideas and beliefs about the text as residing in a *content space*, and one's mental representations of actual or intended text as inhabiting a *rhetorical space.* Figure 2 1 depicts the idea graphically.

Knowledge transforming, then, is about a back-and-forth play between these two spaces in which a writer repeatedly reassesses his or her ideas and goals and his or her written text as writing progresses. Changed goals may well necessitate substantial text revision, and subsequent text production may modify aims and goals further, leading to the picture of a complex, iterative process painted by expert writers which Bereiter and Scardamalia report.

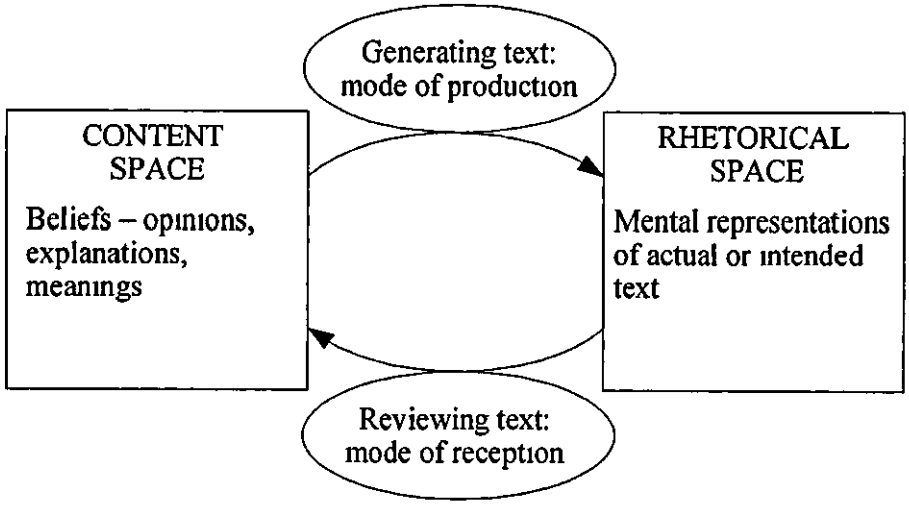


Figure 2.1: Reworking of the depiction of the two-way mental processes involved in knowledge transformation (Bereiter and Scardamalia, 1987, p. 303).

2.1.3 Relationship Between the Models

It is important to note that knowledge telling is not an inferior process to be jettisoned in favour of a superior one; the fact that it forms an integral part of the knowledge-transforming process is something which bears repetition. An author writing under the knowledge-transforming approach still produces text using knowledge telling; however, that activity is now controlled and directed by a further executive strategy The task of encouraging writers to adopt a knowledge-transforming process, or at least aspects of it, therefore lies in getting them to extend their existing writing ability so that it forms part of, and is informed by, a larger, more sophisticated context.

It follows that writing produced via a knowledge-transforming approach may not necessarily appear more cogent, well-reasoned, persuasive, affecting, evocative or anything else when compared to text written by a knowledge-telling author. It is perfectly possible for the simpler strategy alone to produce a polished, coherent result Whether it will or not depends on the degree to which that writer's thoughts on the subject are themselves clear

and well-formed In contrast, under the knowledge-transforming process, the outcome does not depend on the writer knowing what they want to say from the outset, experts have the capacity to write effectively on any subject irrespective of their initial relation to it (Bereiter and Scardamalia, 1987).

This difference alone provides good motivation for encouraging a student to extend his or her writing strategy beyond knowledge telling, but there is another. Bereiter and Scardamalia make many parallels between knowledge transforming and more general problem solving, showing that writing under that process is very much a chance to practise problem solving strategies. This is very relevant to recent interest in teaching 'thinking skills', Wegerif (2002) provides an overview in which it is maintained that such skills cannot be taught in the abstract but instead require some concrete context in which they can be honed.

Knowledge telling and knowledge transforming are cognitive models of a largely internal process; it is hard to reach into a writer's head and pull out direct evidence for either. However, their adoption as a theoretical backdrop provides a framework for identifying techniques which might improve children's writing, both the process itself and, hopefully, the product. These techniques are the subject of the next section.

2.1.4 From One to the Other

Bereiter and Scardamalia detail a great many classroom interventions which were designed to alter children's composition processes in one way or another, and particularly to foster at least some elements of a knowledge-transforming approach, for example greater reflection on text previously written. They identify two general approaches useful for altering these composition processes.

- **The use of a *procedural facilitation.*** This is any activity which provides a simplified, structured external form of some part of the composition process Over time, it is intended that participants in the process internalise the pattern so that they are able to take on its characteristics themselves A procedural facilitation is generally designed to

apply to one part of the composition process, and signs of its effects can be sought in intermediate products of the process, for example plans and writers' conversations, as well as the finished written product

- **The swapping of abstract goals**, such as that of making a piece of writing realistic, for more specific ones which achieve the same effect, for example, hearing one person recount a scary experience and then trying to write about it so as to convince another reader that the experience is one's own (Bereiter and Scardamalia, 1987). This technique, therefore, is one of providing *concrete goals* which more specifically identify how to achieve something Concrete goals can be used profitably within a procedural facilitation.

As noted earlier, it is not possible to tell precisely what kind of process a writer has followed by looking at their end product. However, this fact is not at odds with the assertion that a procedural facilitation can reveal evidence of process change. It is possible to look for specific signs of such changes, particularly when intermediate products are also examined. Thus, although it is too bold to state that a given intervention leads to the full and glorious knowledge-transforming process, it is perfectly feasible to look for students adopting particular techniques and processes which have an affinity with parts of that process

The plan for this research, then, is to design a software-based procedural facilitation process using concepts of moving image literacy, capitalising on any potential for providing concrete goals along the way, and then to test it, looking at the resultant text and intermediate products for evidence. Chapter 4 returns to the subject of designing such a process in this case, but before it does so there is more to consider.

2.2 Connecting Print Literacy to 'Moving Image Literacy'

In order to set the scene for the design of a storywriting procedural facilitation, it is necessary to see how the previous sections connect with a relatively new set of literacy techniques, which are united by the way in which moving image concepts are used to examine conventional print literacy ones.

Central to this is the notion of 'moving image literacy', which has been defined by Burn and Leach (2004b,a) as relating to the following

- The degree to which one is aware of moving image 'texts' in wider culture, and the level of one's knowledge about them in this context;
- One's ability to decode moving image texts, or, loosely speaking, to 'read' them, and detect "systematic patterns of meaning" (Burn and Leach, 2004b,a);
- The level of proficiency one has in designing and producing moving image texts oneself.

Before beginning, a closer look at the theoretical foundations of the moving image literacy concept will be helpful Particularly, it is important to recognise that the word 'literacy' can place an inappropriate reliance on the concept of *language* (Burn and Leach, 2004a). Although casually using such phrases as 'body language' or 'film language' is quite acceptable, really these are not precisely languages, but more general systems of signification, with their own systematic patterns of meaning Burn and Parker (2003a; 2003b; 2001) define the word *kineikonic* to refer to the system of signification deployed by the moving image; thus, a given moving image product employs the kineikonic mode to communicate its meaning. According to Burn and Leach (2004a), this "operates as a combinatorial mode which assembles and integrates other modes (speech, image, gesture, music) through its own 'grammar' of filming and editing" When encountering the terms 'film language' or 'moving image language' or 'camera language' or any other similar language

analogy then, it is suggested that really it is the kineikonic mode, or aspects of it, which is being referred to and which lends these terms their validity

Thus, acknowledging the caveat that the analogy with print literacy and language should not be taken to extremes, and founding that analogy on the suggestion that different communicative modes, such as the written word and the moving image, may "operate certain common semiotic principles" (Burn and Leach, 2004a), it is hoped that discussions using that analogy can remain sensible This approach reflects, for example, Buckingham's conclusion that a literacy of television must ultimately be seen as a metaphorical label (Buckingham, 1993).

2.2.1 How Moving Image Literacy Activities Affect Conventional Literacy

Various pieces of research suggest that moving image activities may be able to feed conventional literacy The nature of the activities involved varies; some use the second aspect of Burn and Leach's above definition by examining the way in which previously-constructed moving image texts may be read, and others appeal to the third aspect by having classes make their own moving image products, be those storyboards, animations, or other artefacts. The link to conventional literacy tends to emphasise narrative and creative writing, and certainly all work included below relates to storytelling and fiction writing, while there has been research into the role of moving image techniques in other curriculum areas (Becta Evidence and Research Team, 2003), as stated earlier the focus of this Thesis's research is chosen to centre on print literacy examined through storywriting

Robinson (1997) identifies the concept of narrative as providing a central link between print literacy and television-based moving image media, although she focuses only on the reading of texts in both media. She argues that people use many of the same strategies to engage with a televisual story, and draw meaning from it, as they do when reading a story in print, and that this is because the narrative - the story being told - transcends media boundaries; it can be told and read in many different media, albeit in different,

medium-specific, ways Browne (1999) sees television and video narratives as rich resources which children can draw on when telling their own stories, first through 'dramatic play' and, later, through writing. The conclusion is that examining stories in media such as television enhances children's opportunities to understand, for example, characters and their perspective on events (Browne, 1999, Marshall, 1997), address significant plot events such as partings (Browne, 1999), and can catalyse children's own storytelling (Browne, 1999). In drawing on such resources, either by retelling stories previously viewed or taking inspiration from their plots, characters and settings, children are doing as Robinson asserts and extracting knowledge about narrative which they then put to use in their own story-making; as stated by Marshall (1997), the idea lies in using children's implicit familiarity and engagement with one medium to explore another.

This is picked up by Parker and Pearce (2002), who suggest that both 'reading' and 'making' activities provide a way for moving image narrative to scaffold and encourage conventional literacy development, and a similar argument is put forward separately by Parker (2002), who cites particular benefits to class discussions of stories, the precision and structure of ensuing work, and pupil motivation and confidence.

Higgins, the organiser of one project cited by Parker, relates the intervention in her own report (Higgins, 2002) She describes how a Year 6 class (10-11 years) viewed a short animated film and was asked to write a condensed version for a younger audience to read instead of watching the film. The exercise was aimed particularly to encourage students to translate techniques from the visual medium to the page, and Higgins cites examples in which students successfully adopted this, turning the animator's use of camera angle to their prose by directing the reader's eye in deliberate ways. Additionally, it is suggested that the activity allowed some writers to deploy more sophisticated character descriptions and time connectives than they would otherwise have done (Higgins, 2002). Again, a significant motivational effect was found, particularly in the case of a group of boys who were described by their teacher as 'reluctant writers' who would easily become distracted and lose interest in their work. Higgins notes that the class engaged strongly with

the work, being pleased with the effects they were able to achieve in writing and able to view the film repeatedly while still developing fresh insights into it.

Oldham (1999) also describes a film-reading exercise, but one aimed at a somewhat older, secondary school-level, audience. Here, two groups of students followed a similar scheme of work centred on Charles Dickens's Oliver Twist; one group used several film and TV adaptations while the other spent the corresponding time focusing on the book itself. Each student in both groups also read through the first seven chapters as the scheme of work progressed Oldham suggests that the 'film group' was able to effect a greater access to the story's narrative structure, demonstrating this by having greater recall of the plot and a higher engagement with it Again, a distinct visuality is noted in the film group's writing exercises, even when those exercises concern scenes or events omitted from the dramatisations. Oldham also asserts that the film group achieved higher attainment targets in both reading and writing than the non-film group, and that the gap between weaker and stronger students in the film group was notably reduced She attributes these effects to a similar scaffolding effect: that interpreting the moving image versions of the story, looking at how they made and conveyed their meaning, helped the students develop their competence in conventional literacy.

This theme is again present in Parker (1999), who here discusses an animation project in a London school Two Year 3 (7-8 years) classes participated; each followed a three-month scheme of work centred on Roald Dahl's Fantastic Mr Fox. Both classes completed a number of writing exercises based on the work, including a diary entry exercise and a general comprehension test, both of which were used as sources of comparison. One class was required to produce a simplified version of the book for younger readers, and the other to make an animated version of the story.

Parker finds that the animation class showed an increased use of spatial and temporal connectives in their writing, drawing the reader's eye to things their character can see and evoking a character's state of mind by referring to visual elements of the setting He also suggests that this class demonstrated

a greater understanding of the plot's structure. These outcomes are again attributed to a scaffolding effect· by transcribing the story from one medium to another, it is suggested that students employ two structural schemes in which to interpret the story, one moving image-based and the other book-based Parker suggests that it is the different means by which these media communicate the same narrative which is helpful to students as they acquire and interpret the story; the contrasting media provide multiple sets of 'hooks' on which to hang knowledge of the narrative. This refers back to Robinson's point concerning the medium-independent properties of narrative, and echoes Sigel's notion of conservation of meaning across media (Sigel, 1978). Parker also draws out a benefit from the way in which the project may have made in-school and out-of-school experience more connected to each other.

The motivational element presented a number of times above is picked out elsewhere, and the suggestion is that the effect arises out of the prominent and pervasive influence which moving images possess in current culture (Film Education Working Group, 1999) First, some moving image activities offer the possibility of a very alluring end product such as presentations and animations which may be exhibited to a class, school or even in public spaces (Burn and Parker, 2001), (Gaunt, 2003). Secondly, there is the suggestion that there is much to be said for linking literacy activities to popular or at least well-known cultural practices (Film Education Working Group, 1999; Marsh and Thompson, 2001), and that such links may help to bridge perceived gaps between home and school, or perhaps learning and living (Marsh and Thompson, 2001), echoing Parker's point above.

2.2.2 Links to Theoretical Models of Writing

Madden et al (2004) point out a possible link between moving image activities and the knowledge-transforming model by considering Burn and Parker's (2001) account of Year 6 (10-11 years) pupils making animated versions of the story of Little Red Riding Hood. Burn and Parker highlight a process which they label 'interactivity', in which the children switched between acting as an audience to their own and others' work, and acting as authors

or producers by modifying their work When one enters a mode of reception, becoming an audience to some moving image or print text, one has the chance to examine and assess it before using this assessment to modify one's beliefs and intentions about it. If the text being received is one's own work, playing the part of the audience may help one to identify potential revisions and alterations. This corresponds to movement from the rhetorical space to the content space. Translation from the content to the rhetorical space is a process in which the author's ideas about their text, held in the content space, feed on to modify the contents of the rhetorical space. This therefore involves entering a mode of production, since the rhetorical space holds the creator's view of his or her end product, and this corresponds to the production side of Burn and Parker's interactivity. Figure 2.1 has made this link graphically, using Burn and Parker's terminology of reception and production

The link may also be interpreted in the light of Sharples' comments regarding external representation, contained in his account of writing as creative design (Sharples, 1999); it is suggested that moving image products and activities may offer a particularly fruitful external representation which might encourage participants to engage in the two-way interaction characteristic of knowledge transforming. This suggestion is echoed in part by Brna and Cooper (2001), who find significant potential creative benefit in the use of computer-assisted cartoon-making. Cartoons are very closely linked to moving image aspects of narrative, and in fact it is worth noting at this point, as Burn and Parker (2003b) do, that they and other similar products such as storyboards, can be used to deploy exactly the same structural schemes of narrative as literal moving images themselves. Thus 'moving image activities' may not necessarily involve any direct moving images Chapter 4 returns to this point in greater detail

2.3 Summary

This chapter has attempted to connect Bereiter and Scardamalia's model of a sophisticated writing process, knowledge transforming, with observations

made about classroom moving image activities. It suggests that those activities are compatible with established writing theory, and has attempted to describe how they fit together. In summary, it is suggested that moving image concepts provide an interesting new way to facilitate literacy activities, and to encourage reflective thought about them The work reviewed shows that moving image concepts may be a promising way of designing a procedural facilitation, and it is therefore suggested that suitable moving image storytelling activities can offer another arena for fostering more sophisticated writing processes

It is also worth noting that it might be very intuitively appealing to categorise the above kind of work as appealing to a strongly visual 'learning style' (see, for example, the report by Coffield et al , 2004). However, this is not the point of the majority of work in this area; rather, the motivation comes from the above suggestion that moving image activities can result in a familiar and appealing or exhibitable context for considering story structure.

The following chapter shall consider where computers enter this picture by examining the existing opportunities which children have to be producers of visual and moving image stories, and will try to demonstrate that there is still room to develop another tool for this purpose.

Chapter 3

Current Ways to Make Visual Stories

This chapter considers how current computer software supports users in deploying or learning about elements of moving image narrative. The first section considers the range of software to be examined and specifies how it will be analysed. Subsequent sections identify relevant software titles and then discuss what is currently lacking in them

3.1 Scope of Review and Questions to Ask

The choice of software titles to consider is based on quite a broad theme; it includes more or less any software which can be used in a primary school to deploy the kineikonic mode for storytelling. As the previous chapter states, the defining features of this mode are its use of filming and editing to integrate other modes of signification such as gesture, speech, music and so on. It is asserted now that the software selection which this covers goes beyond the obvious moving image products such as digital video or animation programs to include such things as presentation and storyboarding tools In other words, it is argued that the kineikonic mode can be deployed in 'texts' which are not themselves made up of moving images. The first kineikonic requirement, that 'filming' be used, can be quite adequately satisfied through

the use of still pictures· all the concepts of shot distance and angle, and their concomitant narrative properties, are present (see, for example Poole et al , 1995), it is just the dynamic time-based aspects of filming which are neglected. These are clearly important aspects of the moving image, but it is argued that the key concepts are captured in still camera shots as well as dynamic ones. Secondly, considering the need for editing to sequence and assemble a kineikonic story, it is perfectly possible to use spatial sequencing as a substitute for temporal sequencing; as McCloud (1994) points out, "space does for comics what time does for film". In fact, there is likely a more intimate link than that: "you might say that before it's projected, film is just a very very very very *slow* comic" (McCloud, 1994). Add to this the choice made by Eisenstein, a noted early film-maker, to describe the temporal sequencing of images with a spatial word, calling it 'horizontal montage' (Reid, 2005), and the distinction between temporal and spatial sequencing begins to look very blurred indeed.

This ability for non-moving image artefacts to exhibit aspects of the kineikonic is recognised in the classroom by, for example, the suggestion in the British Film Institute's Story Shorts educational resource pack (Parker et al , 2001) that students might find value in storyboarding a sequence before writing about it, and several shot analysis and editing activities reported by Durran and Morrison (2004). Examples of non-moving image media which can nevertheless be argued to employ the kineikonic mode are the storyboard, the slide show and the comic strip.

In terms of software, then, any title which allows users to make pictures (here relaxing the precise definition of 'camera shot' to include a wider range of pictures; many pictures which are not camera shots can be nominally imagined to be so) and place them in a sequence shall be analysed for the affordances it offers in telling stories through the kineikonic mode. This criterion admits a great many specific titles and so the intention below is to cover a representative range, but not necessarily provide an exhaustive list of products Most titles tend to operate as integrated, standalone products, but story-making activities can easily use a particular combination of titles at different stages, for example a paint program to create initial art, followed

by an animation program to produce animated scenes, followed by an editing program to sequence the scenes. One example of this process is reported by Burn and Parker (2001); the animation program (The Complete Animator) and the editing program (Media 100) are included in relevant sections.

It should be noted that computer games, which certainly do have a role in story-making and which deploy an interactive form of the kineikonic mode (Robertson and Good, 2004, Burn and Parker, 2003a), are excluded so as to focus on more traditional, non-interactive moving image texts This exclusion is made so as to delimit and define an already broad range of software.

Each software title will be examined for the opportunities it provides in three areas; each choice is now explained.

- **The camera's role: to what extent can different shot distances and types be used?** The intention behind a given picture, and its purpose in the narrative, can strongly influence the way in which the picture is shown; for example, how far the camera is from its subject and whether it is looking from below, on the level, above, over the shoulder, from a hiding-place, and so on (these are issues of shot *distance*, *angle* and *type*; for more detail, see, for example, Parker et al., 2001; Barrance, 2004). Therefore, the degree to which a given title allows users to change how a picture is viewed is an important factor in its support of moving image narrative, leading to the first area for analysis.

  This is not a question of whether an explicit vocabulary of the camera, shot distance, angle or type is used, but rather whether the software provides mechanisms to deploy different shots. For example, the ability to zoom allows the deployment of different shot distances, even if they are not referred to as such.

- **Characterisation: how much flexibility of expression is afforded?** The depiction of characters is obviously central to most, although not necessarily all, visual stories, and such centrality leads to this second area: when examining software story-making opportunities, it is useful to ask to what extent characters can show different emotions and actions, and whether characters can be changed, cus-

tomised or created from scratch. Such questions serve to highlight how expressive characters can be in a given title

- **Guidance in moving image technique: to what extent are users encouraged to explicitly consider the narrative techniques of the kineikonic?** If it is the differences between how pictures tell a story and how printed words do so which are useful in negotiating literacy concepts, as Chapter 2 reports, then to examine, compare and learn from these differences requires that students are able to consciously consider the techniques of each medium, resulting in the third area of analysis. For the moving image, this covers the role of different kinds of camera shot acknowledged above, and extends to editing and sequencing techniques, as well as lighting and sound in the most general cases; Barrance (2004) and the section on "becoming cineliterate" in Bazalgette et al (2000) both offer guidance on the kinds of concept intended here. If software titles are to help users create visual stories, it is worth asking how much explicit use they make of relevant concepts.

The first two areas reflect aspects of what might be called the level of kineikonic affordance which a title offers The camera's role is automatically part of the kineikonic mode, and characterisation has been chosen because any visual story with characters implicitly uses gesture and facial expression as modes of communication. Another logical area which might have been chosen, namely the editing component of the kineikonic mode, has not been selected; this is so because all titles reviewed allow sequences of pictures of one kind or another to be made and presented, temporally or spatially, and this is judged a sufficient minimum affordance for this aspect of the kineikonic. The third point relates to the degree to which the kineikonic mode is explicitly recognised, and guidance in its techniques offered, by each title.

3.2 Available Software

This section is split into two parts The first considers what shall be termed 'content-centred' software, whose rough defining feature shall be taken to be a primary reliance on presupplied characters and artwork. This does not preclude tools which also allow some user-defined input, so long as such user input can only supplement the provided content rather than replace it outright. The contrasting approach is termed 'build-centred', in which a program provides sufficient tools (such as drawing facilities and the ability to import images) that user-created content may take an equal or even dominant role compared to pre-supplied content. The difference being highlighted here is by no means totally clear-cut, but it is suggested that there is a marked and generally quite obvious difference in intention between the two categories The aim of this section is to draw that distinction; the following section will examine what opportunities exist to unite the two approaches, and why this might be desirable.

3.2.1 Content-Centred

Eight programs, hopefully representative of the available options, are described below. Appendix A acknowledges the publishers and describes where further information may be found.

Kar2ouche

Kar2ouche is described as a storyboarding and animation program. Users create pictures by choosing a background image and placing character and object clipart in the scene, different themes, which provide backgrounds and art for a great many subjects, are available. Pictures are placed in a sequence which can be used to effect presentations and stop-motion animations Custom backgrounds can be imported, allowing users to create their own locations for scenes. One use of Kar2ouche is described by Birmingham and Davies (2001).

- **The camera's role**
  Kar2ouche operates from a fixed perspective; there is no notion of controlling a camera and it is not possible to zoom in and out.

- **Characterisation**
  The characters provided with Kar2ouche are all static clipart images, however, each character has a range of snapshots taken showing a variety of angles and poses, and the system creates a simple 'posing' interface by allowing the user to cycle the character through these images. Facial expressions are not considered, and it is not possible to alter a character beyond the preset choices or to create new characters

- **Guidance in moving image technique**
  The Kar2ouche software itself does not explicitly acknowledge any vocabulary or concepts associated with moving image storytelling, although a related education support pack does cover making film trailers, shots and sequences.

MediaStage

MediaStage is designed to allow the creation and filming of 3D sets, populated by 3D actors chosen from a gallery Characters can be made to talk using a text-to-speech feature.

- **The camera's role**
  MediaStage works from an explicit filming perspective, so features like changing the camera's position, and the notion of framing shots, are thoroughly supported

- **Characterisation**
  The supplied characters come with a range of preset animations which allows them to be directed to walk, gesticulate, and pose. However, only those actions and poses which have been predefined can be used; it is not possible to create arbitrary poses. Characters' appearances cannot be modified, nor can users create new characters.

- **Guidance in moving image technique**
  MediaStage and associated teaching materials make substantial acknowledgement of film-making techniques, including camerawork, lighting and editing.

Machinima

Machinima is not a name for any one program itself, but rather refers to the practice of using computer games and adapting their resources, be they characters, objects or environments, for the purpose of film-making. The exact way this is accomplished varies with the game; some allow characters to be programmed and filmed in custom levels, others require that a normal multiplayer game be set up, with one player being the camera and others acting out lines instead of trying to kill each other. Biever (2003) provides a further introduction

- **The camera's role**
  Whether the 'camera' in question is the first-person view of one of the participants or a separate non-player object, machinima generally allows quite a high degree of control over what is portrayed, with a variety of shot distances and types being evident

- **Characterisation**
  The level of characterisation in machinima necessarily varies with the game being used, some methods of production are limited precisely to the normal game's characters and levels whereas others are able to use completely new characters, objects and environments. The tendency seems, as with titles like MediaStage, to be for characters' actions to be scripted or based on the pre-defined motion capture data rather than posed and animated by hand, and this may generally limit the degree of unique expression possible to the options which a given character model can display.

- **Guidance in moving image technique**
  The software used to make machinima, generally a combination of some

game engine and a non-linear editing package, although allowing camera and editing technique to be used, does not generally offer guidance on the subject.

Kahootz

Kahootz has grown out of work described by Bennett et al. (2000). It allows users to construct fully 3D worlds and animations by selecting prebuilt environments and choosing characters and objects from a gallery. Users can also draw 2D elements with the 'notepad' facility, and are encouraged to share their work online via the linked online community.

- **The camera's role**
  Kahootz provides a great deal of control over the camera's viewpoint, allowing users to fly a camera around the world so that any object can be viewed from whatever distance and angle is desired. Some example animations by students show use of a variety of shot distances

- **Characterisation**
  Characters in Kahootz are comparatively inflexible; they can be moved, scaled, and made to follow user-defined paths, but can only display preset animations which have been defined by the library's creators, for example swimming, crawling and so on They cannot otherwise be posed or change their expression, and new characters or objects cannot be created It is possible, however, to define new textures to apply to them

- **Guidance in moving image technique**
  The idea of the camera as an object in itself is explicitly recognised in Kahootz, and this together with controls such as 'attach camera to object', which makes the camera follow the motion of a character or thing, certainly support users in thinking consciously about camera shots Other concepts, such as the way in which sequence mediates the story, seem to have little acknowledgement, although individual online collaborative projects might address this in an ad-hoc way.

Picture Writer

Picture Writer is intended to allow users to make themed pictures and story books by using clipart and backgrounds centred on a given story or topic. Text can be read back to users with text-to-speech.

- **The camera's role**
  It does not seem possible to manipulate the view of a picture, for example by means of a zoom facility.
- **Characterisation**
  Picture Writer characters are static clipart, and cannot be manipulated beyond standard operations of positioning and scaling.
- **Guidance in moving image technique**
  Picture Writer takes no explicit account of concepts surrounding moving image storytelling

i-Theatre Lab

The i-Theatre Lab works from the premise of building a virtual cutout theatre production. Simple sets can be designed, characters placed and animations made. Also supplied with the software are printouts of set and character art which can be used to make a physical analogue of the virtual theatre.

- **The camera's role**
  i-Theatre Lab is intended for the creation of virtual and physical plays; these are viewed from a fixed perspective without any concept of a camera, although the physical theatre can be filmed
- **Characterisation**
  Characters provided with i-Theatre Lab are static clipart, although their position can be animated. It is not clear whether users' own art can be imported.
- **Guidance in moving image technique**
  This software uses a timeline facility for its animation, but does not acknowledge any other related concepts.

MoPix

MoPix is designed to help students explore concepts of editing and sequence. It provides a selection of short video clips, all centred on a particular theme, for example a phone call, and allows users to sequence these clips together to tell the story of the events in different ways.

- **The camera's role**
  MoPix is not designed to allow users to make their own pictures, so any concept of being able to change a camera's view, beyond the ways it changes in the clips themselves, is irrelevant.

- **Characterisation**
  Again, characters flexibility is not particularly relevant to MoPix as it does not supply separate characters in themselves, only as depicted in clips.

- **Guidance in moving image technique**
  MoPix is intended to explore the role of editing in story-making, and the software and related teaching materials explicitly explore how editing can be used to achieve particular effects, such as building tension

T'riffic Tales

T'riffic Tales (Brna and Cooper, 2002; Cooper and Brna, 2001) allows users to construct cartoons, by choosing or drawing characters and backdrops, and write stories based on these pictures It provides word banks which are integrated with the images and are intended in part to inspire ways of using them. Cooper and Brna (2001) cite the example of a baby's thought bubbles showing boredom at watching a love scene between a prince and princess.

- **The camera's role**
  T'riffic Tales does not consider the role of the camera in telling a visual story, and its settings are fixed backdrops. It must be remembered that it is designed for five and six year-old children, and so one might argue that incorporating such factors might make the software too complex for its intended users.

- **Characterisation**
  T'riffic Tales does not allow characters to be posed, focusing more on choosing what kind of people to place in a scene, although new characters can be drawn onto scenes

- **Guidance in moving image technique**
  Users are not explicitly encouraged by T'riffic Tales to consider visual narrative techniques when telling their stories.

3.2.2 Build-Centred

Three specific programs and two more general categories are covered here. Appendix B acknowledges the publishers and describes where further information may be found.

Virtual Puppeteers

Virtual Puppeteers, currently at a prototype stage, aims to allow users to create their own characters by deforming 3D virtual plasticine, and to build their own sets for these puppets to act in. Models can be painted and their motion around the set animated.

- **The camera's role**
  Sets appear to be 'filmed' from a single fixed perspective, and camera controls are not evident in the current version of Virtual Puppeteers.

- **Characterisation**
  It is possible to create a very wide variety of characters by deforming and painting the initial template provided. Separate blobs of plasticine can be moved independently, allowing some different poses to be rendered. It seems difficult for characters to be made to show much variety of facial expression, however

- **Guidance in moving image technique**
  Virtual Puppeteers has an explicit sense of performance; its aim is to allow users to create plays, individually or collaboratively online, with

the puppets and sets they make. However, moving image techniques in themselves are not given an explicit airing.

Presentation and Other Authoring Software

This section gathers together a selection of titles which are linked by their common aim of being authoring tools for slide shows or what might be termed other 'presented content', for example multimedia story books or posters Included here are Textease Presenter CT, Textease CT, BlackCat SlideShow, ImageBlender, 2Create A Story, HyperStudio, KidPix Deluxe 4 and EasyBook Deluxe. They are included here because they all, to a greater or lesser extent, allow the creation of some kind of sequential visual story; Moseley et al (1999) describe one such use relating to KidPix, and MacGregor (2002) discusses a study considering the effect of EasyBook's features on writing.

- **The camera's role**
  All the titles mentioned are really aimed at making more general products than ones specifically related to the moving image, such as storyboards or animations, and this results in the absence of an idea of a camera through which the work is framed.

- **Characterisation**
  These programs provide both drawing tools and clipart selections, but do not generally emphasise expressive characterisation in itself

- **Guidance in moving image technique**
  As noted above, specific moving image concepts are not very relevant to these titles, and do not really appear in them.

Video Compositing and Animators

Presented here is another collection of titles, all related, in this instance, by the facilities they provide to edit together and sequence digital video clips They are Textease Movies CT, iMovie, Windows Movie Maker, 2Animate, I Can Animate, The Complete Animator, Digital Movie Creator 2,

VideoBlender2, VideoStudio 9 and Media 100, some are aimed specifically at stop-motion animation, and others more generally at video editing

- **The camera's role**
  These titles are not designed to help with the creation of visuals, but rather their sequencing, and so it is not possible to construct different kinds of camera shot within the programs themselves. However, the device used to capture the digital video in the first place certainly could allow a great many kinds of camera shot.

- **Characterisation**
  In a similar way to MoPix, these titles do not aim to supply characters as separate entities of any kind.

- **Guidance in moving image technique**
  All of the programs listed above are specifically aimed to allow non-linear editing, and so do recognise this aspect implicitly It is not clear, however, that any acknowledgement of techniques is made, except perhaps in the teacher resources supplied with some of the titles.

Flash

Flash has often been used for creating educational content, and resources such as the Flash Classroom (`www.flashclassroom.com`) suggest that activities requiring students to create their own Flash animations are gaining popularity.

- **The camera's role**
  It seems comparatively easy to create different shot distances in Flash through judicious use of zoom and object scaling, and different shot types can be accomplished by the choice and placement of art on the screen.

- **Characterisation**
  It is possible to construct and manipulate characters in Flash; the results resemble a more general kind of cutout animation with object

morphing However, the construction of characters seems potentially complex, and it does not appear that there are many tools to make the process easier for novice or younger audiences.

- **Guidance in moving image technique**
  Flash as an authoring tool in itself does not appear to explicitly encourage users to consider moving image concepts, although it certainly supports their deployment

Clover

Developed and described by Bailey et al (2006), Clover has been designed to allow 10 to 14 year-olds to create their own animated stories, principally for relating real-world situations and experiences in stories referred to as "vignettes". It integrates tools for planning, scripting, character design, scene design and animation

- **The camera's role**
  Clover does not make any reference to the notion of a camera or of filming

- **Characterisation**
  Users have complete control over each character's appearance, motion around the screen, and their speech or thoughts; indeed, Clover's design philosophy emphasises users making their own artwork rather than using clipart. However, characters are frozen in their initially-drawn poses; as Bailey et al. note, "a limitation of our current implementation is that it does not have a computational model of a character's joints for realistic animation or mouth for precise lip synchronisation".

- **Guidance in moving image technique**
  Clover offers substantial process support for the planning and creation of vignettes, and this overlaps to some extent with support for aspects of kineikonic production, for example the scripting tool, which helps students turn an initial, text-based description of their vignette into a more detailed script prior to animation.

3.3 Motivation for Another Tool

Having seen the variety of software available for making visual stories, it is necessary to ask why another computer tool is worth designing The answer to this comes in two parts.

3.3.1 Scope to Bridge the Content/Build-Centred Gap

The first part lies in the distinction drawn above between content-centred and build-centred titles. In their purest forms, these approaches offer complementary benefits of the *range* of depiction possible, to wit how many different kinds of thing it is possible to show, and the *support* offered in depiction, that is how easy it is to depict things and how much drawing skill is necessary. The content-centred approach offers a structured and focused set of resources which can actually foster creativity (Reid et al., 2002; Birmingham and Davies, 2001), making it possible to generate a limited class of pictures very easily This might be described as offering *low range* and *high support.* The build-centred approach is centred on flexibility and power; it allows one, in principle, to depict whatever one wants, but not necessarily easily! It can thus be said to offer *high range* and *low support.*

It is suggested that it is worth considering how to offer a balanced approach which will unite a broad possible range of depiction with support for depiction Of the titles surveyed in the previous section, four already offer some form of compromise· Kar2ouche, MediaStage, Virtual Puppeteers and Flash. However, they can all be said to have significant shortcomings

- **Kar2ouche, MediaStage**
  These titles permit some manipulation of characters, but do not allow one to create new characters Additionally it is not possible to pose characters at will but only by selecting from the list of options supplied, a factor which impacts the *range* of possible depiction.

- **Virtual Puppeteers**
  It is possible here to create and manipulate characters, but movement

and pose are limited and no facial expressions are achievable, again affecting the *range* of depiction.

- **Flash**
  Flash allows one to create and manipulate characters, but Flash is a complex tool, as evidenced by the quantity of tutorials found at resources such as the Flash Classroom, and this complexity offers little in the way of *support* for the depiction process

3.3.2 Scope to Integrate Three Aspects

The second motivation for another tool comes from the three aspects used to analyse each title surveyed. It is suggested that these features, which are the ability to employ different camera shots, to depict action and emotion by manipulating characters, and to be given concrete guidance in matters of technique, are not fully unified in any one of the tools described above, and that a fuller integration in a new tool is worth investigating

3.4 Conclusion

This chapter has surveyed current options for telling visual stories with software While a great variety of titles exists, it is concluded that, in general, current software sits on one side or the other of a content-centred and build-centred divide, and that, although some titles do make attempts to unite the two concepts, there is still much opportunity to propose another solution. This conclusion is affirmed by the observation that none of the titles discovered fully integrates three aspects desirable in a visual storytelling tool. The process of addressing these issues is the subject of the next chapter.

Chapter 4

Proposal and Research

This chapter proposes a design for a new computer tool for visual storytelling in primary schools which fills the two gaps previously established It goes on to describe the research questions to address with such a tool, and sketches out the process of iterative development and experimentation which is used to answer those questions.

4.1 A New Visual Storytelling Tool: Proposal and Design

The baseline requirement for a tool which aims to support use of the kineikonic mode should ask that it provide the facility to make pictures and place them in sequence Added to this are the following proposals

4.1.1 Bridging the Content/Build-Centred Gap

The objective here is to offer a new compromise between the range of depiction which a tool makes possible and the support for depiction which it offers The starting point is one of the observations made by Burn and Parker (2001) regarding students' use of a vector drawing program, and how those students created characters by manipulating and transforming shapes, tugging at their geometric control points. Burn and Parker identify the notion of

transformation as something which digital technology, and specifically here the vector nature of the drawings, enhances. It is one channel through which digital media can offer a powerful provisionality and flexibility of inscription, provided the data is preserved in an appropriate format, a digital product such as a character, a scene or an animation can forever be reworked and retransformed, and new meanings brought from it.

It is suggested that this kind of transformation provides a useful way to think about compromising between range and support, by allowing artwork, particularly significantly characters, to be manipulated in quite a general way. It is proposed, then, to develop a visual storytelling tool which provides initial characters in a clipart-like bank, but which allows these characters to be transformed far beyond clipart norms. Further, ideally it should allow equally transformable characters to be created from scratch by users, since this would substantially increase the possible range of depiction offered by the tool.

This feature is to be implemented using two complementary approaches.

Use of 2.5-Dimensional 'Enhanced Frontal Orientation'

The approach suggested here starts with a single two-dimensional vector curve-based character drawing, pictured from a straight-on perspective with arms out at the sides in what is sometimes described as a "canonical frontal orientation" (Golomb, 1999, Davis, 1985). The normally 2D control points of this vector drawing are to be stored in 3D space and mapped to a 3D skeleton, so that body parts can be moved as groups to whatever orientation the user desires, hence the label 'enhanced frontal orientation' In addition to this posing, transformation should be further enabled via 'warping', that is, moving any of the control points of a given curve within a plane of a particular bone's coordinate frame. The skeleton is to be manipulated by dragging endpoints of limbs with the mouse, and inferring sensible 3D parameters from this 2D input The proposed effect leads to something like a more flexible version of a paper cutout character; it remains essentially flat but can bend out of the plane and be viewed from any angle.

It is suggested that this approach can act as a powerful enabler for inscription, as it allows one to do much with, and get a lot of 'value' from, a single character drawing, Figure 4.1, produced with the aid of an early proof of concept implementation, illustrates this point. Further, it is argued that it is in some sense at least a natural extension of the way children work: Matthews and Jessel (1993) describe a pattern in which children first bring "robust and enduring strategies" for depiction to a new medium, and that these subsequently "become incorporated into and transformed by the potentialities and constraints" offered by that medium Although this statement is made in the context of much younger children, Golomb's canonical frontal orientation is identified here as just such an enduring strategy, for as she relates it often lasts well into adolescence It is asserted that the enhanced-frontal-orientation approach helps users to leverage that strategy to achieve a greater range of representation, and that it provides a potentially natural and easy way for users to make their own characters, depending on the ease with which drawings can be made and mapped to skeletons In other words, the approach may help children to use their existing strategies in new ways

Emphasising Cartoon Representation

It is asserted that a cartoon representation style, rather than, say, a photo-realistic or semi-realistic rendering style, is the natural partner to an enhanced-frontal-orientation approach using vector drawings. There are two reasons for this, both of which come from McCloud (1994). The first involves a spectrum of depiction which McCloud paints from 'realistic pictures', whose extreme end lies somewhere near the photograph, to 'iconic abstractions', at the far end of which lie alphabetic characters and other symbols which represent something, but which do not at all resemble the appearance (if there is one!) of the thing represented Cartoons occupy much of the ground between these extremes, and all employ at least some degree of what McCloud terms 'iconic abstraction'. It is suggested here that the enhanced-frontal-orientation approach automatically simplifies and abstracts its characters, and thus inevitably moves from the realistic towards the iconic; realistic

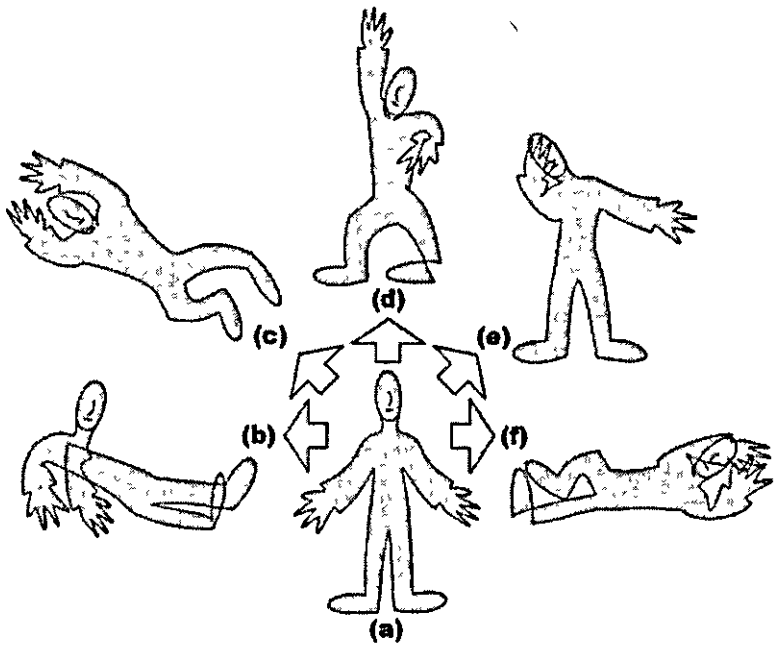


Figure 4 1: When a single initial drawing (a) is mapped to a skeleton under the enhanced-frontal-orientation approach, many different images can easily be produced (b-f)

characters resemble neither paper cutouts nor vector drawings, unless a vast number of vector lines is used, and so characters depicted in such ways have by default moved into the realm of cartoons.

The second reason for asserting a natural connection with cartoons lies with the notion of warping characters, and particularly with warping control points of individual lines to change a character's expression. In a simple vector-drawn face, facial features can be made up of one or a few lines each, and changes to even one control point can make eyes widen, eyebrows raise, closed mouths curl and open mouths yawn, all to a far greater extent than is merely realistic This ties in very naturally with cartoons' ability to offer what McCloud calls 'amplification through simplification', that is, their ability to focus the viewer's attention on a few simplified, exaggerated lines by leaving out the rest.

It is important to note that different cartoons vary a great deal in the extent to which their visuals abstract from reality; therefore, the proposal does not, and realistically cannot, enforce a specific style of cartooning or level of visual realism. However, in the software studies described in this Thesis, to be sketched in Section 4.2 2, the artwork involved was drawn at quite a simplified level of cartooning. This reduced the number of vector curves present, particularly in faces, so as to make warping of the vector drawings as straightforward as possible.

4.1.2 Integration of Two Further Aspects

It is proposed that the approach to characterisation described above be combined with two other facilities.

Simple Camera Functionality

The scope of the software review in Chapter 3 included any software which could be used to make pictures, irrespective of whether it was possible to alter the point of view of a notional camera in those pictures. However, if the proposed visual storyteller is really to support kineikonic storytelling, it becomes necessary to allow at least some latitude for varying camera angle

and shot distance. An important design issue to address concerns the freedom of manipulation to be offered; shall users be able to fly the viewpoint to any location in a fully 3D scene, or will they be more constrained?

A fully 3D 'flyable' camera is likely only to be justified if the ability to move to any possible viewpoint offers real visual benefits This in turn requires fully 3D sets, which seems to significantly increase the complexity of the proposed tool. This, and the philosophy of taking and extending 2D representations presented above, suggest that an appropriate approach lies in the following alternative. Treat the camera as being fixed above a notional infinite 'page' which contains characters and artwork in three dimensions, but which hides use of the depth dimension from the user. Allow the camera to move 'horizontally' and 'vertically' around the page, and to zoom in and out, and all the ingredients necessary to choose the framing of a shot and to construct a variety of shot distances are provided. This is conceptually similar to the way in which hand-drawn animations are filmed; Figure 4 2 gives some indication of the concept

In addition to shot framing and distance, it is proposed to allow the camera to tilt up and down to some extent, in much the same way that a person looking at a poster can tilt their head up and down to look at different parts of it This allows the construction of low- and high-angle shots, which are often used to signify power relationships between characters, and which thus may be worth allowing in a storytelling tool. In the interests of preserving a remnant of simplicity, no other camera manipulation will be allowed

This approach makes the creation of scenes comparatively easy, as they can be constructed from backgrounds and props made from 2D clipart. In the spirit of extending purely two-dimensional resources, it is proposed that bitmap images be effectively texture-mapped to planes so that they, like characters, can be rotated out of the plane of the page.

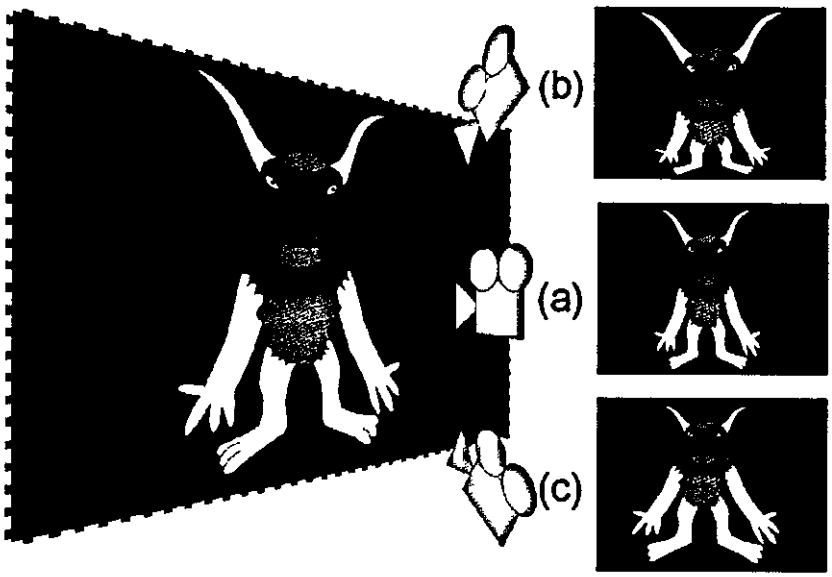


Figure 4.2 Indication of the conceptual model used for limited camera functionality The camera can translate parallel to the plane of an infinite page which can hold characters, clipart and a background, characters and clipart can bend and rotate out of the plane of the page. The default straight-on camera configuration is shown in (a); (b) and (c) show the combinations of tilt and translation necessary for high and low angle shots, respectively.

Direct Process Prompting

The final aspect which, it is suggested, could valuably be integrated into the proposal concerns the provision of explicit guidance in storytelling technique A partial analogue of the HARRY system (Holdich and Chung, 2003) is proposed. HARRY is a text-based writing tool which prompts users to create their own original stories which are built around a pre-chosen theme, for example a woodland adventure or a space story. The user progresses their story by typing it piece by piece in a series of theme-determined stages, each stage is presented on a separate screen as in Figure 4 3, and different stages relate to different storytelling objectives, for example opening the story, describing characters, introducing a complication, and so on. On each stage's screen, a guiding prompt labelled 'HARRY says' is presented which introduces the aims of that particular stage. In addition to this guiding prompt, Figure 4 3 shows the three kinds of help available at each stage These are accessed by clicking on the links in the top right of the screen, and are displayed in a small, separate window as shown. The guiding prompt and subsidiary help prompts are always designed to offer the user storytelling guidance and options, without prescribing exactly what they must write about

As Holdich and Chung report, HARRY's structured process prompts have been shown to have a positive effect on 7 to 11 year-olds' storywriting. There is rather more to the system than described here, particularly concerning the way in which prompts are varied at run-time and can respond to the user; this section has focused on the simplest elements which are directly relevant to the proposal. This proceeds as follows. First, it is argued that both the guiding prompt and the ideas help are more directly concerned with story events, settings, characters and so on in general, and less specifically with *writing* about them. It is suggested, therefore, that the HARRY prompting scheme could be adapted to the process of making a *visual* story; the concept of breaking a story into stages, each having a guiding prompt and an ideas help, translates directly, and it seems quite natural to replace the sentence and word help with the two concepts specifically designed into this tool character visualisation and use of the camera. It is thus proposed that a

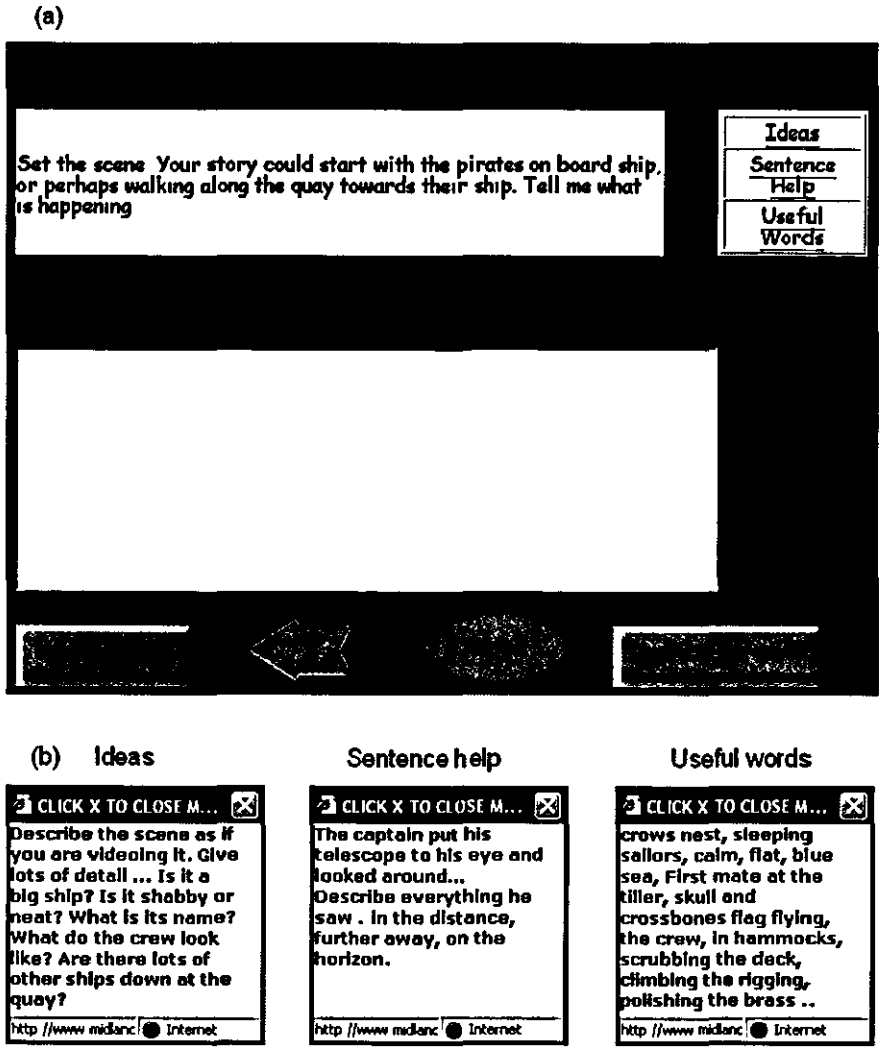


Figure 4 3: (a) A HARRY storywriting screen. The user progresses through a number of these screens as they write their story; each screen is concerned with completing a particular section. The one shown above encourages the user to write the opening of their story. Note the links to the subsidiary help prompts 'Ideas', 'Sentence Help' and 'Useful Words'. These subsidiary help prompts each display their contents in a separate window overlaid onto the main screen; the results for the stage shown above are collected separately in (b).

set of 'visual storytelling prompts' be supplied by the tool to guide users in effective technique as they go about using the tool to make a visual story, just as the text typed into a single HARRY stage is likely to contain more than one sentence, so these analogous prompts are intended to encourage more than one picture per stage. Appendix C gives an example of a complete set of HARRY prompts and a similar set of visual storytelling prompts for comparison.

4.2 Using the Proposal in Research

It must be noted that the software proposals above make no mention of writing. This section will bring this part into focus as one of the research questions to address Once these have been enumerated, the process of implementing the proposal and using the resulting software to answer those questions will be considered.

4.2.1 Research Questions Which the Proposed Software will be Used to Examine

On the grounds of the review carried out in Chapter 3, it is asserted that the tool sketched above represents an original contribution to visual-story-making software, the capabilities it offers children have not been presented to them in an integrated form before. It follows that the first research area to address concerns usability, and this is reflected in Questions 1 and 2 below. Only with affirmative answers to these can issues of literacy, and other effects of the tool, be considered meaningfully; therefore, Questions 3, 4 and 5 follow on.

1. **Is the enhanced-frontal-orientation approach feasible?**
   The test of feasibility here is whether children in the target age range are able to use the character posing and warping features purposefully, time-efficiently, and ideally whether they might be able to create their own posable characters. Titles such as Kar2ouche show that children

are able to use limited posing features to good effect, but the freeform posing and warping presented above offers much more flexibility and so requires a greater degree of direct user manipulation. Whether Key Stage 2 children are able to apply this level of control is the first question to answer

2. **Can children make a sequence of pictures using combinations of posable characters, camera shots and visual storytelling guidance?**

   If the enhanced-frontal-orientation concept proves workable, it becomes time to test how easily students can use it as part of an integrated package which also requires them to choose the camera angle, place multiple pictures in sequence, and respond to visual storytelling prompts. It is also worth seeing how much use is made of the subsidiary helps, to get some feel for their effectiveness.

3. **In what ways can this visual story be used to elicit writing, and what effect does it have on writing?**

   There are many possible models to follow when considering how to use pictures to affect writing, and it is far from clear which one to choose. The guiding principle suggested is the following: whatever approach is chosen should enable resulting writing to stand on its own and not rely on the pictures which were used to plan or stimulate it, since it is standalone written products which tend to be emphasized in the National Literacy Strategy (Department for Education and Skills (DfES), 1998), and, therefore, teaching

4. **Do the visual stories created with the software exhibit any noticeable differences to those created with pencil and paper?**

   Allowing the assertion that providing posable and warpable characters represents a novel software contribution, it becomes interesting to ask if the software-based visual stories differ from those made without using ICT. Pencil and paper is chosen as a comparison medium because it is likely that children will be very familiar with it

5. **What degree of engagement do the users show with the software and the tasks?**

   Finally, it is worth asking how students respond to using the software, and whether they are engaged and motivated by it.

4.2.2 Iterative Testing and Implementation: Roadmap for Answering the Research Questions

The process of answering the above questions covered more than two years from start of implementation to end of final study, and Chapters 5 and 6 present the details. This section aims to summarise the stages in that process to give an idea of the context into which those chapters fit Each stage had its own software implementation whose design fed on to the subsequent stage. Further details as to software development may be found in Appendix D

First Pilot Stage

The first area of software to be implemented was the enhanced-frontal-orientation facility. A simple custom-built sketching tool was developed so as to avoid having to import a potentially complicated vector format from another tool The skeleton aspect was implemented using a standard Denavit-Hartenberg representation (see, for example, Spong and Vidyasagar, 1989), and the necessary interfaces to pose the skeleton and warp the character were created.

This resulted in an early prototype offering users only the posing and warping facilities for a preset character. Testing this prototype, and thus answering Question 1, is covered in the first part of Chapter 5.

Second Pilot Stage

Following affirmative results from the first pilot study, the first integrated form of the software tool was developed, and its usefulness for making visual stories and eliciting writing assessed; this therefore addresses Questions 2

and 3, and sheds some initial light on Question 5. The results of this stage form the second part of Chapter 5.

Main Study Stage

Finally, the lessons learned from the pilot studies were applied in a second version of the full software and the design of a further study. This was intended to further address Questions 3, 4 and 5. Chapter 6 describes the findings

Implementation Caveats

Software implementation of the concept sketched in Section 4 1 progressed before and throughout the time of the studies noted above. However, some features did not progress so far as desired.

Perhaps the most significant departure from the aspirations of Section 4.1 is that the facility to enable users to make their own posable characters was not completed. A toolkit for character creation was produced for the investigator's use quite early on, but it was judged that refining it to the point where it could be used easily by children would take too much additional time. However, this does not invalidate the assertion that the enhanced-frontal-orientation approach can facilitate children's production of characters; the assertion simply remains to be tested.

A second point concerns the failure to implement speech bubbles. The desire to have these was raised by teachers, but again time constraints prevented their development.

Finally, it is worth considering the degree to which the visual storytelling prompts depart from the idea of the original HARRY system. The most notable discrepancy arises from more or less practical concerns. as described, HARRY prompts guide the user in telling a story on a particular theme, but do not assume the precise events which will occur. By comparison, all the studies to be described in this Thesis require users to re-tell a known story, be it a fable, a religious sacred story or a poem. This approach was chosen largely because it significantly reduced the amount of artwork necessary to

be supplied; if latitude is given in the story's possible events, as HARRY encourages, provision must be made for many different possibilities to be visualised by users, and matching the level of implicit variety in the HARRY prompts with visual content, by supplying a suitable range of characters and clipart, would only have been workable had the investigator been able to secure appropriate external help. It is important to recognise that this does not restrict the *way* in which the story can be told; as Queneau (1981) shows, the same story can be retold in many different ways, and the software's visual storytelling prompts were intended to allow this kind of latitude at least. There are other discrepancies; as can be seen from examining Appendix C, the sequence of visual storytelling prompts covers far fewer stages than the HARRY sequence. Again this was something of a practical choice based on a cautious attitude to the time it would take children to produce pictures for each stage Finally, this system's visual storytelling prompts contain no notion of a 'keyword response' or of a revision/feedback stage (Holdich and Chung, 2003)

Now that these implementation caveats have been acknowledged, it is time to consider how the research and the software progressed over the course of the studies. This is the subject of the next two chapters

Chapter 5

Pilot Studies

This chapter discusses two field tests of the software as its development progressed The first took place after the character posing facility had been implemented in a proof of concept program. Following this, the software was expanded into a first-approximation implementation of last chapter's proposal, and its usefulness in eliciting writing was tested in the second study. The findings are presented below, and the chapter ends by summarising the necessary modifications, both to writing process and software, which were carried into the main study.

5.1 Pilot Study 1: Character Posing

As identified in the last chapter, the character posing facility is the first element of the software proposal to test; if this proves unworkable, the rest of the proposal needs substantial modification. Accordingly, the first part of this chapter discusses a small-scale test performed at the end of the Summer term 2004 which aimed to answer the first research question· is the enhanced-frontal-orientation idea for characters feasible?

The measure of feasibility defined in Chapter 4 covers three areas first, whether children are able to purposefully pose and warp an enhanced-frontal-orientation character to achieve deliberate effects, second, how efficiently they spend their time in achieving these effects, and thirdly, whether they are able

to create their own transformable characters. This study concerns itself with the first two areas, ideally, further research would address the feasibility of character creation. The achievement of deliberate effect is measured through setting small characterisation tasks to be described below, the length of time a participant took until they stopped doing the task is used to get a sense of time efficiency.

5.1.1 Process Design

The version of the software used here is an early proof of concept, which provides the features shown in Figure 5 1. When started, it displays Sylvester the (other!) cat in a large area above a small text caption which summarises a particular task, the initial one being a practice. The character warping and posing functions are mediated by two mutually exclusive modes, when the warp mode is enabled, the character is drawn without the underlying skeleton, and mouse motion over each vector curve comprising the character causes that line to 'light up' with draggable 'handles' which allow the vector control points to be edited When pose mode is selected, the skeleton is made visible within the character, and handles appear which allow the bone endpoints to be manipulated; mouse motion over the curves in this mode produces no effect For more details on the mechanics of these processes, see Appendix D, the choice of mode separation will be revisited briefly in the summary section.

The investigator brought this software, pre-installed onto a personal laptop, into a Birmingham primary school for two separate sessions, each with a pair of participants who took turns to use the software. Each pair was given the same short guided introduction to demonstrate the software's features, and after this each participant was asked to pose Sylvester to reflect four different text captions sad, thinking, scared, and running. These were arbitrarily chosen with the intention that they would represent good opportunities for expression; the last was intended to be a more challenging task requiring an action pose. The arrow buttons shown in Figure 5.1 allow users to cycle through each task; the software automatically saves their work on

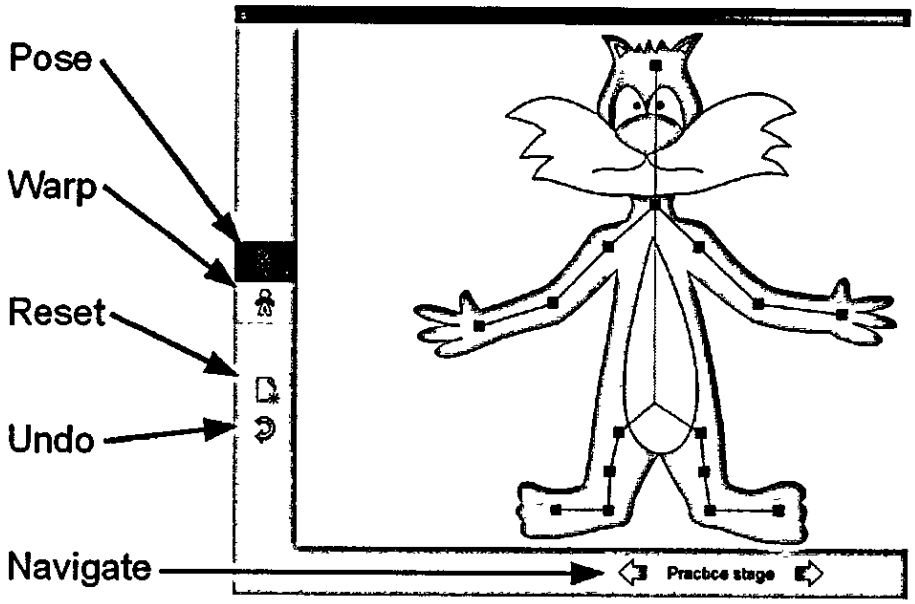


Figure 5.1: The proof of concept software presented to participants in the first pilot study. Users are able to switch between the warp mode and the pose mode (the latter mode is displayed here), reset the character, undo changes, and navigate between the tasks summarised in the text caption at the bottom

the current task each time they click through to the next.

One pair of participants came from Year 4 (8-9 year-olds), and one from Year 6 (10-11 year-olds); they were selected non-randomly using each class teacher's judgement regarding which students were best suited to participate as a pair on the day.

The Year 4 pair worked with the software on one day, and Year 6 on a subsequent day without having seen what was previously done An hour was budgeted for each pair's session; the first ten minutes were spent introducing both participants to the software's capabilities, and then participants took turns to choose and execute a task.

5.1.2 Achieving Deliberate Effect: Software Usability

The initial answer as to whether target users can create specific effects is affirmative: in this study all participants handled the stage navigation easily, chose to approach the tasks in their own preferred order, and posed and warped the character appropriately in the subjective judgement of the investigator. It should be noted that 'appropriately' does not necessarily mean 'distinctively' or 'comprehensively'; all participants demonstrated that they understood the function of each part of the interface, but the younger pair in particular seemed uncertain as to exactly what to do with the facilities at their disposal. Figure 5 2 illustrates this point in the case of the scared posing task. It can be seen that the Year 4 versions are very similar to each other; in fact Participant (d) simply made a slight adaptation to the top half of Participant (c)'s effort, rather than choosing to reset the pose. The Year 6 efforts, on the other hand, demonstrate a greater focus, Participant (b), whilst seemingly having made quite a similar pose to the Year 4 pair's, was observed to take significant care to move the arms and warp the fingers so that they were able to touch the character's mouth, and Participant (a) put substantial effort into warping the character's face. This greater sense of attention and adventurousness seems to run through all the tasks to some extent, although the distinction lies more in the *degree* to which the character is altered, not in what aspects are chosen for alteration; both pairs widened the eyes, altered the eyebrows, moved the limbs, and so on, but to different extents.

Considering the effectiveness of the interface, that is, to what extent its features helped and/or hindered users in achieving their chosen effects, one main observation is made; participants took some time to get used to the idea of having to switch between the pose and warp modes to achieve different effects, and often forgot that it was necessary This would lead to a rather unforgiving cycle in which participants would decide on a pose or warp action, move the mouse to the requisite place on the character to carry out the intended action, and only then remember that this action required the other mode; they would then have to move the mouse over to the 'change mode'

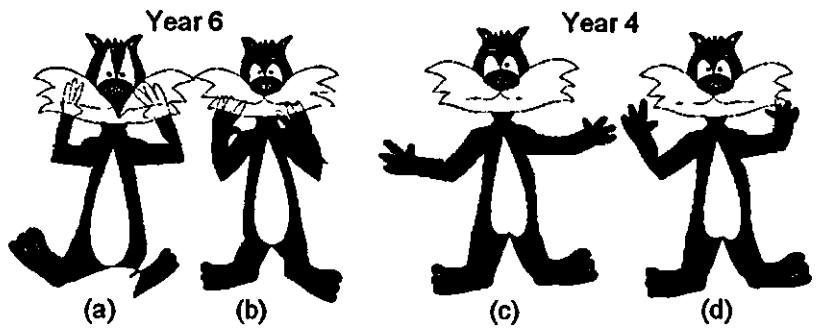


Figure 5 2: Comparison of all four participants' scared poses.

button before moving back to the original area. The methods of posing and warping themselves, effected by dragging curve or skeleton handles, proved quite successful, with all participants proving able to alter limbs and features to at least some extent. The results for the sad, thinking and running tasks are shown in Appendix E.

5.1.3 Time Efficiency

A marked difference arises in the time the two pairs spent on the four posing tasks, the average time spent by a Year 4 participant was 2 minutes 58 seconds, whereas for a Year 6 participant it was 3 minutes 57 seconds This is consistent with the observation that the Year 6 participants generally made more extensive alterations to the character.

The comparatively short time each pose task required led to a considerable amount of spare time in each session. Both pairs were offered the chance to leave early, but instead all chose to stay and produce some extra work. The Year 4 pair jointly decided that they would each make a surprised Sylvester, while in the Year 6 session, a game of charades emerged spontaneously when participants took turns to secretly choose a new caption, depict it and then ask the investigator to guess what they had in mind, both participants succeeded in communicating their choices. These 'extra time' poses are shown in Figure 5.3.

5.1.4 Pilot Study 1 Summary

This pilot study serves to validate the overall enhanced-frontal-orientation concept; asking users between 8 and 11 years old to transform a character through posing and warping is feasible. Users proved able to employ the software functions for deliberate effect, and were capable of achieving that effect quickly. The younger pair produced poses which were less different to the initial pose, and could be judged to be less adventurous or effective, than the older pair. However, all four participants got to grips with the basic features of character manipulation very quickly The probable age differentiation effect may suggest that the software would best be aimed at the later half of Key Stage 2, covering Years 5 and 6, that is, 9-11 year-olds.

The explicit distinction which the software's interface makes between a pose mode and a warp mode was workable but proved unintuitive; nevertheless, it was decided to maintain the mode distinction. The only immediately apparent alternative was to have skeleton and curve manipulation handles available in the same mode; informal tests of this approach showed that it often caused overlapping handles to interfere with each other, leading to an unhelpful interface. It was thus judged that testing this approach in more depth was not worthwhile

Finally, the 'reset pose' feature was marked for replacement with a redo feature to complement the support for undo, resetting a pose is implicitly supported in later versions of the software by reloading a character.

5.2 Pilot Study 2: Cartoon Storywriting

The first pilot study verified that the most novel aspect of the software, that is the provision of warpable, posable clipart, was usable. The second aimed to see how children coped with the first version of the whole software package, in the context of making a cartoon version of Aesop's fable of the Fox and the Crow, and writing about sections of it from the point of view of one of the characters. The writing was compared with that of another group who were given the same task, but who followed a closer-to-normal process The

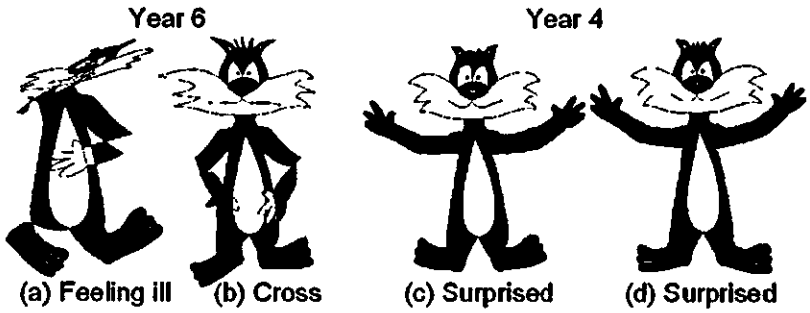


Figure 5.3: The additional poses created by all participants. The Year 4 pair jointly chose to depict a surprised Sylvester. The poses are very similar, it is suggested that this younger pair were less confident at making independent decisions as to what to visualise, and so tended to copy ideas from one another.

second pilot study took place late in the first half of the Summer term 2005.

5.2.1 Software and Process Design

The software used in this study represents the first attempt to implement the full proposal of the previous chapter It is described here, alongside the study context in which it was used.

Software Design

The second pilot study's software follows the HARRY design in its integration of story stages, but here, as per the proposal, the prompts are geared towards helping users create a visual story rather than a written one. The software presents a sequence of 'stage view' screens like a series of pages as shown in Figure 5.4. Each stage view shows its stage's shots as thumbnails placed on a free-form 'page', no shot-to-shot sequencing is enforced, so that a thumbnail may be placed anywhere and moved around on its page The visual storytelling guiding prompt, intended to convey the purpose of the stage, and the three subsidiary help buttons, are placed at the bottom of the stage view. In order to better view and edit a shot, the user is required

to 'jump into' it, whereupon the screen changes to the 'shot view' shown in Figure 5.5.

The previous study's pose and warp functions are located in this shot view, together with options to load artwork, scale it, change the order in which it is drawn, and set a background image The investigator was further advised to include the facility to change characters' colours; thus in this version of the software, recolouring is supported as a secondary mode of the warp mode. This might not seem an obvious choice, but in fact recolouring and character warping share much of the same interaction features, particularly the selection and editing of a character's lines and areas with the mouse All of these artwork-related controls are presented in one tab; a separate tab gathers together the camera controls, namely zoom, translation and tilt

Concerning the camera controls, it is worth noting that this version of the software exhibits a substantial limitation which will be termed the 'constant background effect' It consists of the fact that picture backgrounds are unaffected by zoom, translation or tilt, so that no matter how these camera parameters change, the background image resolutely retains a constant appearance. This is to be contrasted with characters and clipart, which render correctly under camera changes.

Finally, it is also possible to 'jump into' a shot in a second way, not to edit it but to write text for it, in which case the picture is displayed in large view above a text entry box. More shall be said about writing for the pictures in Section 5.2.4.

Process Design

This study aimed to compare point-of-view storywriting work produced under two different processes: one using a group brainstorm-then-write approach and the other using the software These processes were followed by a control and an experimental group, respectively, both groups' sessions were led by an experienced teacher-leader, previously a teacher of this age group at a different school The investigator was present at all sessions to act as a facilitator.

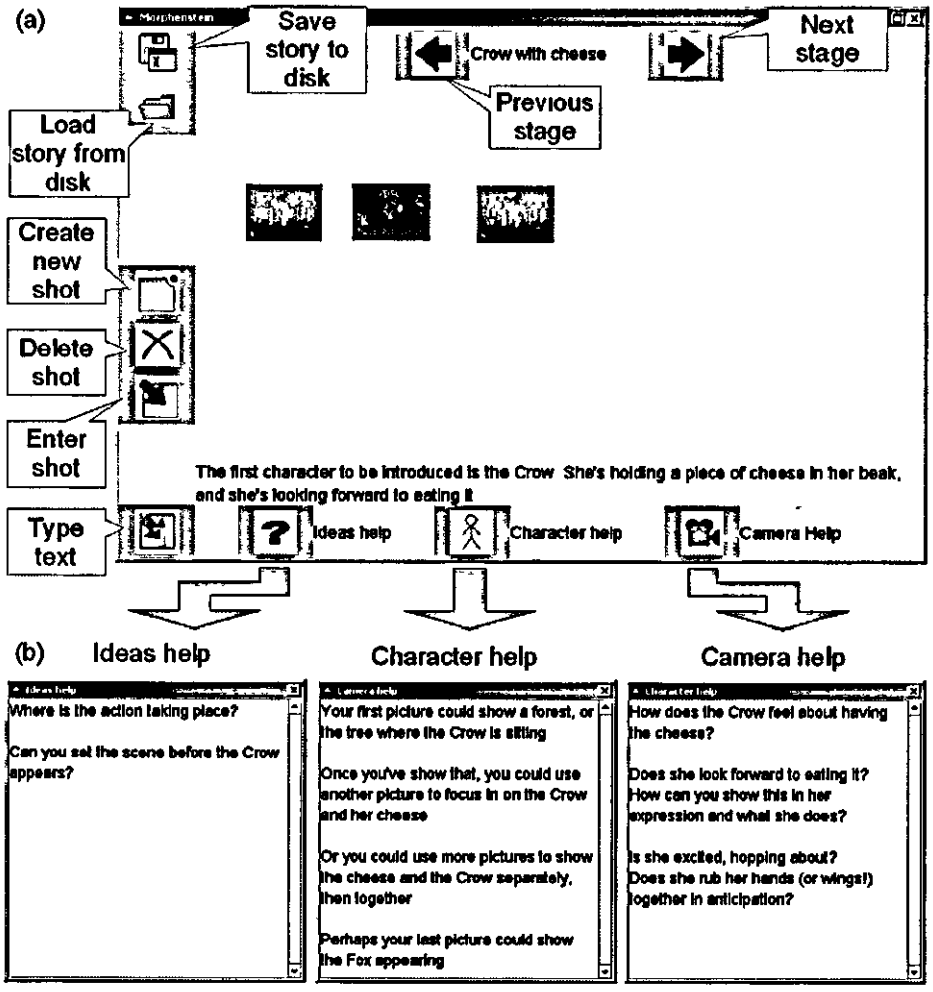


Figure 5 4: (a) A typical 'stage view' screen, with the visual story-telling guiding prompt to be seen to the bottom. The three subsidiary help prompts are shown in a smaller window when the user clicks on the relevant button As with HARRY, at most one of these extra help windows is shown at any one time; for convenience all three are collected together in (b)

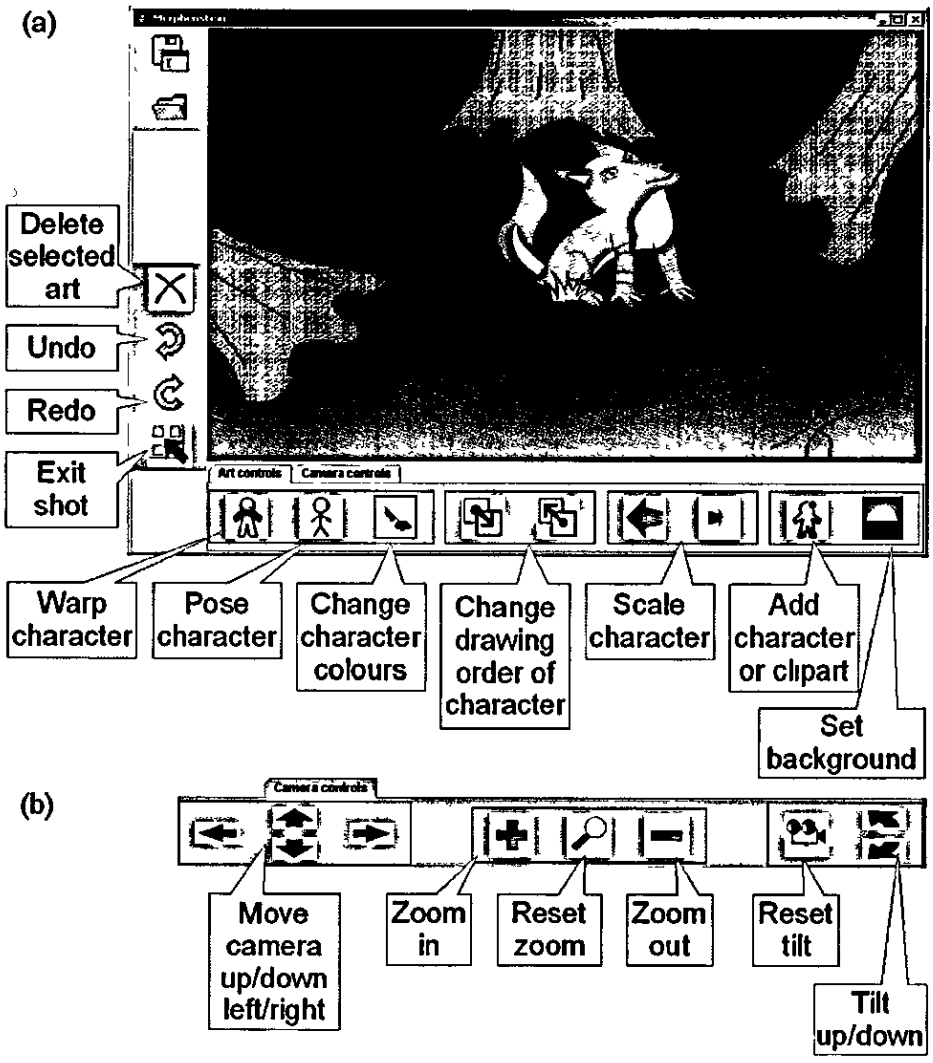


Figure 5.5: (a) A typical 'shot view' screen, where the user can manipulate artwork and backgrounds, and change the camera view. These functions of artwork manipulation and camera control are mediated by tabs at the bottom of the screen, (a) includes the former tab, and the latter is shown in (b). The 'change drawing order' buttons may be used to make characters or clipart appear in front of or behind others.

The control process reflected the teacher-leader's preferred practice of first guiding a brainstorming period, to orient participants to the task and highlight useful words, and then initiating an independent work period in which participants wrote to the task identified in the brainstorm In addition, it was intended that the control group would be given a chance to use the software after their writing was complete, so that they would not feel left out or marginalised.

The experimental process was chosen so that the final outcome would resemble an illustrated storybook, consisting of a series of pictures, each one paired with its own piece of text. It was intended that participants would first create their pictures in one period, then 'jump into' each one in turn in a writing period to enter the appropriate text.

Each group consisted of six participants from the school's only Year 5 class, they were taken out of their normal class routine for the sessions. All participants used school laptops for their work; the pattern of use is depicted in Table 5 1. As can be seen, the experimental group were given an introduction to the software in a preparation week, however, the activity chosen here did not involve the fable of the Fox and the Crow or its characters or artwork.

The fable of the Fox and the Crow was split into three sections: the opening (Crow with cheese), the middle (Crow is conned) and the end (the Fox gets the cheese), and appropriate visual storytelling prompts created; these may be found in Appendix C. Each group followed their process for each story section in turn over three weeks, as shown in Weeks 1 to 3 in Table 5 1. These weeks were planned to encapsulate fairly self-contained exercises; the intention was that in each week, the participants would write about a new stage in the story. This meant that the control group wrote the story in three separate chapters. The experimental group also had three separate prepare-then-write sessions, each focusing on a separate stage of the story, but in Week 3 the investigator was advised to collate their previous week's work so that participants could have a chance to finish text which they had begun entering for pictures they had made in Weeks 1 and 2.

The three-week approach of separating writing into discrete, short, ses-

	CONTROL GROUP		EXPERIMENTAL GROUP	
Preparation week	———		30 minutes	software introduction
Week 1 Crow with cheese 45 minutes	30 minutes 15 minutes	brainstorm/plan write story	30 minutes 15 minutes	make cartoons write captions
Week 2 Crow is conned 45 minutes	20 minutes 15 minutes 10 minutes	brainstorm/plan write story software play	30 minutes 15 minutes	make cartoons write captions
Week 3 The Fox gets the cheese 45 minutes	20 minutes 15 minutes 10 minutes	brainstorm/plan write story software play	30 minutes 15 minutes	make cartoons write captions

Table 5.1: The process design for the second pilot study

sions, was taken after a preparatory classroom observation session. This gave a sense of the tasks typically set for students; in particular, it was noted that, given a simple theme, they were expected to be able to decide on appropriate content and transcribe it by hand in fifteen minutes. In this study, therefore, it was judged that a fifteen minute computer writing period, after content had been planned in the initial brainstorming or visualisation period, was reasonable

Initial Reactions to the Control Process

It was found in Week 1 that the four participants initially present in the control group did not use their time constructively, frequently moving off-task, suggesting inappropriate content and feeding off each other's disruptive behaviour. Despite the best attempts of the teacher-leader and investigator to engage them, several participants were observed to put little effort into their tasks. It is suggested that this response can be interpreted in light of the fact that the pilot study task was very obviously separate from the participants' normal school context: it was led by two visitors unconnected to the school,

and the work produced did not form part of the whole class's portfolio. This lack of context may have given rise to a sense among participants that the task being set was arbitrary, irrelevant to their other activities in school, and thus did not require them to take proceedings seriously.

Therefore, in Weeks 2 and 3 the control arrangements were modified, in an attempt to better draw those participants into the task. There were two main adaptations made. First, it was the teacher-leader's and investigator's judgement that the control group's chance to use the software should be brought forward to Week 2, so that it could be used in that week as well as in Week 3, as an incentive to stay on task. Although taking this time clearly reduced the time available for text generation, this reduction was judged acceptable given that the participants had used the extra time in Week 1 unconstructively Secondly, one control group participant seemed especially disaffected at the prospect of typing at the laptop keyboard, so in Weeks 2 and 3 the teacher-leader acted as a scribe, typing the sentences which this participant dictated. In Week 3, the investigator also acted in this capacity for one experimental group participant. This was not done because of disaffection, but rather to enable this participant to finish their intended text in the time available

5.2.2 Moving Image Language in the Visual Stories

This section will examine the pictures and sequences made by the experimental group participants. It will pay particular attention to the moving image language employed, that is, to what extent filming and editing techniques are used The following software affordances relate to these aspects

- the ways in which participants tried to use the software camera to go beyond a single fixed perspective
  - the shot distances used;
  - the use of tilt;
- the extent to which sequencing was used

Shot Distance

The camera translation and zoom features were reasonably well used; participants made use of a variety of shot distances, mainly in the long to mid shot range. Table 5 2 shows the breakdown; to make classification robust, a coarse system spanning three distances, those of long, medium and close-up, is used. It can be seen that long shots dominate, with five of the six participants making at least half of their pictures long shots. Close-ups are much rarer; three participants produced one each. This may be largely explained by the constant background effect identified earlier, no background images were supplied depicting a close distance, so it may not be very surprising that there were few close-ups!

Depicting backgrounds in close-up is not impossible; greater flexibility can be achieved by assembling backgrounds from the limited bank of clipart supplied to the participants, and this is just what Figure 5.6 shows was done in some pictures. Manually assembling a background by repeatedly choosing, inserting and scaling individual pieces of clipart is a rather more involved task than just choosing a single image, so it is likely that the constant background effect was dominant

Overall, however, the participants showed at least some ability to move beyond a single fixed perspective in order to better focus on salient story elements, even though this was not expressed as fully as it might have been had more close-ups been deployed Figure 5.7 shows four examples of particularly effective choice of zoom; it can be seen from the accompanying text which the participants wrote that they were thinking about what to depict and how to depict it.

Tilt

Use of tilt to construct low or high angle shots is likely a secondary concern; not every shot of a moving image sequence can be classified as specifically a low angle or a high angle one, and these names tend not to be emphasised in introductory material (see, for example, Parker et al , 2001). It was nevertheless decided to allow use of tilt just to see whether it would be applied

Participant	Pictures made	Frequency of Long	Mid	Close-up	Long shot percentage
1	4	2	2	0	50
2	5	3	1	1	60
3	10	7	2	1	70
4	9	5	3	1	56
5	7	3	4	0	43
6	6	5	1	0	83

Table 5.2: Breakdown of shot distances deployed by the experimental group participants. As can be seen, long shots took a lion's share in each case, while close-ups were very rare.

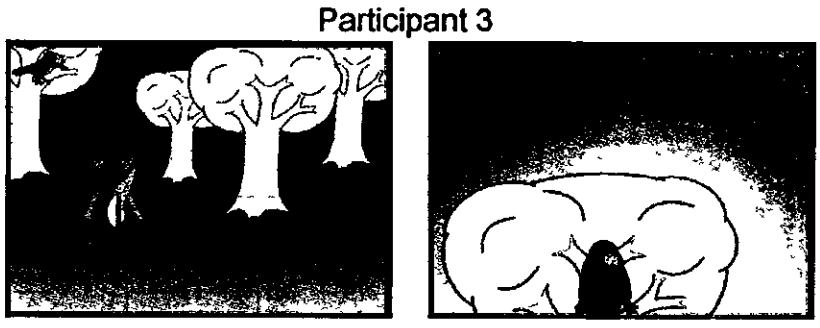
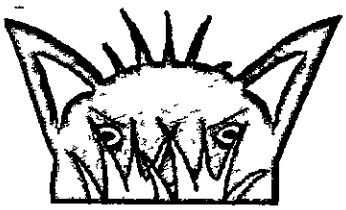


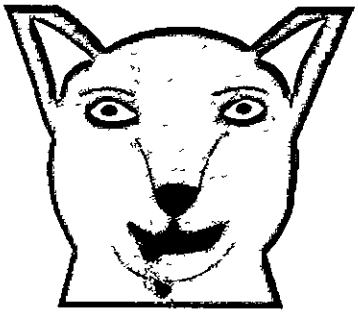
Figure 5 6: Two examples in which a participant has assembled a background to their scene by combining simple elements

Participant 2 – fox narrates



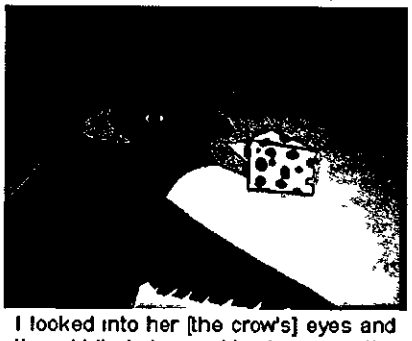
I am spying on the crow because she has got cheese that I want

Participant 3 – crow narrates

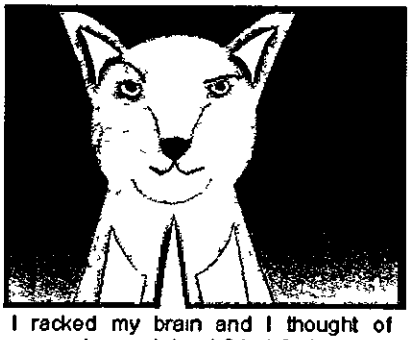


Look at that fat stupid ugly fox dribbling with his mouth open he's such a pig How dare he think he can have my nice chunk of cheese He looks so ugly I don't even feel sorry for him It's his fault he hasn't got any nice lovely cheese he should look harder next time

Participant 4 – fox narrates



I looked into her [the crow's] eyes and thought that she would not give me the cheese so I thought of a plan to get it



I racked my brain and I thought of some plans not 1 not 2 but 3 plans just in case one of them did not work

Figure 5 7 Four pictures, together with captions, which when taken together demonstrate that participants have used zoom to focus in on a specific element of the story, and to direct viewers' attention to it

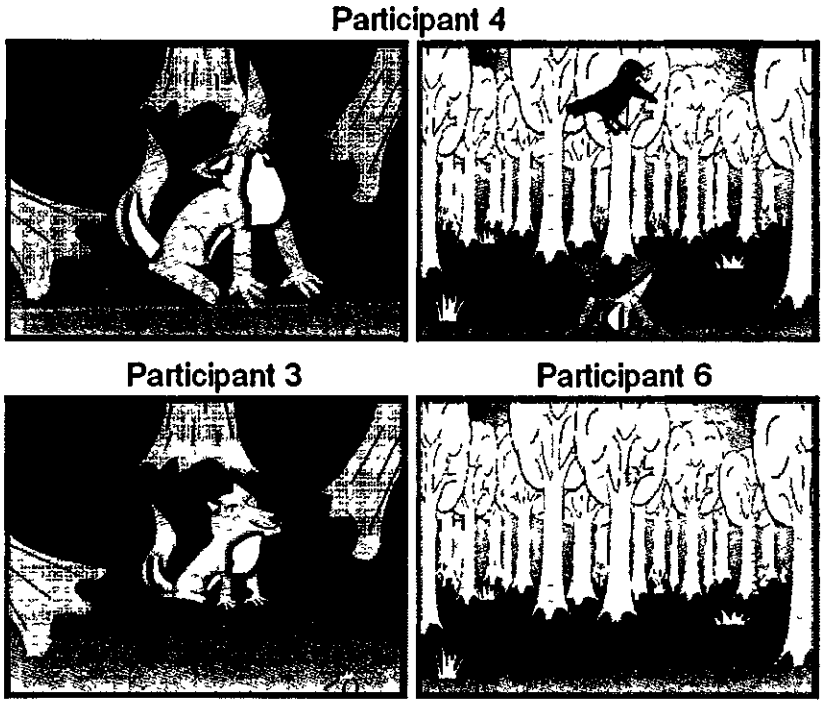


Figure 5 8 All four pictures which made use of the tilt facility Note how the 'constant background effect' reduces the effect of tilt drastically.

by participants.

As with zoom, the effect of camera tilt was rendered a great deal less noticeable in this version of the software owing to the constant background effect described earlier. However, three of the six participants experimented with the facility, two applying it in one of their pictures and one applying it twice as shown in Figure 5 8. There is a strong sense in all of these pictures that participants were deliberately trying to look up at the crow or the cheese in contention, or down at the fox, and so it is concluded that the concept of tilt can be accessible to participants in situations where there is a strong sense of height in the story.

Use of Sequencing

The version of the software used in this study does not impose a strict notion of sequence; story stages are presented sequentially, but for each of these a user can make an arbitrary number of pictures and arrange them however they desire on the stage view screen. Indeed, one point of interest of the study was to see to what extent sequences arose out of the participants' work when they were not a prescribed feature

The default behaviour of the software causes newly created pictures to appear in the stage view sequentially 'stacked up' on top of each other, each subsequent one slightly below and to the left of the last, until they are manually repositioned Well-defined sequences can certainly be made by appropriate manual positioning, but this is by no means the only configuration of pictures which the stage view permits. Consequently, although all participants made use of the ability to move pictures around at the stage view, only one *consistently* arranged pictures into a linear comic strip arrangement for all three story stages. Three other participants used the repositioning facility to generate clear left-to-right sequences for at least one of their stages, and the remaining two arranged each stage's pictures across the screen with no discernible sequence. In the majority of cases of well-defined left-to-right sequences, the order in which pictures were initially created is the same as the order in which they are finally presented at the stage view; the intended sequence thus seems to be inherent in the making of the pictures themselves, with participants having it in mind either openly or implicitly from the inception of each picture

Moving Image Language Summary

One of the aims motivating the software's design was to make simple camera language more accessible and easier to achieve, and it is suggested that the features of experimental group's work discussed in this section show that aim to have been achieved to some extent. The tools the software provides for narrative expression via camera language were, at least partly, successfully used; participants chose a variety of shot distances, some attempted

to use camera tilt, and half spontaneously created well-defined left-to-right sequences The overall conclusion is that the software's camera language features proved usable enough to be applied at least some of the time.

5.2.3 Software Use

This section will turn from the pictures made by the experimental group to the way these participants used the software's features to make them. The aim is to see what conclusions can be drawn about the software's interface, and the main area of interest is that of artwork manipulation the way in which the characters were posed, had their expressions changed, were recoloured, and were layered in scenes.

Manipulation of Artwork

So far as the character pose and warp features are concerned, there seems to be quite a sharp distinction between participants who used the facility to a large extent and those who did not. As shown in Table 5 3, half of the participants significantly posed or warped characters in 71% or more of their pictures, while the other half made significant changes 33% of the time or less, with one never substantially deviating from the characters' default poses or expressions at all!

It can therefore be seen that each participant made a significant number of pictures which used characters in or close to their default poses In part, this may be due to the fact that these default poses were not all that neutral. The Fox in particular was depicted as already wearing a reasonably interesting, that is, non-neutral, expression, and was probably appropriate for use in a number of contexts 'straight off the shelf'. It must be noted that pictures using the default poses were not necessarily unimaginative, for example, one participant used the Fox in its default front view but made it hide behind some grass in quite an imaginative way (see top left picture in Figure 5 7). However, five of the participants produced one or two pictures making quite interesting use of pose and warp to achieve a deliberate effect. Figure 5 9 highlights these.

Participant	Number of pictures with significant pose/warp	Total number of pictures made	Percentages
4	7	9	78
1	3	4	75
5	5	7	71
3	3	10	30
2	1	5	20
6	0	6	0

Table 5.3: Percentage of pictures made by experimental group which used significant posing and/or warping.

The facility for altering the colour of parts of characters was not used at all, except for one picture in which one participant turned the ordinarily black Crow into a blue one for no immediately apparent reason.

User Interface Issues

So far as the visual storytelling prompts are concerned, although it is not possible to tell how much attention users paid to each stage's guiding prompt, since it is automatically displayed, software logs show that they very rarely requested the *subsidiary* helps. There is also evidence that the explicit partitioning between story stages and screens was not welcomed; of the four experimental group participants who were present for all sessions, two chose to conclude their cartoon stories on the second stage screen, adding to the pictures already there and leaving the third stage screen blank. This is particularly notable in the case shown in Figure 5.10, where the participant in question has very clearly chosen to show an unbroken sequence of pictures which spans the middle and end stages. The inference drawn here is that users' desire to make a continuous sequence may conflict with the guiding prompt suggestion that each screen should contain only pictures for that stage.

In addition, participants encountered a number of problems with the user interface for certain tasks. Perhaps the most notably problematic area was

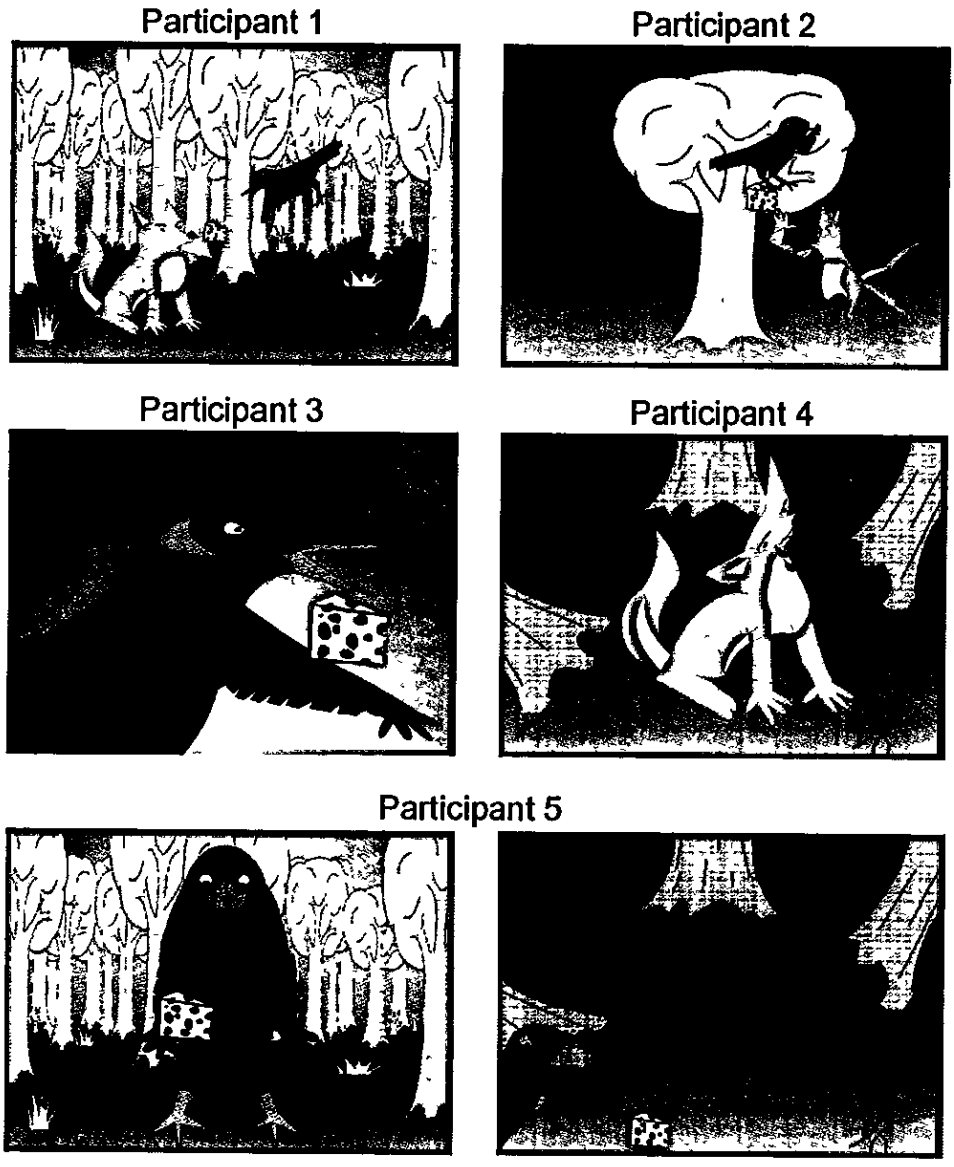


Figure 5 9: Six notable examples making use of non-default poses and warps.

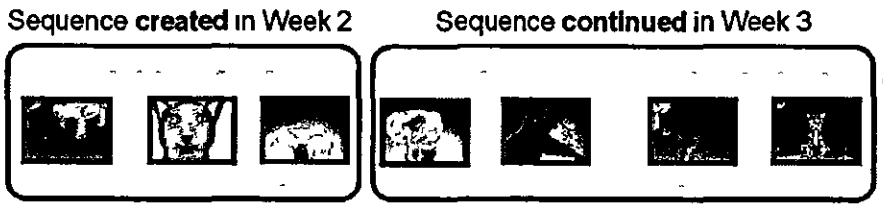


Figure 5.10: An example of a participant ignoring the partitioning of story stages between different screens in favour making an unbroken sequence. The leftmost three pictures were created in Week 2, and the rightmost four in Week 3.

the area colouring facility, which is presented as an offshoot of the character warp mode. The warp mode presents two methods of selection: the default, which uses simple mouse pointer motion to select a line or an area, and a click-based mode. In the default selection mode, a user can alter the shape of a line by first pointing at it, causing it to 'light up', and then manipulating the draggable 'handles' which appear automatically. The line remains selected as long as the mouse is near the line and does not point at any other line This scheme works very well for most situations, but, when there are many lines near each other, selecting the exact line one has in mind becomes very hard In this not uncommon situation, this version of the software allows a line to be selected indefinitely if it is clicked on, the selection being cleared only by another mouse click somewhere else

Areas can also be click-selected, and it is through this mechanism that they are coloured. When the mouse passes over a coloured area of a selected character in warp mode, this area is drawn with a green dashed border to indicate that a subsequent click on that area will select the area itself, which can then be recoloured by means of a menu button.

This approach is workable, but it led to quite a fiddly trap, observed on several occasions Participants would often inadvertently click-select an area and then be unable to leave this selection mode without the investigator's intervention; they had some other task in mind but, on their way to carrying it out, became locked in the area selection feature instead.

It is suggested that two factors combined to create this trap. The first relates to task separation in this version of the software. Since coloured areas occupy a great deal of 'real estate' on-screen, they are very easy to point to and click-select, making the area-colouring procedure very easy to fall into by accident; the process is thus in a sense very close to that of altering a line to warp a character. The second issue, which served to exacerbate the first, is that of mouse precision All participants were very familiar and confident with the laptop touchpads being used, most actually expressing a preference for these over normal mice when this alternative was offered. However, while being perfectly happy with using the pads, participants were quite often observed making what can be termed 'click-and-miss' precision errors, in which they aimed the mouse at something but hit something else, and 'click-instead-of-drag' errors, in which they attempted to initiate a mouse drag on an object but ended up clicking on it instead. Both of these errors can result in the inadvertent click-selection of an area and thus cause a user to fall into the trap described.

The problem of pointing precision had been anticipated, and buttons and handles were deliberately sized larger than is normal, but it seems that the handles were not large enough to prevent click-and-miss on quite a few occasions The click-instead-of-drag problem had not been anticipated.

Finally, the way in which the software handles art layering, so that characters and clipart are drawn in the order in which they are added by the user to the picture, caused some confusion when participants wanted to move one piece of art behind another However, in the short term, solving this was simply a matter of having the teacher-leader and investigator answer broadly the same question many times.

Software Use Summary

All experimental group participants proved able to use the software to make several pictures which incorporated characters and clipart placed on a background image. As noted, all adopted a simple clipart-like approach, by not posing or warping characters, in a significant number of their pictures How-

ever, there are examples which show participants using the pose and warp features to go beyond the capabilities afforded by a clipart-based approach at least some of the time; all but one participant seemed to use these functions to achieve some deliberate effect in some of their pictures. The most notable of these have been highlighted

So far as the user interface is concerned, a certain degree of fiddlyness has been identified Click-and-miss and click-instead-of-drag errors were observed on several occasions, and the interface must be tweaked to avoid side-effects of these errors like the area selection trap described.

5.2.4 Comparison of Story Text

This section examines the story text produced by experimental group and control group, to see if the different writing processes followed by the two groups resulted in noticeably different end products. The issue of quantity will be the first to be examined, followed by a discussion of the tense used, the nature of the content and, finally, some comments on language use

Quantity of Text Produced

Table 5 4 shows the number of words typed by each participant each week and in total. The two participants who were scribed have been separated from the rest of their respective groups, since they were effectively given extra input compared to the others.

Week 1 seems to have presented something of a hurdle to the experimental group so far as text production is concerned, this was the first week in which they followed the full writing process, not having had time to enter text in their practice session. It is suggested that the main cause of the text shortfall in Week 1 relates to participants prioritising picture creation over text production, the writing process followed by this group involved first making pictures, then writing about them, and participants did not seem to handle this switch very neatly, particularly in Week 1. Even when the leader gave clear and repeated instructions to bring the picture editing to a finish, it proved hard to persuade all members of experimental group to move from

Experimental group				
Participant	Words typed in Week 1	Week 2	Week 3	Total word count
3	33	78	83	194
4	16	93	63	172
5	21	61	85	167
6	0	25	–	25
1	14	–	0	14
2	0	14	S(64)	78
Control group				
Participant	Words typed in Week 1	Week 2	Week 3	Total word count
6	97	211	81	389
2	–	168	98	266
4	80	53	51	184
3	–	114	47	161
5	56	–	41	97
1	17	S(136)	S(60)	213

Table 5.4: Word counts for participants in experimental group and control group. Absences are indicated with a dash, and scribed sessions are indicated by enclosing the relevant number with S().

picture editing to text production in a timely fashion. The issue did not seem to be one of deliberate intransigence so much as the visual aspect of the activity exerting a greater pull on participants; there may be a sense in which the picture production side of the activity was dominant. Additional evidence of this effect comes from Participant 1, absent in Week 2, who spent all of their time in Week 3 focused on making pictures rather than text.

Putting this participant's data to one side, together with that of Participant 6, who was not present in Week 3, and that of Participant 2, who was scribed in Week 3, yields three participants who were reasonably proficient in keyboard use and who were present for all three sessions These appear in the first three rows of Table 5.4, and here there seems to be a levelling-off effect, the amount of text these participants produced in Weeks 2 and 3 is more consistent It is suggested that these participants were able to internalise a more balanced relationship between the picture production and text production tasks when given the chance to practice the process.

Overall, it is clear that in each session the experimental group wrote fewer words than the control group Unfortunately, it is not possible to tell exactly how long any participant spent specifically on writing in any week, so it is not clear whether this discrepancy arises out of the experimental group continuing to spend more time than anticipated on their pictures in all weeks, or whether there is an additional effect related to having to produce text to match a specific picture rather than simply producing text about a given story.

Story Tense

One marked difference in story text between the two groups emerges when tense is considered, and it is suggested that this highlights a corresponding implicit difference between the media in which the groups were working. The control group, working in the text-only medium, consistently adopted a past tense narrative whereas the experimental group, working with their visual-and-text medium, expressed a more varied approach in which the present and past tense both occurred, sometimes in the same caption.

Participant	Picture text tense			Total pictures for which text written
	Past	Present	Mixed	
1	1	0	0	1
2	0	1	1	2
3	0	5	0	5
4	2	3	2	7
5	0	5	1	6
6	0	1	0	1

Table 5 5: Tenses used in picture captions, from experimental group. Captions described as using mixed tense are those which contain both references to the past, for example "I said", and present-tense narration from a character's point of view

The past tense is entirely to be expected of the control group's writing, as it is the commonest way of writing a normal story and one which schools emphasise as part of the National Literacy Strategy.

By comparison, experimental group participants seem to have had two conflicting narrative modes in mind, Table 5.5 shows the number of different tenses used. A substantial proportion of the picture text presents action as it happens, describing what the characters are thinking at the time of the picture, what they are doing, and what they can see. Other portions of text show one of the characters recounting events and actions in the past tense, much like a flashback. It is almost as though the pictures are naturally prompting a present-tense mentality which affects the captions written for them, and sometimes overrides the tendency for prose to speak in the past; this is backed up by the fact that both experimental group participants who wrote in a completely consistent tense chose the present

Neither group was given explicit instruction as to which tense to adopt, so it seems reasonable to conclude that this variation in choice of tense arises largely from the difference in medium.

Story Content and Form

The stories also differ somewhat in terms of content Both groups' text contains elements not found in the original story; actually, given that each session's exercise involves writing from a character's point of view, new elements are virtually invited as writers consider a particular character's take on the story's events. However, the evidence suggests that the story events told in the experimental group's writing was substantially more on-topic than the control group's, of the five experimental group participants present in Week 3:

- three produced pictures and text showing and describing an end to the story which was largely in-line with the original;
- the remaining two produced pictures showing the main aspect of the story's end, that is the crow dropping her cheese and the fox getting it, but did not get so far as to write any captions for those pictures.

In contrast, three control group stories deviate from the original: two end differently, and one of these and another with the 'proper' ending introduce rather random events involving new characters. It is as though many of the participants generated ideas and text which serve as digressions or dilutions of the story, rather than as appropriate additions or developments.

It was the teacher-leader's opinion that the experimental group captions contained more on-task descriptions appropriate to retelling the story. It seems as though these participants accepted and engaged with the story as it was told, rather than introducing other events in an attempt to change it. She also felt that these participants had immersed themselves in the story to a greater extent. In her words, "they were putting themselves in the picture"

It is also worth noting that the experimental group's text is not really stand-alone, it does not make a great deal of sense when read separately. Sentences tend to implicitly rely on the pictures to show action and to introduce objects and characters, and so written descriptions of action, and written introductions of things, seem to be thin on the ground. There are instead a great deal of references to "that fox", "this cheese", "I can see

Nottingham from here", and so on, which rely on the appropriate picture to establish their context.

Visual Language

Following Parker's suggestion (1999) that students who created a visual version of a story before writing about it included more visual references in their text, a brief analysis of each group's 'visual writing' tendencies is given here. The analysis proceeds by first coding any sentence fragment which uses some word which appeals to sight, such as look, see, stare, or descriptions of appearance which refer to colour or shininess and so on, the results of this coding are shown in Appendix F. Once this is done, the number of such visual references a participant makes is divided by that participant's word count to give a sense of the 'visual density' of their writing; this figure is then averaged over each group, and these averages compared using Student's t-test The conclusion is that there are no statistically significant differences in the two groups' visual density; although the experimental group's average is about twice as great as the control group's, the small sample sizes involved here mean that this difference is not reliable

Story Text Summary

It can be seen that the experimental group's picture-making process resulted in quite different writing to the control's It is judged that their pictures and text are more on-topic, as compared to the control group's brainstorm suggestions and text However, the experimental group displayed uncertainty as to which tense to use, oscillating between the past and present, produced less text, perhaps sacrificing writing time in favour of spending a few more minutes editing their pictures, and the text they did produce made frequent implicit references to the picture for which it was written

It is suggested that the visual process must be reexamined to determine how it might encourage production of story text which stands on its own rather than relying on pictures to help it tell the story.

5.2.5 Pilot Study 2 Summary

This second pilot study has strengthened the conclusions of the first. The usability of the software as a whole has been validated; users were able to use the whole package to make visual stories by posing and warping characters, placing them in scenes, choosing a camera angle, and sequencing pictures. A number of problematic usability areas have been noted, most importantly the 'constant background effect', the awkwardness of character colouring, and inconsistent use of sequencing combined with the conflict between continuous sequences and stage/screen breaks.

In addition, the storywriting process, and particularly text entry, proved comparatively problematic; some students had substantial difficulty with typing, some were disaffected by it, and the text which experimental group participants produced for their pictures did not form a full story on its own. The text produced for the pictures showed more 'visual density', but not at a statistically significant level It is suggested that a greater number of participants, and a more detailed text analysis, is needed in future studies. Finally, the control group in this study showed significant unwillingness to participate and engage with their task. This must clearly be addressed.

5.3 Conclusions Drawn From Pilot Studies

The two studies described above validate the overall software concept, while providing some hints as to how it, and the study process for which it is used, should be modified These modifications are now considered.

5.3.1 Process Modifications

It is necessary to find a visual process which results in a stand-alone written story, and tackle the typing and the control group engagement issues noted in the second pilot study. The following sections address these in turn.

Greater Separation of Writing and Pictures

The second pilot study's approach to using pictures to elicit text proved unsuccessful; the writing produced was dependent on the pictures and was not sustained It is proposed that an alternative be tried which places all writing in a separate phase after the cartooning is completed: in other words, that future experimental participants make a finished cartoon sequence, then write about it afterwards in an explicit transcription-like phase.

An alternative approach, of eliciting captions much like the pilot study, but then extracting these to use as a purely text-based initial 'bare bones' story to add to and rework, was considered but judged too difficult to apply in experimental and control situations unless both groups use computers to type on. The next section rules this option out

Typing on Computer or Writing on Paper

In order to maximise the probability that all participants in future studies will produce a reasonable quantity of text for analysis, it is proposed that future stories be handwritten on paper. It is intended that this should sidestep the problems encountered in the second pilot study; although this runs the risk instead of punishing students whose handwriting skills are poor, it is argued that these students will have far more experience at, and hopefully classroom support for, coping with this problem than poor-typing students have at coping with keyboards.

This route was strengthened when initial explorations preparatory to the larger-scale future study showed that doing the whole exercise in the schools' ICT suites would be difficult at best, in both the schools approached, the suite represented a limited resource in high demand.

Make the Study Task Less Arbitrary and More Relevant

In light of the second pilot study, it is desirable to find a way to make future studies more closely linked to the class's general school experience, so that all participants are encouraged to take the work seriously There are two immediately obvious ways to accomplish this. First, increased teacher

involvement will be sought; it is suggested particularly that the normal class teacher mediates the subsequent writing task, given the reactions to writing observed earlier. It is also argued that any control groups used, who will necessarily do work which they might see as being less exciting or interesting compared to the experimental group, are much better placed with one of their normal teachers, because that context is more authentic than is the case if a couple of strangers take them out of class and ask them to do the same work. Ideally, known school teachers or classroom assistants will be asked to lead or at the very least be present for all sessions, be they experimental or control

Secondly, the story topics should be related to class work for that term, so that participants can see that the tasks they are doing are reflected elsewhere.

5.3.2 Software Redevelopment

There are two primary areas to examine when the software's features are considered. The first relates to the way in which it integrates the visual storytelling prompts and story stages, and the second to the presentation of character pose and warp modes.

Visual Storytelling Prompt Integration

The second pilot study software's approach to HARRY-like stages must be revisited. Given evidence of the benefit of such a scheme on written stories (Holdich and Chung, 2003), it is still desired to find a way to use the visual storytelling prompts, but a different way to supply them should be found

It is proposed that, instead of breaking a story sequence across screen-based stages, the software should present a single left-to-right sequence metaphor much like that of a slide show, indeed, the request that a playable slide-show feature be added was one of the first things to come out of teacher consultation undertaken after the second pilot study.

Removing the notion of a stage view will also simplify the interface and make it easier to implement, because the requirement to navigate between stages is removed.

Instead, then, it is planned that all visual storytelling prompts be mediated via a requestable 'story summary' window, so that navigation of story stages is decoupled from navigation of the visual sequence.

Further Separation of Modes

The character recolouring mode should be separated from the character warp mode. It might be argued that, given the lack of use of this facility in the second pilot study, it could be removed altogether, but it shall be retained to see if future participants utilise it more Consequently, a dedicated 'character colouring' mode shall be added to complement the character warp and pose modes. It is recognised that increasing the number of modes does not help the mode confusion observed in both pilot studies, but it is judged the lesser of two evils

5.4 Pilot Studies Summary

This chapter has described two formative pilot studies used to test the software concept Overall this was validated, but significant alterations to both the storywriting process and to the first full software were identified The next chapter will relate how these changes were carried through into a main study

Chapter 6

Main Study

This chapter addresses the last three questions identified in Chapter 4 what effect does making a visual story have on storywriting, does the software lead to different kinds of visuals than a pencil-and-paper process, and how much engagement do the users show with the software and the tasks? It begins by describing the version of the software used and the experimental set-up devised to provide the necessary data, and then considers the specific comparisons and analyses which will be used to determine the questions' answers. These are subsequently brought together in the conclusions section.

6.1 Software, Process and Experiment Design

The software used here represents the second implementation of the full concept It incorporates the changes identified from the second pilot study; most of these can be seen in evidence in Figure 6 1. In this version, all work is done within a single screen; the active shot is shown in editable form in the largest part of the screen, and its place in an explicit left-to-right sequence is shown in the sequence bar, which contains controls for adding, removing and reordering shots. All camera and art controls are arrayed to the right of the active shot area. No typing interface for making captions is provided; this version of the software aims to emphasise purely visual aspects of com-

munication. The visual storytelling prompts are accessible via a story help button to the bottom right of the screen; the effects of this are also shown in Figure 6.1.

The software was used in two sub-studies which jointly make up the main study. One was carried out over September and October 2005 in a Nottinghamshire primary school, and the second in November and December 2005, in a Leicestershire primary school Both schools have above average standards in English teaching according to the most recent Ofsted reports. These sub-studies are depicted in Figure 6.2, as can be seen, each contains an experimental and a control group The overall process followed by each group was intended to follow a three-step pattern, beginning with the collection of a first story, produced under entirely normal conditions before the investigator or the study were introduced to the participants. There then follows an intervention designed to encourage participants to prepare to retell a story; after this intervention concludes, the written version of this story is collected and analysed to see if the interventions produced different results The number of stories indicated may seem smaller than expected given that two entire classes took part; however, the numbers indicate only those participants who produced both first and second stories. The other participants, or more accurately their incomplete data, are excluded from the analysis and so do not appear in the depiction.

The earlier sub-study was designed to fit into class work on India, and so the subject selected for the intervention and second story involved a section of a Hindu sacred story, The Ramayana. The later sub-study grew out of the class's 'writing worlds' work and resulted in an intervention and story version of the spooky poem The Visitor, by Ian Serraillier. The teachers of both classes were asked to select the groups so as to include a comparable mix of abilities in each. The following sections shall provide additional detail to Figure 6 2, consider questions of experimental bias, and indicate the kinds of data analysis to be performed

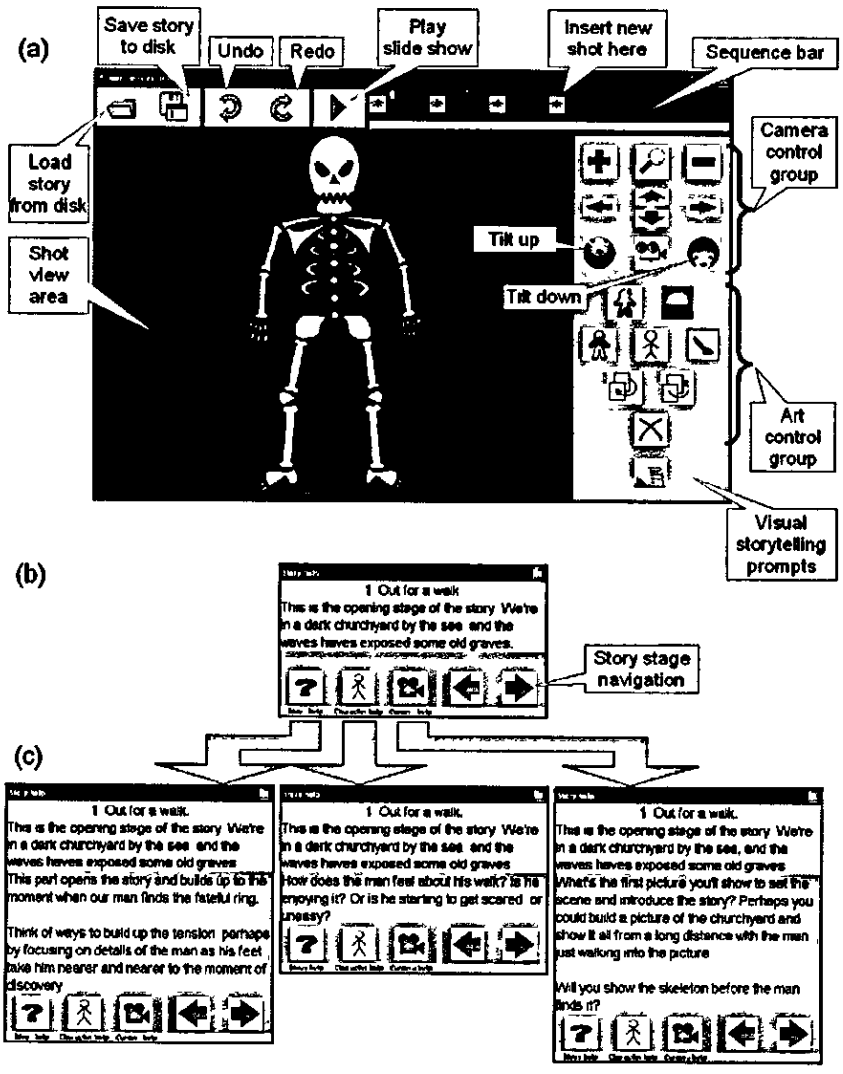


Figure 6.1. (a) The version of the software used in the main study Almost all of the art and camera controls are the same as the pilot study 2 software, with the exception that the tilt up/down icons have been changed. The visual storytelling prompts are, by default, collapsed into the button at the bottom right of the screen; when this button is pressed, a separate story navigation window (b) appears. The subsidiary ideas help, character help and camera help prompts can be displayed in the grey area of the this window by selecting the relevant button; the results are shown in (c).

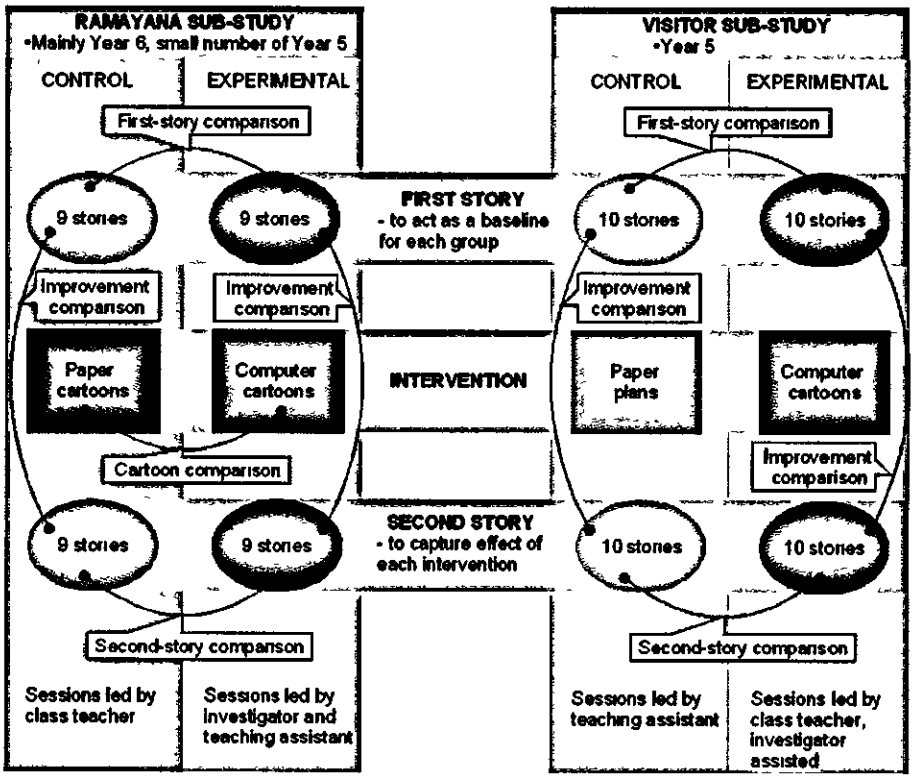


Figure 6 2 Overall structure of the main study and its constituent sub-studies. Only participants who produced both first and second stories are included in the resulting analysis

6.1.1 Ramayana Sub-Study

In this sub-study, each participant produced a first story in completely normal conditions, consisting of the opening part of The Ramayana. Beginning the following week, participants divided into experimental and control groups and focused on a later section. The control intervention activity was chosen to be a modified version of a process the teacher had carried out with a previous year, in which students made a captioned comic strip version of a Greek fable Here, it was agreed that the control group would draw a comic strip without captions, telling the story in mime so as to make the activity as close as reasonably possible to the software one. In the second week, both groups were given a short camera language briefing which consisted of analysing a sequence of eight still clips from a television cartoon, looking at how different shot distances were employed and how the sequence of clips told a story. After two afternoons of their respective intervention work, spread over two weeks and totaling three hours per group, the whole class came together to write the second story. Experimental participants were given printouts of their computer cartoons, and control participants were given their paper cartoons, which they could refer to whilst writing The first story was written on 20 September, and the second on 5 October. After the second story had been written, the control group were also given time to use the software.

6.1.2 Visitor Sub-Study

Here, each participant's pre-experiment story involved an island rescue, again produced under completely normal conditions. The teacher then gave the experimental group a half-hour software introduction before beginning the story visualisation work. At the time of this software introduction, the class had not yet been told the story of The Visitor, so the introduction served only to let the experimental group learn the basic software ropes and did not give them extra time to do the story task.

The control group participants were given a planning sheet on which they could draw up to eight key scenes of action, and write useful story words under each frame This was an entirely normal, unmodified activity which

was chosen solely by the teacher. In this case, the control and experimental interventions took place over three consecutive days, and totaled a maximum of three and three-quarter hours, the final three-quarters of an hour on the last day were supplied as an optional extra after a software glitch eliminated some experimental participants' first-day work.

As in the Ramayana sub-study, groups came together to do their writing after they had completed their respective preparation activities, working from either their paper plans or printouts of their cartoons The class wrote the first stories on 25 November, and the second on 5 December. Again, the control group also took a turn to use the software after the second stories were complete.

6.1.3 Hawthorne and Experimenter Effects

Having introduced the experimental structure, it is worth considering two pitfalls which can easily introduce experimental bias. The first is the 'Hawthorne effect', which has been interpreted as an increase in a group's motivation and productivity arising from that group's knowledge that it is participating in an out-of-the-ordinary process (Mayo, 1960, 1975). It is asserted here that, in both sub-studies, any potential for a Hawthorne effect applies equally to all groups This is so because, firstly, both classes were aware that they as whole classes were doing a piece of work which was being studied by the investigator, and it was made clear that all participants would have a chance to work with the most out-of-the-ordinary part of the exercise, the software, just at different times This is backed up by comments made by the Ramayana sub-study teacher, who noted that the control group were aware that, while they were drawing their paper cartoons, their compatriots were doing a novel task, but this did not demotivate them as they knew that they would have a chance to do that same task In addition, the Visitor sub-study teacher commented that all participants had gone to significant lengths to make a well-decorated final story, which suggests that no one group felt more 'special' or specially-treated than the other. Thus there should be no Hawthorne effect bias in favour of, for example, either experimental group

The second potential pitfall concerns the 'experimenter effect', whereby the leaders of the intervention can (unconsciously or deliberately!) convey the idea that they are interested only in the work of one group of participants. It is suggested that this is addressed here by the fact that both teachers wanted to get good work and good effort out of all students, and so each group was working to an equally relevant and valued finished story. In addition, it was made clear to both teachers that the purpose of the study was to investigate differences in writing rather than showing that, for example, the software resulted in better work.

6.1.4 Data Analysis

In addition to the experimental structure, Figure 6.2 also shows the various comparisons which will be applied to the stories and cartoons, and initially there do seem to be overly many However, they really only represent specific instances of two general categories· longitudinal comparisons and cross-sectional comparisons There are four specific longitudinal comparisons to make here, between each of the four groups' first stories and second stories, to pick up what might loosely be termed an 'improvement effect' or a 'degradation effect' in each case, depending on whether performance improves or decreases. In addition, five specific cross-sectional comparisons shall be applied. There will be two first-story comparisons, in an attempt to detect any gross prior differences in aptitude between control and experimental groups, and two second-story comparisons, to see if any intervention produced a significantly different effect to its peer. Finally, a cartoon comparison will be made between the software and paper-based cartoons in the Ramayana sub-study, to see if the two media used for cartooning had different effects on the cartoon product. It is not possible to do a similar comparison in the case of the Visitor sub-study; the paper plans are not available, and, even were this not so, they represent rather different animals to the software cartoons The latter, although they use no text, are capable of standing as complete representations of the story in themselves and represent something finished. By comparison, the paper plans are precisely plans which look to a next stage

in production, that is the written story. Sample pairs of cartoon story and resulting second story are provided in Appendix G.

The analysis is broken into two sections, the first relating the first/second and improvement comparisons and the second to the cartoon comparison. Additionally, a third section considers some qualitative observations

6.2 Data Analysis 1: First-Story, Second-Story, and Improvement Comparisons

This section covers the eight comparisons in Figure 6.2 which deal with participants' actual stories: the first-story comparisons, the second-story comparisons, and the improvement comparisons. These use indicators provided by two analytical tools

6.2.1 Choice of Indicators and Analytical Tools

Two complementary tools, described below, are used to gather quantitative data for each participant's stories. This numerical data is then used as input for Student's t-tests, the longitudinal comparisons are applied as standard paired t-tests, and the cross-sectional comparisons as unpaired t-tests with equal or unequal variance as appropriate All tests are performed at the 95% level of significance

CHECK TEXT: Statistical Features of Prose

The first set of indicators is a set of statistical features for each story, produced by a tool called CHECK TEXT (Holdich et al , 2002). This is designed to focus on areas of a piece of writing which are of particular interest to teachers For a given story, it computes 12 different measures ranging from total number of words used and their variety to the percentages of adverbs, common verbs, words over five letters, and use of commas. The full list, together with the tool's own explanatory text, is reproduced in Table 6.1. The twelve features it describes boil down to eleven actual indicators, because the aver-

age sentence length is used in two different ways All eleven indicators are used here so as to obtain as much detail as possible, although the following caveats are acknowledged First, the total number of words in a story is not an enormously satisfactory measure, as Holdich et al. note; the quality of a piece of writing is not proportional to the number of words it uses. Secondly, the measure of average sentence length may not necessarily indicate the variety of sentence lengths used, since a story with uniform sentence length can score the same as a story with mostly uniform sentences, some long, and some short sentences. Finally, for the comparisons it is necessary to calculate the reciprocal of the sentence to comma ratio, so as to remove the numerically inconvenient infinities which can otherwise occur.

Teacher Coding: Qualitative Impressions

The second set of indicators used arises from each story's qualitative impression in three areas, as assessed by a qualified teacher unconnected with either sub-study She was asked to highlight

- **Strong imagery** and good **spatial descriptions**,
- Good use of **narrative point-of-view**, that is, instances where the storyteller effectively directs the reader's attention towards a significant story element;
- Strong **descriptions of characters** or of **actions characters do**

The first two of these codes are motivated by a moving image activity's implied benefits, described in earlier chapters, particularly a greater visuality of work and a greater visualisation of a story's action and events. The last aims to see if the software's flexible characters feed on to any textual description of story characters. The number of occurrences of each code is counted for each story, and these totals used as input for the appropriate t-tests.

The teacher was given a shuffled and unnamed set of 56 stories, consisting of the first and second stories of seven randomly chosen participants from each of the four groups.

Total number of Words	A long story indicates that much detail has been included, whilst a short story lacks sufficient detail
Variety of Words	A low % indicates frequent repetition
The connective **and**	**And** is the most basic connective used by children A more mature style is achieved by substituting alternative connectives for **and** or replacing **and** with a comma or a full stop A high % of **ands** indicates immature sentence constructions
Common connectives (then, so, but, because)	Use of these basic connectives indicates immature sentence constructions
Simple sentence starters (sentences starting with The, He, She, His, Her, They, We, I)	Sentences which begin with pronouns indicate a weakness in sentence construction - using the same way to start sentences A low % indicates a more varied writing style
Average sentence length	Writing should contain a wide variety of sentence lengths When writing a story, short simple sentences should be interspersed between longer more complex constructions Short sentences can add suspense or impact Long sentences can be used for description
Word length (% of words longer than 5 letters)	A high % indicates an adventurous vocabulary
Common verbs (frequency of the verbs said, saw, went, was, were, got, get)	A high % indicates limited verb choice A more adventurous choice of verbs helps to make writing more lively and interesting for the reader
Use of adverbs to ascribe shades of meaning	A high % indicates a more sophisticated vocabulary
Common words (verbs said, saw, went, was, were, got, get + connectives and, so, but, then, because)	A high % indicates a limited vocabulary
Commas	The use of commas to demarcate clauses is a sign of advanced writing skills This is the ratio of average sentence length in words to the number of commas used (not including commas in lists) A high number of words to commas indicates a lack of commas A low number of words to commas indicates mostly correct use of commas

Table 6.1: The CHECK TEXT measures, reproduced from the tool itself.

6.2.2 CHECK TEXT Analysis Findings

The findings for each sub-study are considered separately, and conclusions drawn afterwards.

Ramayana Sub-Study

Here, the control and experimental group first stories show four differences

- The control group first stories score better for **simple sentence starters**;
- The experimental group first stories score better for **common verbs**, **common words** and **common connectives**

Following the intervention, at the second-story stage all these differences disappear except common verb usage, which remains better in the experimental group. In addition, the experimental group second stories use more words than the control group second stories. These changes are depicted in the middle two columns of Table 6.2; they are partly reflected by the improvement and degradation effects found, which are shown in the last column Briefly, the experimental group **improved the use of simple sentence starters**, raising their second stories to make them equal to the control group, and experienced a **degradation in usage of common words** and of **common connectives**, making the experimental second stories comparable with the control group's. Additionally, **both groups improved use of adverbs**, this is consistent with the fact that their stories were comparable in this respect both before and after the intervention.

In addition to these 'consistent' improvements and degradations, a number of longitudinal effects are present which do not appear as significant differences between the groups' second stories The control group show some improvement in **use of common verbs**, although not enough to change the difference seen in Table 6 2, whereas the experimental group made some improvement in **use of commas**, and experienced a degradation in **use of the word 'and'** and **use of words greater than five letters** Since there is no corresponding second-story difference accompanying these effects, they are judged to be weaker.

CHECK TEXT aspect	First story	Second story	Consistent improvement or degradation?
Simple sentence starters	Control better	———	Experimental improvement
Common words	Experimental better	———	Experimental degradation
Common connectives	Experimental better	———	Experimental degradation
Common verbs	Experimental better	Experimental better	———
Total words	———	Experimental better	———

Table 6 2 The first-story differences and second-story differences in the Ramayana sub-study.

Finally, the significant second-story difference in the average number of words used by each group, shown in the last row of Table 6 2, must be contrasted with the fact that no significant experimental group improvement effect is found. As with the weak improvements and degradations noted above, this second-story difference is judged less likely to be indicative of a strong effect.

To summarise, the strongest effects, that is those for which an improvement or degradation is found which is consistent with the corresponding first-story and second-story differences, are

- **A benefit to the control group and the experimental group** in use of **adverbs**;
- **A benefit to the experimental group** in use of **simple sentence starters**;
- **A penalty to the experimental group** in use of **common words** and **common connectives**.

Visitor Sub-Study

In this instance, both the first-story comparison and second-story comparison yield no statistically significant differences; in other words, the two groups'

stories are comparable to each other, in the sense of every CHECK TEXT indicator, before and after the intervention.

There are four improvement effects evident in this sub-study: the control group improved their scores for **average sentence length** and use of **common words**, and both groups improved their scores for **use of the word 'and'**; however, none of these improvements are reflected by any second-story differences, so as with the Ramayana sub-study they are judged to be weaker effects. No degradation effects were found

CHECK TEXT Analysis Summary

It is suggested that the main conclusion to be drawn from the above results is that no one intervention produced clearly different results from the others, in the sense of the CHECK TEXT indicators; it is particularly notable that the improvement effects in one experimental group do not show up in the other.

Further, the results of the Ramayana sub-study experimental group seem internally inconsistent The improvement effect noted for use of adverbs and simple sentence starters might suggest that their second stories use a richer vocabulary, but on the other hand the degradation effect present in use of common words and words greater than five letters tells precisely the opposite story. An even more pronounced contradiction emerges between both sub-study experimental groups when one considers use of the word 'and'; here they flatly contradict each other, one improving and the other degrading.

Thus it is suggested that the software intervention produced **no consistent effect** on the quality of the participants' stories, as measured by CHECK TEXT, compared with the other interventions. Appendix H presents the full CHECK TEXT details.

6.2.3 Teacher-Coded Analysis Findings

There are fewer results found in this case, not least because this analysis uses three dimensions compared to CHECK TEXT's eleven. Accordingly, both sub-studies are treated together and then summarised

Results for Both Sub-Studies

The only statistically significant cross-sectional difference arises from the Ramayana sub-study, in which the experimental group's first stories and second stories score more highly for the number of strong descriptions of characters or of actions characters do. There is no significant corresponding improvement or degradation effect, suggesting that this group may have started off and finished with slightly more ability in this area

Longitudinally, two improvement effects emerge, the Ramayana sub-study experimental group are found to have improved their use of narrative point-of-view from the first to the second story, although not sufficiently to distinguish this from the control group's story in the second-story comparison. Both Visitor sub-study groups are found to have improved their character descriptions.

Teacher-Coded Analysis Summary

As with the CHECK TEXT findings, there seems to be **no consistent effect** across both sub-studies, again the improvements and differences found in one case are not repeated in the other. A sample of the coded stories used may be found in Appendix I.

6.3 Data Analysis 2: Cartoon Comparison

Attention now turns to an analysis of the Ramayana sub-study's intervention. This is similar to the teacher-coded analysis in that it consists first of qualitative coding, followed by comparisons of difference using unpaired Student's t-tests with equal or unequal variance as appropriate; again, the level of significance is set at 95% Concerning population sizes, since this comparison relies only on the intervention-produced cartoons, it includes all the participants who produced a cartoon, irrespective of whether they also wrote a first or second story This results in a control group population of seventeen, and an experimental group population of thirteen.

It is important to acknowledge that there is no baseline data set for this

comparison. However, a baseline data set is rather harder to define and acquire here than for storywriting: during the intervention the two groups by definition did different tasks and so can be argued to have been utilising different sets of skills, the experimental group's task very likely helped ICT manipulation and adaptation skills come to the fore, whereas the control group's task probably relied more on physical drafting and representation. Consequently, it is difficult to imagine what kind of baseline test would accurately capture the total set of skills required over the two groups; a simple paper cartooning baseline would neglect prior ICT skills and could be argued to give one group extra practice, simply testing ICT skills is obviously insufficient and anything which tries to build a comprehensive picture risks becoming too complex and intrusive to normal class routine Instead, it is intended that the class teacher's partitioning of the two groups, as described earlier, led to a reasonably equal distribution of skills between them. This certainly represents a comparatively quick and dirty approach, but in the context of the overall study it is judged acceptable

Figures 6 3, 6.4 and 6 5 illustrate the complete set of resources available to the experimental group, consisting of the posable characters, some items of clipart and various backgrounds; the control group began with paper and pencil or pen, and were allowed to use colour as they chose. Both groups worked from the shared understanding of characters' appearances which the whole class had gained through earlier work on the Ramayana.

It should be noted that no attempt has been made to consider the role of the clipart provided within the software, and whether props and backgrounds are used or rendered differently on paper and in software, beyond the coding of how often characters are shown carrying objects. These questions are considered outside the scope of the current work; a proper study of them would likely require either a more comprehensive clipart bank or the facility for users to easily create their own artwork

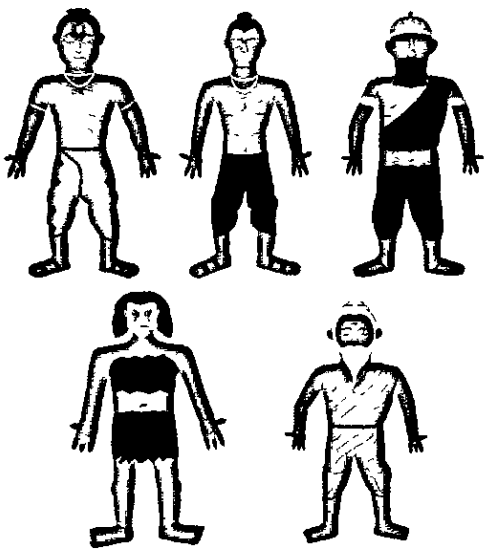


Figure 6 3: The characters provided to the experimental group for use within the software In addition to the front perspective seen here, each character has a back view and can be made to open and close their mouth and eyes From left to right and top to bottom, the characters are Rama, his brother Lakshmana, their father, King Dasaratha, a female demon, and a holy man. The holy man asks King Dasaratha for his sons' help in vanquishing the demons who are bothering his group, the brothers travel with him to the forest where they fight one such demon.

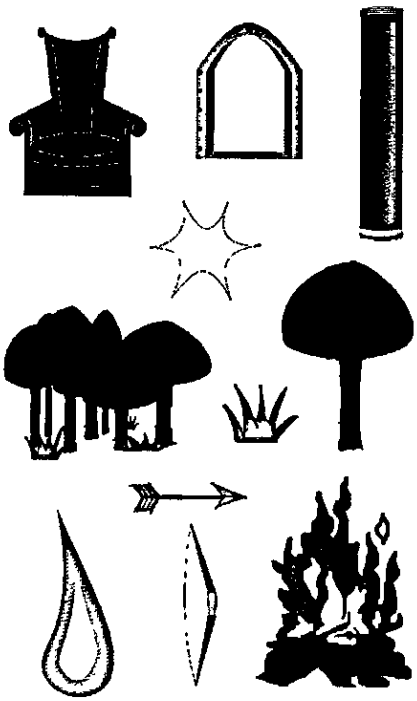


Figure 6 4: The clipart used by the experimental group.

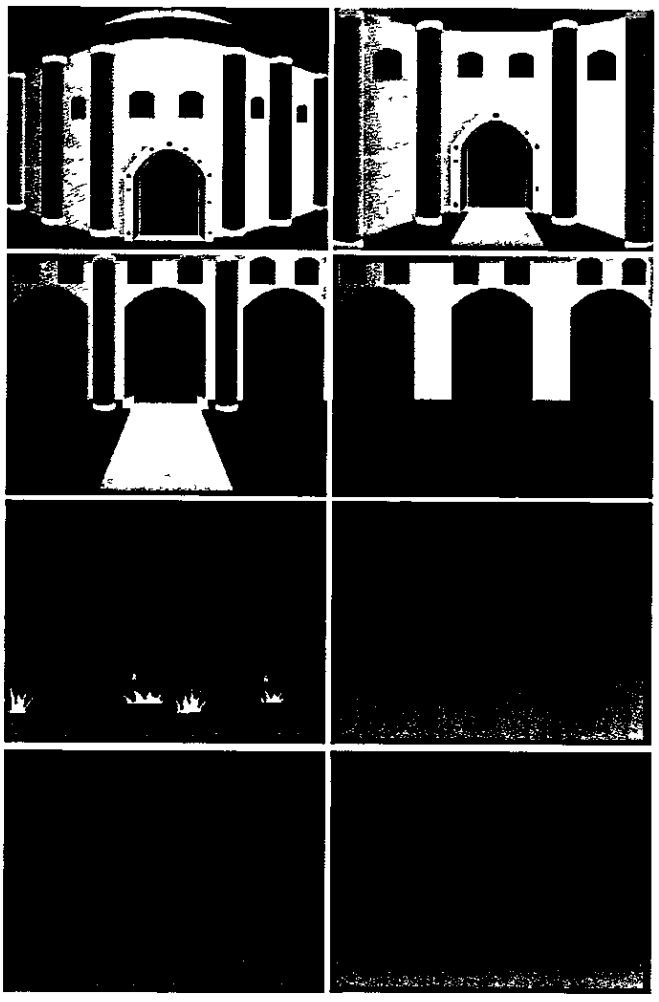


Figure 6 5. The backgrounds used by the experimental group; some were intended to be usable with no additional clipart, and others to be amenable to customisation with clipart items.

6.3.1 Coding Scheme

The cartoons were analysed for three broad categories of feature, one aiming to detect any differences in use of camera language between the groups by examining the different shot distances used; and two focusing on characterisation, looking at facial expression and character pose.

In each category, the intention is to get a measure of the degree of 'expressiveness' displayed by participants; this is loosely defined as involving any choice of depiction which requires the default option to be modified, so that the participant has been required to 'express themselves' by putting effort into changing the camera or characters. Of course, this camouflages instances in which a participant deliberately chooses all the default options for a picture, this seems virtually unavoidable.

Expressiveness in shot distance, in characters' facial expressions, and in characters' poses will be considered separately, since these categories are fairly independent of each other. For each category, two kinds of analysis will be used.

Fine-Grained: Differences in Specific Type of Expressiveness

This analysis examines the total number of times each participant makes a *specific* choice of signification from the options available in a given category, for example the number of times they specifically choose to deploy a close-up rather than another non-default shot distance. Each set of figures is averaged over the relevant control or experimental group to see if any significant differences arise in the groups' specific choices of signification.

Coarse-Grained: 'Expressiveness per Shot'

For a given category, this method measures the total number of times each participant makes *any* expressive choice and averages the total over the number of shots they make to give a rough sense of the participant's 'expressiveness per shot' It is described as coarse-grained because it ignores the specific way in which the default has been modified To see why this is necessary when averaging per shot, consider the alternative· that each participant's use

of every kind of expressive mode in a given category is averaged over their shots. Take as an example the depiction of emotion through facial expression; it is possible to imagine that each participant will then receive a figure for 'anger per shot', 'happiness per shot' and so on. The problem with this is that, in a visual story, there is not a clear relationship between the number of shots shown and the number of times a specific choice of depiction may be made, it is possible to choose to fill a sequence in many different ways. Some of these ways may include more depiction and emphasis of facial expression, others of another mode (for a discussion of how these choices relate to juxtapositions of, and transitions between, pictures, see McCloud, 1994, pp. 69 and 160) Thus, for example, a longer sequence of shots themed on the same story topic as a shorter sequence *cannot* be expected to show simply a linearly increased level of some specific expressive choice, be it anger per shot or anything else, all that can be meaningfully asked is whether the total number of expressive choices in a given category has varied

Comparisons are made between the control and experimental groups, and between the six male and seven female participants in the experimental group The results of all the comparisons made in this section are presented in Appendix J.

6.3.2 Fine-Grained Analyses

Camera Language Findings

When coding for use of different shot distances, it is first necessary to clarify what the default option is and how to tell when it is used, since these concepts are not immediately obvious The guide used is the finding of Burn and Parker (2003b) that children "showed a tendency to draw everything in long shot, as if needing to see whole figures against backgrounds all the time", this sounds very much like a kind of default behaviour. Accordingly, a default shot distance will be chosen for each participant which is judged to most represent this description, and this shall be used for comparison with the rest of that participant's pictures Three non-default levels of shot distance are coded, corresponding to long shots, medium shots and close-ups; the

non-default codings are only applied when a picture is judged to show a clear departure from the default mode identified above See Appendix K for examples of coding

The only statistically significant finding to emerge from comparisons of shot distance is that experimental group participants produced on average **almost twice as many long shots** as control group participants. No significant differences are found for medium shots or close-ups.

Additionally, whether or not each participant produced a cartoon sequence which can be interpreted as finished, that is one which depicts events from the story's beginning, middle stages and end, and the total number of cartoon frames s/he used to tell the story, is recorded. All but one of the thirteen experimental group participants **finished their cartoons** compared to fewer than half of the control group participants, and experimental group participants produced an average of **twice as many shots** as control group participants over the two afternoons of work

No significant differences between boys and girls in the experimental group are found; use of shot distance and number of shots appears to be independent of gender, at least at this admittedly small-sample level.

Characterisation Findings: Facial Expression

Four different facial expressions are found in both groups' cartoons. These are happiness, unhappiness/discomfort, surprise and anger. The unhappiness/discomfort category is broader than the others, and in some cases it is arguable that a more specific description, such as fear, may be applied. However, such distinctions were not drawn so as to ensure a more robust classification Figure 6 6 gives three examples of the variety of expressions included under unhappiness/discomfort; the intention is that this category does capture the broad intention behind each expression without trying to infer too much extra information. Examples of all four expressions may be found in Figure 6.7.

Neutral expressions were also coded during analysis, though they are not included here because the concept of neutrality varies between the groups.

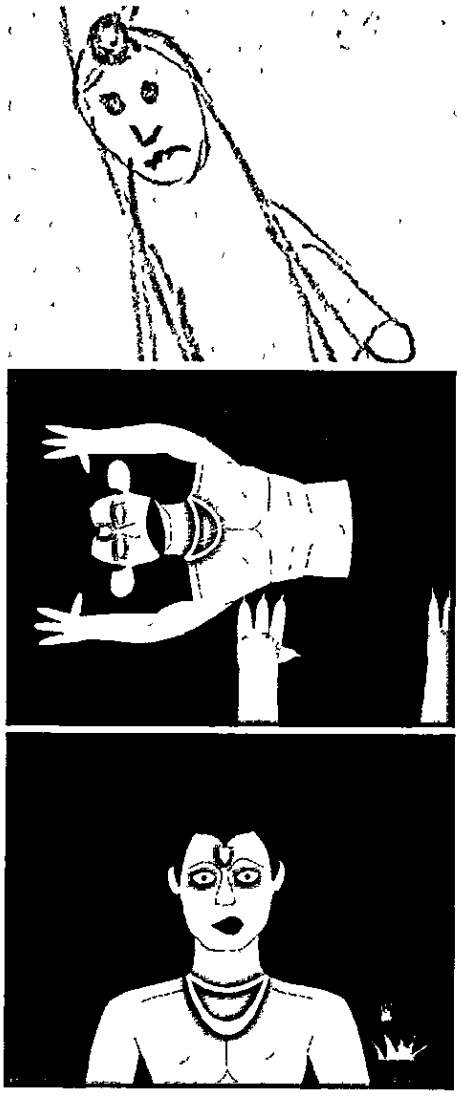


Figure 6 6. Three examples of the kinds of expression included in the unhappiness/discomfort category The intention is to unite a small variety of generally negative emotions rather than infer more specific emotions, such as sadness, concern or fear.

Neutral expressions in the software cartoons are easy to define as the characters' default expressions, so that no attempt has been made to change any facial features. Although there might be instances where that default expression is considered appropriate, it is judged that in the majority of software cases it has been used precisely as a default rather than as a deliberate choice, though ultimately it is impossible to be sure. In the paper cartoons, some participants appear to have used a happy face as a default state (for example, when every character in almost every shot is smiling!), and others a neutral face. A similar ambiguity also crops up, as there are instances where control participants appear to have had the definite intention of indicating happiness and perhaps neutrality. These ambiguities are judged to make the comparison of neutral faces largely pointless between groups, though they are included in the gender comparison for the experimental group.

The total number of uses of a given expression was calculated for each participant, and these totals were averaged over the relevant group to yield the mean number of uses of that expression for that group.

To turn to findings, there are more than **twice as many** instances of **happy characters** on paper, that is, the average control group participant depicted twice as many happy faces as the average experimental group participant. **No significant differences** between the average number of depictions of unhappiness/discomfort, surprise or anger are found. The fact that happiness is the only area of difference in facial expression strengthens the above suggestion that many paper participants were tending to use happiness as a default expression.

The difference in happiness also carries over to gender, with the girls in the experimental group depicting **almost six times as many happy faces** as the boys. By contrast, boys depicted **more than four times as many angry faces** than girls on average. Both happiness and anger require the characters to be modified from their default expressions if the depiction is to count in the relevant total, so there may be a significant gender difference in character depiction here. No other gender differences, including the use of the default expression, are found.

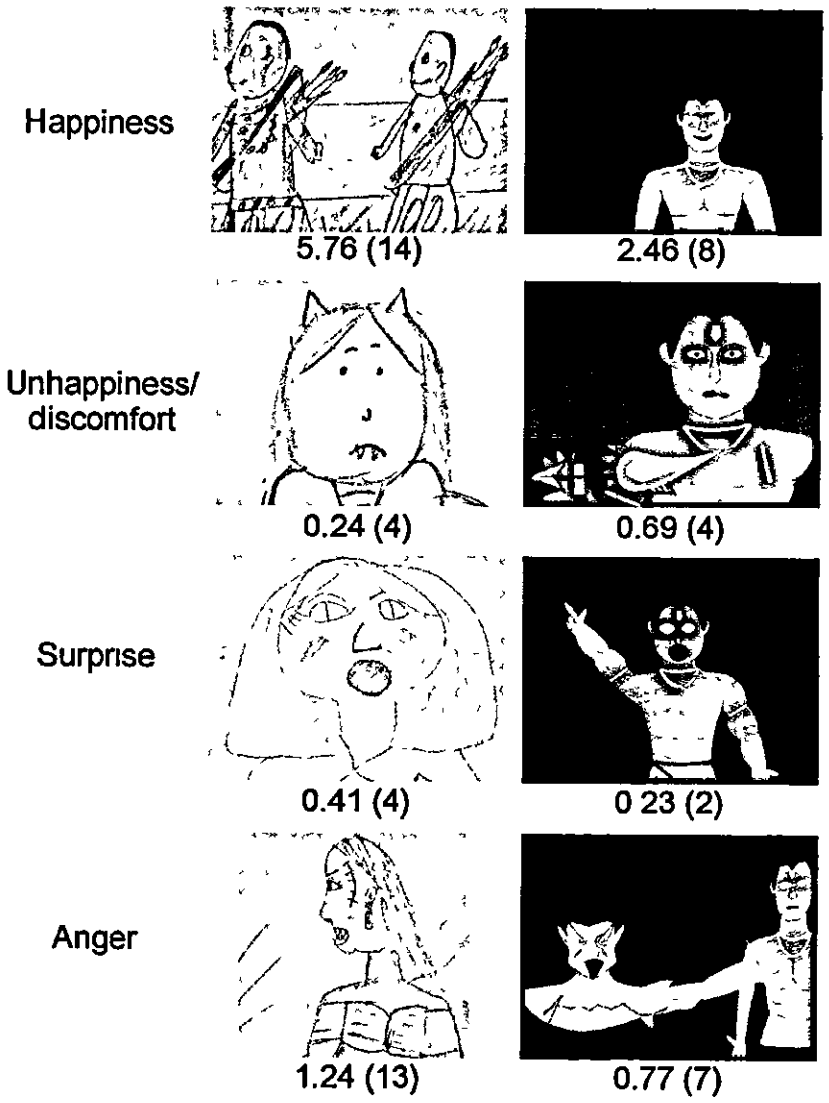


Figure 6.7: Examples of the four kinds of expression judged to have been depicted by the control group (left-hand side) and the experimental group (right-hand side). Two numbers are given below each picture; the first, unbracketed, number shows each group's average number of depictions of the expression, and the second, bracketed number indicates how many participants in the relevant group depicted that expression

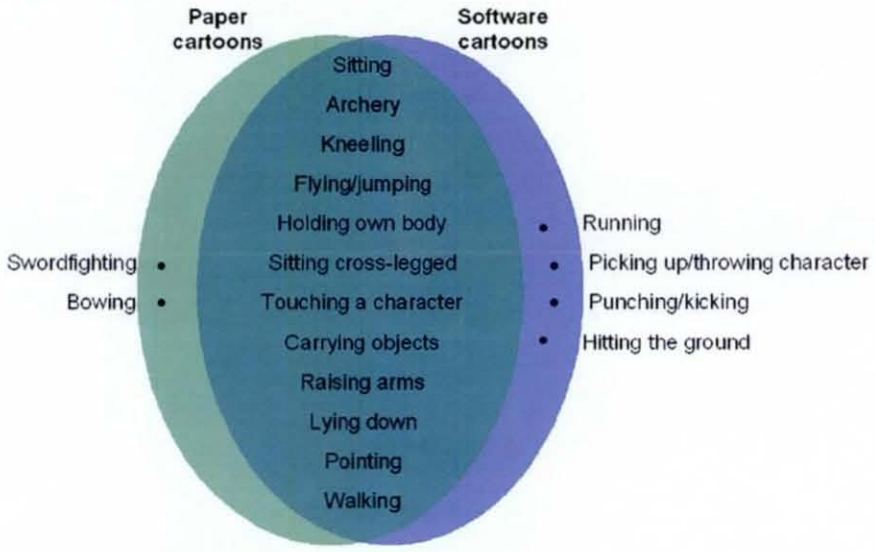


Figure 6.8: The sets of poses depicted in the paper and software cartoons, and their intersection.

Characterisation Findings: Characters' Poses

The final flavour of analysis promised to focus on characters' poses and the actions they are shown to be doing. A rather larger list of possibilities was found, depicted in Figure 6.8; this indicates that a few kinds of pose were unique either to the control or experimental group, although the majority of types were used by both groups. Most of the categories apply to single characters, but some encompass two, for example picking up another character, and some are combinable, so that, for example, sitting cross-legged whilst raising one's arms counts in two categories. The 'touching a character' category refers to nonviolent touch, of which a fair number of instances were seen; violent touch is reserved for the less euphemistically-named 'punching and kicking' category. An initial flavour of how two of these poses look may be found in Figure 6.9, which shows a sample of the two groups' renditions of a character holding their own body, and of a character sitting cross-legged.

The counting and averaging proceeded in the same way as for facial ex-

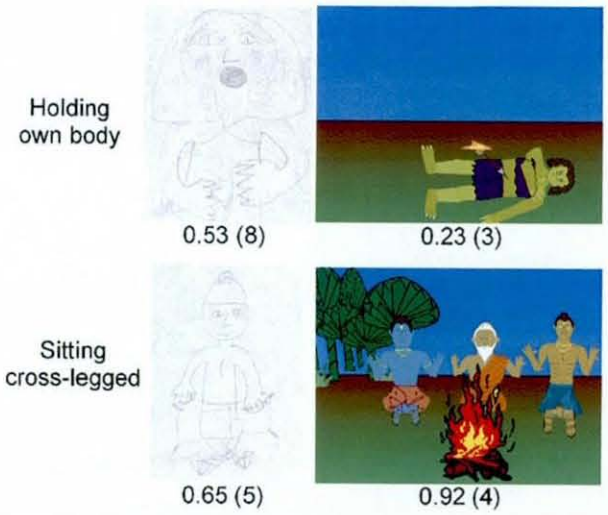


Figure 6.9: Examples of two poses depicted comparably often by the control group (left-hand side) and the experimental group (right-hand side); again, the unbracketed number shows the average number of depictions for each group, and the bracketed number shows how many participants in a group made the depiction.

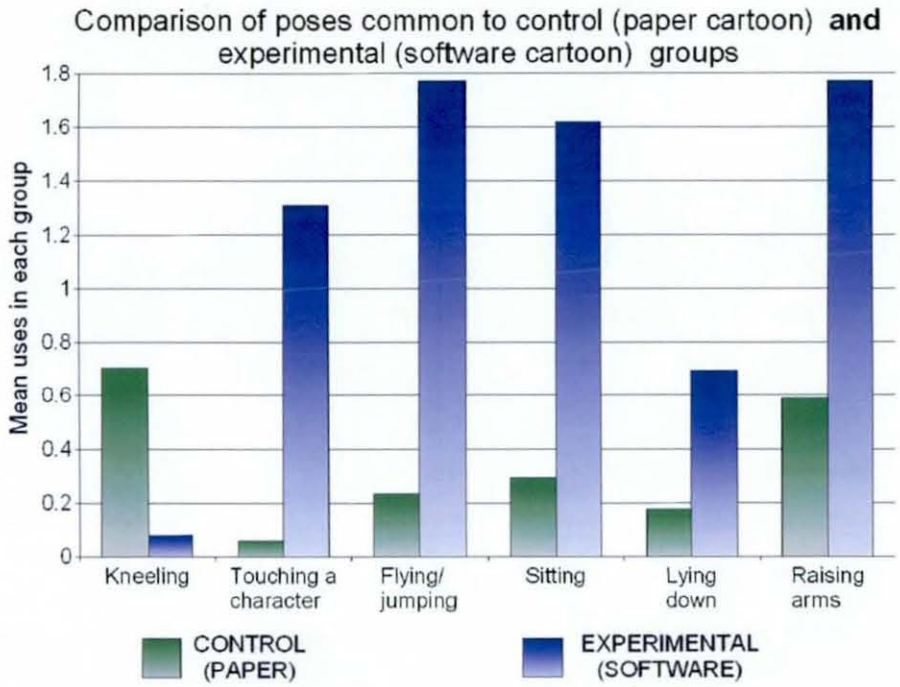


Figure 6.10: The statistically significant differences for the poses depicted by both groups.

pressions. Six statistically significant differences are found for the poses which are common to both groups, that is, the poses in the intersection part of Figure 6.8. They are indicated in Figure 6.10, from which it can be seen that the average control participant **depicted one pose more frequently** than the average experimental participant, whereas the average experimental participant **depicted five kinds of pose more frequently** than the average control participant. Figures 6.11 and 6.12 show what these poses actually looked like.

Figure 6.13 shows the average use of poses unique to one group or the other; here, the control group exhibits **two unique kinds of pose** and the software group shows **four unique kinds of pose**. Again, examples are provided in Figures 6.14 and 6.15.

Figures 6.10 and 6.13 suggest particularly that the software cartoons show

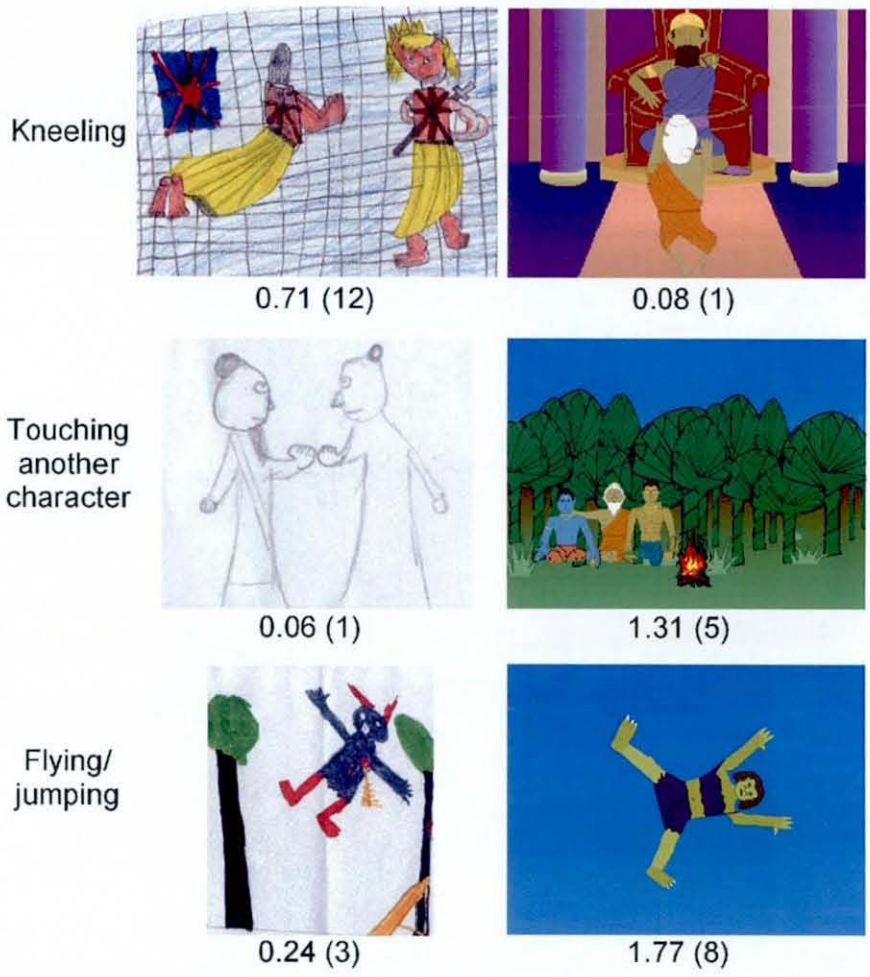


Figure 6.11: The first set of example poses whose average use, indicated in Figure 6.10, differs between the control and experimental groups.

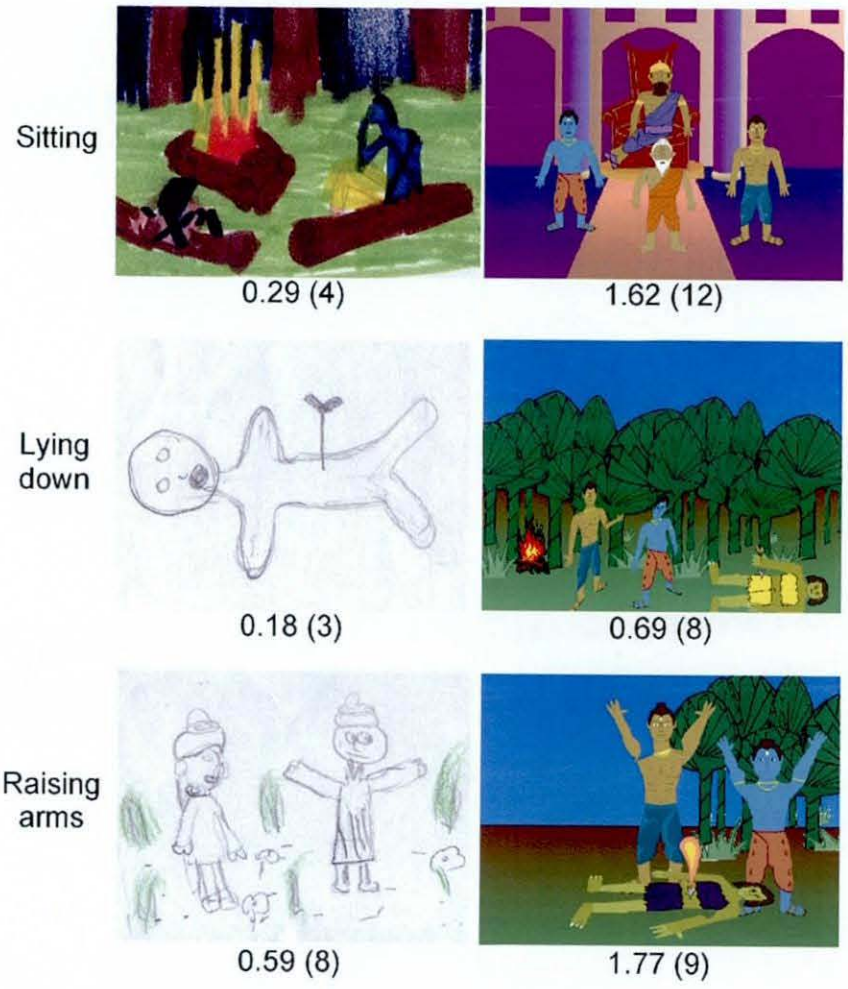


Figure 6.12: The second set of example poses whose average use, indicated in Figure 6.10, differs between the control and experimental groups.

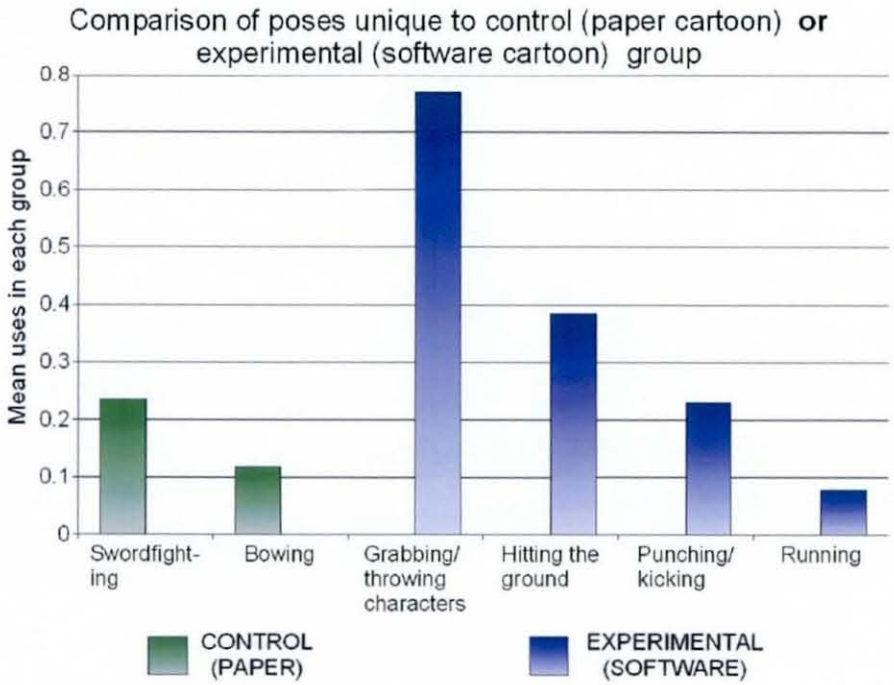


Figure 6.13: The statistically significant differences for the poses depicted only by one group or the other.

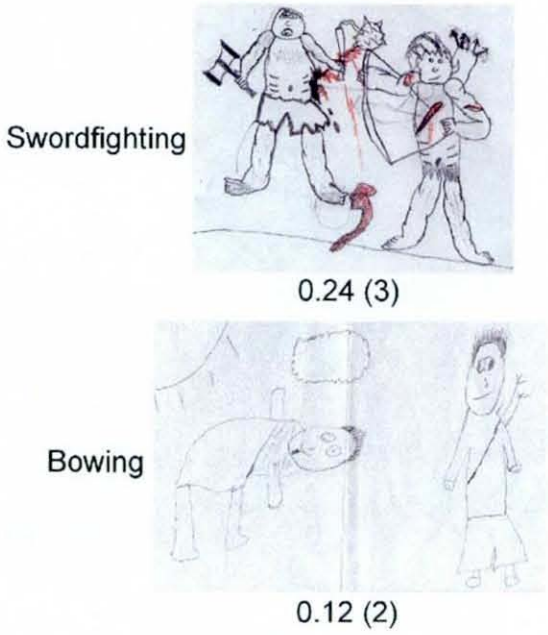


Figure 6.14: Examples of the two types of pose depicted only by the control group.

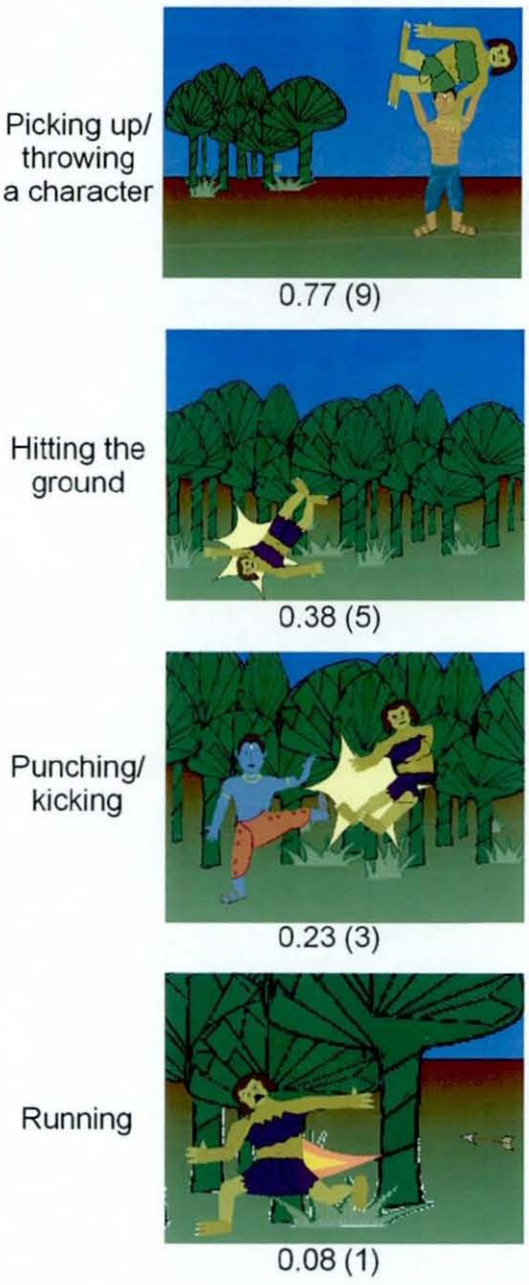


Figure 6.15: Examples of the four types of pose depicted only by the experimental group.

much more physical interaction between characters; this is implied by the groups' differences concerning three types of physical interaction. First, the average number of instances of a character touching another is more than twenty times greater for the experimental group than for the control. Secondly, nine of the thirteen experimental participants showed a character picking up or throwing another character, and, thirdly, three showed a character punching or kicking another, whereas no control participant showed either of these actions. The experimental group's depictions of these three kinds of touch seem to be quite evenly split between the boys and the girls and no significant difference between their use of this pose type is found.

There is one kind of direct physical interaction between characters which is unique to the paper cartoons; three of the seventeen control participants depicted two characters swordfighting. The experimental group could not depict any swordplay, because their bank of clipart limited their choice of weapons to bows, arrows and fire. It is thus judged that the absence of swordfights does not weaken the trend of increased physical interaction in the software cartoons, but rather highlights an inflexibility of the specific version of the software used in the study.

The other kind of pose unique to the control group's cartoons is that of a character bowing. It is possible that this pose, like that of kneeling, which was more common on paper, is more difficult to accomplish with the software, particularly since no side views of characters were provided; both of the bows were drawn from a straight side-on perspective. However, it is suggested that the pose may simply not have occurred to any experimental participant; one experimental group participant did create a pose which would be very like a bow if it were rotated, with the legs bent almost perpendicular to the body (see Figure 6.16). This, in conjunction with the fact that only two of the seventeen control participants thought of drawing the pose, is taken as supporting evidence that at least some experimental participants would have been able to achieve bows but that none thought of it.

As noted, the average control participant depicted kneeling characters more often, and this may represent a type of pose which is currently difficult to render using the software. The single experimental participant who suc-

Figure 6.16: A pose created by one experimental participant which would, it is suggested, also function as a bow if rotated. This is taken as evidence to support the assertion that experimental participants might have been able to render bows but did not think of doing so.

cessfully depicted a kneeling character is also the only participant in either group to make a character run (see the bottom of Figure 6.15), so it seems likely that this participant was more adept than average at manipulating the characters and so was able to achieve comparatively difficult poses.

6.3.3 Coarse-Grained Analyses

Attention now turns briefly to the measures of expressiveness per shot for the three categories. Between the control and the experimental groups, the results show **no significant difference in use of non-default shot distance per shot**, that **the control group averaged about three times as much facial expressiveness per shot** as the experimental group, with a confidence level approaching 100%, and that **the experimental group averaged about one and a half times as much pose expressiveness per shot**, with a confidence level of 94.5%. Within the experimental group, no gender differences in overall expressiveness per shot are found.

These differences can be interpreted in terms of what the software may make easier and what it may make harder. It is suggested that, with the current version, facial expression is harder to manipulate than pose; it is

very often necessary to zoom in so as to be able to drag a line, whereas a character's pose can be quite easily changed from a greater distance.

6.4 Qualitative Observations and Participant Opinions

This section will move from quantitative analysis to look at participants' opinions and experiences. Comments are drawn from the investigator's experiences during the intervention, an interview with the Visitor sub-study teacher, who had direct experience with using the software, and feedback forms filled in by the Visitor sub-study class after everyone had been given a chance to use the software. This questionnaire and some sample responses are given in Appendix L.

6.4.1 Responses to Posable Characters

The ability to pose and warp characters was viewed both as one of the software's best features and one of its hardest; a few participants expressed both of these opinions simultaneously! Opinions as to best thing about the software include the following.

- "You can do whatever you want with the characters";
- "Being able to move the skeleton and people";
- "You can change the face's features";
- "The best thing is that you can do a lot with the people".

By contrast, responses as to what was most annoying or hard feature comments like

- "You couldn't do the right thing that you wanted to do";
- "I could not get the skeleton to lie down";
- "Moving the legs and arms";

- "The little buttons to change the shape".

This dual reaction suggests that the posable characters are seen as being valuable, challenging and problematic, in need of further user interface improvements.

There is a strong sense that users are keen to take more ownership of the artwork, and to adapt and individualise it; one feedback question asked whether users would like to be able to make their own characters, and many responded affirmatively to this, also asking for a greater variety of characters, and the ability to change their clothes Further, during the intervention, a significant number of software participants were seen to make use of the ability to change the colours in the character drawings, lending support to the idea that allowing students to further customise artwork, or to create their own, would be a well received feature

6.4.2 Use of Other Software Features

Participants did not easily make spontaneous use of close-ups, needing much encouragement to do so, as was also found by Burn and Parker (2003b). Participants also needed to be prompted to extend the initial short but complete sequences that most had completed by the end of their first session These tended to consist of three or four sequenced pictures telling the bare rudiments of the story, after which a common reaction was to express the opinion that they had finished. The fact that virtually all went on to expand these starting sequences, after it had been made clear that this was the desire in the subsequent sessions, shows that a kind of editing was happening, although it was mostly limited to the act of 'fleshing out', inserting extra detail and extra shots, and did not extend to editing the sequence in which shots were presented.

The visual storytelling prompts received very little use unless participants were virtually ordered to use them; it seems that the current iteration of the software makes this help too low-key. It is suggested that the motivation for providing such prompts is still valid, however; both teachers expressed the opinion that they were a good idea and the lack of resequencing and use

of close-ups described above shows that users do need explicit prompting if they are to deploy a fuller range of visual techniques.

It is judged that the ability to display a slide show of one's work in full-screen was valuable; participants made much use of this to show their work to peers and the teachers.

The mode-switching issue originally raised in the first pilot study again cropped up in the feedback forms, with a number of complaints about "having to change buttons", it was belatedly realised that a simple patch to this would be to provide a 'mode switch' keyboard shortcut.

6.4.3 Engagement and Motivation

Reactions observed during the interventions and user and teacher comments all suggest that participants found the software to be very engaging. The Visitor sub-study teacher observed that the software users had "put a lot more into planning [the story] than the children who used the paper and pencil .. those children had quite a few hours on it; they were completely absorbed in what they were doing". This teacher was additionally of the opinion that the software was useful because it provided an engaging additional way to mediate storytelling concepts, saying that "the more ways that you can present something, the more chance you've got of hitting more children, of pressing their particular button, and it [the software] did it with that". This point is echoed in other comments which identified the software as providing another way for children to gather their thoughts and for making them think through the stages of their story more carefully. This latter point perhaps ties in with the 'fleshing out' noted above; participants may have had to think more carefully about the stages when faced with the task of inserting more detail to their 'first drafts' This kind of behaviour is very likely easier in software, where the product is digital and can be edited and changed more easily than a paper plan or sequence can be.

Irrespective of how or why the software was beneficial to them, the participants themselves made many positive comments, as with the desire to be able to customise or create their own characters, there was a definite sense

that extra features and improvements were wanted. A few of the comments made include:

- "It was great it can be improved";
- "It was brilliant but it can get better still";
- "It's one of the best things on the computer I have ever been on It can still get better though";
- "Brilliant, exciting useful";
- "It is the best thing I have ever been on";
- "I think it will be a hit".

The last word on the software's reception in school is left to the Visitor sub-study teacher, who asked "when it's done, can we have a copy?"

6.5 Summary and Conclusions

Finally in this chapter, the findings made earlier will be summarised collectively, and some interpretations drawn.

6.5.1 Summary of Findings

- **Interventions' effects on writing**
  No intervention produced consistently different results so far as writing is concerned.
- **Software/paper cartoons: number and type of shots**
  The cartoons made with the software show on average twice as many total shots and twice as many long shots as those produced on paper, and all but one of the software cartoons are finished, compared to fewer than half of the paper cartoons.

- **Software/paper cartoons: character emotion**
  The software and paper cartoons show broadly the same four kinds of emotion. The paper cartoons show on average twice as many happy faces per participant, and more instances of expressive faces per shot.

- **Software/paper cartoons: character poses**
  The software cartoons show a greater number of depictions of character actions, for example sitting, jumping, or raising arms, and interactions, such as hitting or hugging. Software cartoons also demonstrate a greater variety of pose: they exhibit sixteen kinds compared to the fourteen on paper.

  The average software participant depicts five kinds of pose more frequently than the average paper participant. Several of these poses relate to character-character interaction, which is thus seen far more often in the software cartoons. Only kneeling is depicted more frequently on paper.

  Two poses are unique to the paper cartoons, though the software group had no chance of replicating one of these, and four poses are unique to the software cartoons

  The software cartoons show more instances of expressive pose per shot.

- **Software cartoons: gender differences**
  Two gender differences are found in software use. girls depicted a greater number of happy faces, and boys depicted a greater number of angry faces.

6.5.2 Overall Interpretation

The findings summarised above almost seem to be in conflict From the Visitor sub-study comes the suggestion that the software cartoon process had the same effect on writing as the conventional preparation process. Then the Ramayana sub-study suggests that the software cartoon process also produced similar storywriting results to the paper cartoon process. However,

the software cartoons were very different to the paper ones, showing more character action and interaction, and more shots.

It is concluded that these differences in cartoon depiction are real, but that they did not carry over to writing; given that arguably the greatest average difference between the software and paper cartoons, that is the number of shots produced, did not produce any different effect on writing, it may not be surprising that the other differences also failed to manifest themselves in print.

This cannot be attributed to participants being fazed by the notion of using pictures as a lead-in to writing, because both teachers confirmed that their classes were familiar with the idea, employing it in such activities as drawing cartoons of Greek fables and the Bible story of Exodus, or using images or sequences from live-action or animated versions of stories The teachers also confirmed that the groups writing from software or paper cartoons did refer to their images as they wrote

In interpreting why the written stories failed to exhibit significant differences, then, attention must turn to the way in which the pictures were transcribed to text. The conclusion is drawn that participants did not possess picture-to-text transcription strategies capable of utilising the greater degree of expression which the experimental group's cartoons demonstrated; although experimental group participants often made more expressive choices as to what to depict visually, it was not apparent to them how to translate these decisions into text

This perhaps demonstrates another area in which explicit process prompting may be valuable. Holdich and Chung (2003) demonstrate that software-mediated guidance in storywriting technique can lead to writing improvement, but the software used in this study did not provide explicit writing guidance, and this may be worth considering.

Despite this lack of impact on writing, it is concluded that the software led to a positive change in cartoon production and visualisation; software users produced more shots, were much more likely to finish their cartoon sequences, and showed the beginnings of greater expression through their increased use of long shots. In addition, it is concluded that the posable

character facility helped software users express more types of pose, and to do so more frequently; the software cartoons show more instances of character actions such as sitting, flying through the air, and lying down, and more character-character interaction, be it through depictions of touch, picking up, or fighting Finally, the software participants were very engaged with their task, and all these effects together with the Visitor sub-study teacher's belief that the software users put more into their task than the others suggests that there is a definite productivity gain associated with using the software, at least as far producing visual stories is concerned.

Some features of visual storytelling were either unaffected or made harder by the software. It seems that concepts of shot sequencing and juxtaposition were not employed any more fully than on paper, and they, like the transcription process itself, may need more explicit attention if they are to be of full value in literacy activities. Additionally, the current version of the software probably made the depiction of emotion harder than on paper, although it is only the average number of expressions per **picture** which is lower, not (happiness excepted) the average number of different kinds of expression per **participant.** It is therefore concluded that this difference indicates a weaker area of the software's interface.

6.5.3 Conclusion

The assertion that motivated the software's design, that children are able to make use of more complex visualisation features than are presently provided in other tools, has been revalidated and extended by this main study. It has also been seen that the software intervention devised benefited cartoon production but had no distinct impact on storywriting; this is one of several areas in which the concept requires further alteration. Such alterations and extensions are the work of the future, and are considered in the next chapter

Chapter 7

Conclusion

This final chapter gathers what has gone before, summarises the answers to the research questions, identifies the contributions made by this Thesis and presents thoughts on the directions which future work could take.

7.1 Summary of Thesis: Aims and Objectives Revisited

This Thesis aimed to identify the scope for the development of a new story visualisation tool which uses concepts of moving image literacy, and to develop such a tool and test its impact on writing. These aims were to be fulfilled through four objectives first stated in Section 1.2; these are recapitulated here with summaries of how each has been met.

1. *Obtain a precise definition of the term 'moving image literacy' and establish how it relates to the theories and practice of written composition, and specifically fiction writing.*

   Chapter 2 used the concept of the kineikonic mode of communication (Burn and Parker, 2003a,b, 2001) to affirm the meaning of 'moving image literacy'; it also linked the concept with a theory of written composition by highlighting similarities in the production process.

2. *Survey existing visual-story-making software, and identify gaps in its provision*

   Current visual-story-making software was analysed in Chapter 3. By grouping existing tools into two broad categories based on each individual program's position in a spectrum which ranges between high support for depiction and allowance for a broad range of depiction, a gap in the current software provision was highlighted.

3. *Identify specific research questions which may be asked concerning the relationships between ICT, visual storytelling activities, and storywriting, and specify and develop a new software tool to be used in answering those research questions.*

   Chapter 4 established the relevant research questions and made concrete proposals for the shape of a new story visualisation tool. The actual answers to the research questions shall be addressed in Section 7.2.

4. *Design and carry out formative experiments to answer the research questions.*

   The evolving implementations of Chapter 4's proposal were used in three successively larger studies described in Chapters 5 and 6, which provided data on the feasibility of the concept and its relation to writing, paper cartooning, and student engagement. The conclusions which may be drawn from the studies are presented at the end of Section 7.2.

7.2 Research Questions Revisited

The research questions first posed in Section 4.2 1 are now reviewed, together with their suggested answers.

- **Is the enhanced-frontal-orientation approach feasible?**
  Yes, at least as far as the later half of Key Stage 2 is concerned. In all three studies, 9 to 11 year-old users quickly picked up the different ways of manipulating enhanced-frontal-orientation characters.

- **Can children make a sequence of pictures using combinations of posable characters, camera shots and visual storytelling guidance?**
  Yes, although caveats apply. The second pilot study's implementation showed that sequencing does not necessarily arise if it is not demanded, and this study and the main study both failed to find a way to usefully integrate the visual storytelling prompts.

- **In what ways can this visual story be used to elicit writing, and what effect does it have on writing?**
  Two processes for eliciting writing from a visual product were designed, one for the second pilot study and one for the main study It is suggested that the former process identified the pictures too closely with resulting text, which could not stand alone, and that the latter process separated the two products too far, so that the pictures did not have a discernibly different effect on writing as compared to other processes This, together with the inconsistent CHECK TEXT results summarised on p. 93 and the generally small study sizes, disallow any firm conclusion to be drawn regarding the effect of the visual stories on writing.

- **Do the visual stories created with the software exhibit any noticeable differences to those created with pencil and paper?**
  The cartoon comparisons summarised on pp. 100-115, and reproduced in Appendix J, yield 13 differences found to be significant at the 0 05 level Ten of these involve greater expressiveness in the software-created cartoons, which:

  - show a much higher completion rate;
  - use more total pictures,
  - use more long shots;
  - depict seven kinds of pose more frequently than the paper cartoons.

In addition, the software cartoons can be argued to show a higher degree of pose expressiveness per shot. By comparison, the paper cartoons show greater expressiveness in only three areas: they

- show more instances of happy characters, although perhaps, as noted on p. 103, more as a default option than as a deliberate expressive choice,
- show more facial expressiveness per shot;
- contain more depictions of characters kneeling.

Thus the general tendency in the Ramayana sub-study can be argued to be towards a greater level of expressiveness in the software cartoons Again, since the sample size in the main study was small, it is not possible to make a strong conclusion or inference about the general effect which the software might have on visual storytelling, however, it is argued that the differences summarised above are at least indicative of a potential which merits further investigation

- **What degree of engagement do the users show with the software and the tasks?**
  The comments from the Visitor sub-study's teacher reported on p. 117, and the participant responses from pp. 115, 118 and Appendix L suggest that the software has the capability to enthuse and engage users and encourage them to stay on focused tasks, in this case visually-retelling a specific, known story. It is an open question as to what extent the engagement and enthusiasm cited are transient 'honeymoon' effects, a larger, more extended study would be needed to assess this.

7.2.1 Subsequent Conclusions

It is concluded first that the enhanced-frontal-orientation approach, as embedded in the software, was a suitable, appropriate tool to present to students participating in the investigations, and, further, that it was well-received among these participants and promoted focused and productive visual work.

These conclusions, specific to the studies reported in this Thesis, may be firmly founded on the following evidence.

- Suitable and appropriate: backed by the observations made on p. 52 during the first pilot study, in which it was noted that the participants were able to successfully manipulate a posable character to achieve deliberate effect in a short time, and the fact that all participants using the software in the second pilot study and the main study produced some kind of visual story.

- Well-received backed by the observation on p. 52 that all participants in the first pilot study elected to stay on and do additional tasks, the Visitor sub-study teacher's comments concerning engagement reported on p. 117 and the positive comments made by the Visitor sub-study participants themselves, for example p. 115 and p. 118.

- Promoted focused, productive work backed by the second pilot study teacher-leader's opinions noted on p. 75 concerning the task focus displayed by software users, the main study cartoon comparison differences noted on p 101, showing that software users produced more pictures and were more likely to finish their visual stories than their pencil-and-paper counterparts, and the Visitor sub-study teacher's impression noted on p. 117 that the software group put more into planning their stories and were absorbed in their task

When this conclusion is taken with the lack of any firm effect, positive *or* negative, on written products, it may be argued that there are implications for other techniques here, particularly those which seek to leverage students' facility or enthusiasm for certain artefacts and media The role of computer games in education provides one example; even if a particular new process offers novel affordances for expressiveness and is received positively by students, care must be taken to see that these affordances can be transcribed to conventional products such as written work if they are to be seen to have strong educational value

The second conclusion to be drawn concerns the claim made for the combined support for, and range of, depiction enabled by the enhanced-frontal-orientation approach. Since that claim is a general one, the conclusion must be more tentative since there is little experimental data from which to draw inferences However, as argued above, the evidence provided on pp. 100-115, and reproduced in Appendix 6.3, is sufficiently consistent to be seen as being weakly indicative of a possible effect

There are two areas in which it is only possible to state that no firm conclusions may be drawn one way or another, one is the effect of the software and interventions upon participants' written stories, as noted above Secondly, concerning the visual storytelling prompts, all that can be said is that participants tended not to use them! Since they were used so little, it is not possible to make any further statements regarding their usefulness or potential impact.

7.3 Contributions of the Thesis

In looking at the debate on the relationships between ICT, moving image literacy and writing, four theoretical contributions are identified

- By establishing a link between the knowledge-transforming model of composition and the kinds of behaviours which moving image activities can foster, such as the switching an individual may repeatedly make between the role of producer and of audience, the Thesis has in Chapter 2 placed moving image activities into a wider theoretical framework. This serves to compound links to conventional literacy which others have made.

- By surveying the range of visual-story-making software currently available in Chapter 3, the Thesis has identified a twofold problem applicable to current visual story-making tools· that of providing support for depiction whilst preserving scope for a range of depiction.

- In proposing the enhanced-frontal-orientation approach in Chapter 4, the Thesis has provided a novel way to address this twofold problem.
- In proposing the visual storytelling prompts in Chapter 4, the Thesis has demonstrated how proven research concerning support for writing stories can be adapted and extended to apply to the creation of visual stories.

In addition, the Thesis has made two practical contributions to this area.

- The development of a novel software tool for the creation of visual stories, which has been shown, albeit on a small scale, to be suitable for use in certain classroom contexts.
- The testing of the visual storytelling prompts and of the enhanced-frontal-orientation approach has provided initial data on their validity and highlighted further directions for development and research.

7.4 Limitations of the Tool and Opportunities for Future Development

This section and the next consider the prospects both for extending and developing the software and for continuing research into its effect on storytelling and storywriting. The former are addressed first.

Perhaps the greatest limitation of all versions of the software so far developed over the course of this project is that the posable characters could not realistically be created by children As noted in Chapter 4, the enhanced-frontal-orientation approach is well-suited to child art, and so it seems highly desirable to allow children the chance to create their own characters.

In order to supply such a feature, it is necessary to create an interface which can specify how a particular stick-figure skeleton should distort a given drawing, that is, how the drawing is 'bound' to the skeleton. The current method for this requires the user to specify by hand which skeleton coordinate frame influences each vector point, this is both time-consuming and

error-prone, and as such is not considered suitable for the software's target audience.

A related limitation arises from the underlying mechanics which govern how the drawing is bound to the skeleton. At present, this uses the simple approach commonly known as 'rigid binding', in which precisely one bone of the skeleton influences each vector point Rigid binding has the consequence that different vector points, though they may be physically close to one another, must sometimes belong to different bone coordinate frames; in turn, this sometimes means that such points become subject to very different displacements when the skeleton's pose is changed. This 'all or nothing' approach can lead to somewhat ugly artefacts, for example the localised warping depicted in Figure 7.1.

Both the problem of designing a suitable 'binding interface' and that presented by the rigid binding approach might be solved by following the example of automatic 'smooth skinning' algorithms in 3D modellers such as Maya (Autodesk). Such algorithms automatically distribute the influence of multiple skeleton bones to a point depending on its distance from them This creates a much smoother joint bend

The second significant limitation of the current tool pertains to the kinds of product which can be made with it. At present, it is geared towards the creation of still pictures in a linear sequence; however, it could very naturally be extended to cover animation It is likely that this would further enhance student engagement and motivation, might allow greater peer review of work, and might enhance opportunities to consider the role of editing and sequencing in storytelling. A further extension might cover the production of products closer to comic books, in which a number of heterogeneous frames are composed into a page.

Third, the software as it stands supports the notion of transformation but provides limited affordance for combination/recombination, that is the facility to create permutations of characters and scenes by selecting different combinations of artwork, like hats, axes, arms, trees and so on, and it provides virtually no support for fixing/unfixing, that is grouping subunits together to form, for example, characters, these latter two aspects are also identified by

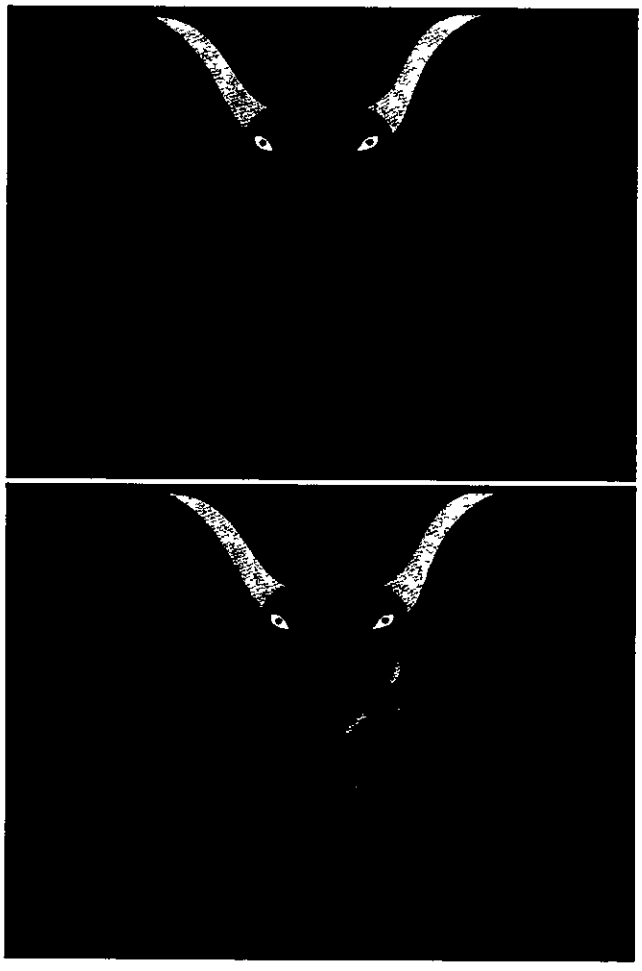


Figure 7.1· An example showing how rigid binding can create ugly artefacts In the small circle, note that the edge of the Minotaur's face, controlled by the shoulder bone, has moved, whereas the nose, ear, and eye, all controlled by the head bone, have not been affected at all In the large circle, see that the at-first evenly distributed ruff has stretched all at one point.

Burn and Parker (2001) as valuable inscriptional aspects, and offering greater affordance for them might enhance the software's power of representation

Fourth, both attempts to integrate the visual storytelling prompts into the software met largely with failure, and so their implementation so far must also be considered a limitation and an area for change. The corresponding opportunity involves finding a way to supply such help in a way which is neither too intrusive, as was the case in the second pilot study, nor too unobtrusive, as in the main study.

Finally, many other aspects of the user interface need improvements and changes, particularly the mediation of pose and warp modes, a particular current problem relates to the fact that posing and warping is currently accomplished from within the camera shot, so that if a character is small in a particular shot, it is very hard to manipulate them one must first zoom in so as to warp the lines desired, then zoom back out to restore the shot to its earlier distance. Many users had difficulty with such a composite, 'zoom in, then zoom back out', operation A suitable change might involve providing a separate posing/warping area for the currently-selected character, rather than placing all control in the shot view. The camera tilt function was also not implemented in the most helpful way, and did not receive much use

7.5 Opportunities for Further Research

In addition to further software development, a number of further research areas may be identified. It is first recognised that the visual storytelling prompts concept needs further research; since they have not yet been well-used, it is difficult to tell whether the concept can bring benefits Assuming that users can consistently be persuaded to pay attention to the prompts, it may be possible to determine their effect by using an approach analogous to the case studies reported by Holdich and Chung (2003), in these, two computer tools were used, one the full HARRY system, and the other a cut-down version which supplied a single guiding prompt and reply text box, but gave no other help Therefore, the visual storytelling prompts might be tested by supplying two versions of the cartoon storytelling software; one

would supply the full range of subsidiary helps covering ideas, characters and the camera, along with the main guiding prompts, the other might only supply a very general main guiding prompt. The resulting cartoon stories could then be analysed for differences.

Additionally, the visual storytelling prompt concept has so far only been developed for a 'feedforward' stage; the actual HARRY system also provides a second set of feedback prompts, organised in the same sequence of story stages, aimed at encouraging revision and editing. Determining an analogous procedure for visual stories could be worthwhile research, insofar as it would bring the visual storytelling prompts closer to the original, proven, concept This might be accomplished by having a checking system in place to detect if users have, for example, used a certain number of pictures in each story stage, have used particular types of camera shot such as close-ups of a particular character or object, and so on. It is not proposed to attempt the implementation of a general 'picture analyser', but rather to detect the use of specific characters, shot framings, and perhaps sequences and so on. For example, by tagging character and art files with useful semantic information, it might be possible to detect whether a user has shown a shot of a monster followed by a close-up of a character's face, as a simple action-reaction sequence.

Two aspects of process design could benefit from further research. First, the task of designing a writing process which assists transcription, so that student-created picture prompts more fully elicit writing, may still be fruitfully pursued, the approaches used in the second pilot study and the main study are far from the only possible ways of linking pictures with text. One suggested approach involves revisiting the idea of captioning pictures as a first draft of writing, asking users to rework their caption text when it has been removed from its pictures Another idea involves using the pictures to stimulate various different categories of textual response, for example allowing students to brainstorm metaphors, similes, descriptions of action, and so on, before using these 'snippets' as starting points for text generation.

Secondly, the process of visual story-making alone may merit closer attention. For example, it is desirable to find ways to better encourage students to deploy concepts of filming and editing, so that they make informed and

deliberate choices as to shot framing, sequence and purpose, one possible way to do this might involve the visual storytelling prompts, if they could be suitably developed. Additionally, the concept of revision and editing of pictures and story sequences may prove fruitful, since users were not observed to revise or edit their existing pictures or sequences very much, preferring to make new pictures to add instead.

Finally, it is desired to explore the software's potential in other curriculum areas, most obviously art and design, and its role in further supporting children's cartooning.

7.6 Concluding Remarks

The work presented has located new avenues for research into children's picture-making and storywriting. It has certainly not exhaustively mapped these opportunities, but it is hoped that the reader is able to trace a thread of continuity through the preceding chapters to see how choices were made as to which areas to explore. If the reader is persuaded that the decisions taken were well-motivated and have led to interesting results, then the Thesis will have done its job.

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Appendix A

Content-Centred Software

All URLs presented here are correct as at 25 April 2006.

Kar2ouche
Immersive Education:
http://www.immersiveeducation.com/uk/Kar2ouche_Default.asp

MediaStage
Immersive Education:
http://www.immersiveeducation.com/uk/MediaStage_Default.asp

Machinima
No single publisher; http://www.machinima.com provides a wide range of information.

Kahootz
Australian Children's Television Foundation:
http://www.kahootz.com/kz/
See also:
http://www.curriculumonline.gov.uk/TitleSearch/Resource.htm?oid=28163&t=kahootz

Picture Writer
JVSoft:
http://www.jvsoft.co.uk/products/picturewriter.html

i-Theatre Lab

Mantra Lingua:

`http://www.mantralingua.com/` describes Mantra Lingua but does not provide much description of i-Theatre Lab; most information on the software was obtained from a hard-copy of Mantra Lingua's "eLearning Resources 2006" booklet.

MoPix

Film Education:

`http://www.filmeducation.org/interactive/MoPix.html`

T'riffic Tales

Not published as software; all information obtained from Brna and Cooper (2002) and Cooper and Brna (2001).

Appendix B

Build-Centred Software

All URLs presented here are correct as at 25 April 2006.

Virtual Puppeteers
Squidsoup:
`http://squidsoup.com/2005/`
Further information at:
`http://www.futurelab.org.uk/showcase/virtual_puppets/puppeteers.htm`

Textease CT, Textease Presenter CT, Textease Movies CT
Softease
`http://www.softease.com/products.htm`

BlackCat SlideShow
BlackCat:
`http://www.blackcatsoftware.com/products/slideshow.asp`

2Create A Story, 2Animate
2Simple:
`http://www.2simple.com/programs/`

HyperStudio, EasyBook Deluxe
Sunburst Technology:
`http://store.sunburst.com/ProductInfo.aspx?itemid=176444`

and·
http://store.sunburst.com/ProductInfo.aspx?itemid=176605
For HyperStudio, see also
http://www.hyperstudio.com/Home.aspx
http://www.curriculumonline.gov.uk/TitleSearch/Resource.htm?oid=8047&t=hyperstudio

KidPix Deluxe 4

Broderbund:
http://www.broderbund.com/jump.jsp?itemID=588&mainPID=588&itemType=PRODUCT

The Complete Animator

Iota Software:
http://www.iota.co.uk/tca/
See also:
http://www.curriculumonline.gov.uk/TitleSearch/Resource.htm?oid=13532&t=complete+animator

iMovie

Apple:
http.//www.apple.com/ilife/imovie/

Windows Movie Maker

Microsoft:
http://www.microsoft.com/windowsxp/using/moviemaker/default.mspx

I Can Animate

Kudlian Soft·
http://www.kudlian.net/products/icananimate/
See also·
http://www.curriculumonline.gov.uk/TitleSearch/Resource.htm?oid=27528&t=I+can+animate

Digital Movie Creator 2

Digital Blue:
http://www.playdigitalblue.com/products/dmc/info/

VideoBlender 2, ImageBlender

Tech4Learning:
http://shop.tech4learning.com/index.php?main_page=product_info&products_id=24
and:
http://shop.tech4learning.com/index.php?main_page=product_info&cPath=3&products_id=28
See also:
http://www.curriculumonline.gov.uk/TitleSearch/Resource.htm?oid=8651&t=videoblender
and:
http://www.curriculumonline.gov.uk/TitleSearch/Resource.htm?oid=8628&t=imageblender

VideoStudio 9

Ulead:
http://www.ulead.co.uk/vs/runme.htm
See also
http://www.curriculumonline.gov.uk/TitleSearch/Resource.htm?oid=27377&t=videostudio

Media 100

Media 100:
http://www.media100.com/Media100HD.asp

Flash

Adobe:
http://www.adobe.com/products/flash/flashpro/?promoid=BINT

Clover

See Bailey et al (2006) for a full discussion.

Appendix C

HARRY and Visual Storytelling Prompts

This section presents an example of a complete set of HARRY prompts, reproduced from Holdich and Chung (2003), followed by the visual storytelling prompts used in the second pilot study.

Story stage and guiding prompt	Ideas help	Word help	Sentence help	Check
Welcome				
The King is very ill Travellers must fetch a special magic healing stone Your story should be about the dangers they meet as they return with the stone Make a list of ideas for this story in the box below	This should be a mysterious story where strange things sometimes happen The stone will probably nearly get lost or stolen several times on the way How? Will your characters be modern or from the past? Will they be young or old?	Explorers, rugged clothes, trailing cloaks, ventured, strode, lingered, plodded, ventured, trekked, dangerous, nsky, challenge, quest, mission, strange	Wnte down any good phrases you can think of which you could use later like The mission was far harder than they could ever have imagned	Come back to this or any other page to find ideas for what to wnte
Start				
Set the scene Descnbe the King's Palace Perhaps the King is ill on a bed and the courtiers are discussing what should be done	Does the King sneeze or cough? Have a fever? Pale and weak? Do the servants speak loudly or in hushed whispers afraid to disturb the King? Is there a doctor examining the King?	Think of different adjectives to describe the palace like vast windows, tiled ceiling, marble floor, sumptuous red velvet curtains, golden statues, magnificent candelabra,	Use similes to descnbe the size and splendour of the palace - as enormous as As shiny as as smooth as magnificent like cluttered like	Does your descnption flow well Did you use lots of adjectives and adverbs How about a simile?
Character				
Tell me more about how the travellers chosen to undertake the difficult task of getting the healing stone introduced themselves at the palace	Give them unusual names? Wnte about what the travellers say, think and do to show what they are like! How will they prove they are brave and courageous enough for the task?	Use words which show how someone feels like suggested interrupted boasted, exaggerated, claimed Were they looking senous or smiling, with a gnn which stretched from ear to ear, or something else?	Use dialogue to show how confident they are "Of course I'm not scared, I killed a pit of snakes and wild wolves on my last mission!" or "It'll be easy, a piece of cake! I'll be back with that stone before you can say " "Have no fear is here!"	Have you given the travellers interesting names? How did the travellers prove they had the courage to undertake the mission?

Figure C 1· HARRY prompts for the 'enchanted journey' story theme

Setting				
Tell me how the travellers prepare for the mission Describe the first part of the journey Where do they find the stone?	Do they take any special equipment to help them on their dangerous journey? Perhaps a map, a rope, a knife, food and water? What do they all think of the stone when they find it? Boring and dull until	Gem sparkled, shone, beautiful, gleamed, glistening, flashing, flickering, dazzling, glowing, quivering, as small as a or as bright as or it erupted like	Build up to seeing the stone using two short sentences followed by a long Like this At last! There it was! The stone was lying on in the middle of next to	Try to make the part where the healing stone is seen or touched for the first time really dramatic Do lights flash and sparks fly? What sounds does it make?
Action				
The travellers may stumble across a town on their journey back to the Palace	Perhaps they buy food or equipment for the rest of their journey Perhaps they stay the night at an inn	Comfortable warm beds, welcomed, exhausted, thankful, crowded, busy, hustle and bustle, noisy, market day, blare of music, loud chatter, shouted, pushed and shoved	Turning the corner Further up the road Across the street Opposite Outside Beyond When With	Do you think you could improve your description of the town? Imagine you have a camera to take some pictures Describe what's going on everywhere
Key (town)				
Not everyone turns out to be friendly and helpful in the town!	The stone could get stolen by a pickpocket!	Hustle and bustle, chased, hot pursuit, cunning trick, thief, culprit, grabbed snatched, zig zagging	Close on their heels scaling a wall pinned to the ground brushed up close caught sight of pushing through the crowd,	Make sure the travellers get away from the town safely with the precious stone!
Complication				
I have a feeling something will go very wrong in your story soon! But maybe things don't turn out to be quite as bad as they seemed at first	Perhaps something or someone could get lost or left behind or injured. Organise a search or rescue party! Or someone could land someone else into trouble by accident.	Everyone will be anxious and worried at first then relieved, pleased thankful or ecstatic when the lost person is found	Build up the event with lots of sentences Something could be glimpsed Something could catch someone's eye Someone could hear something important. Someone could move something and discover	Did things happen too quickly? Could you have described what happened and the scene a bit more

Figure C 1 continued

Action				
Tell me about the route the travellers take on their way back Do they meet anyone on the way? Are they friendly or not?	Get the travellers to talk about adventures they have had in the past, as they walk along the track Maybe they meet a magician or a wizard What do they say to each other?	Link words next,later, eventually, after, before, clearly, among, behind obscured by, opposite, in between Words meaning walked ambled, scrambled, strode, trekked, tramped,	Expand a short sentence like 'They walked down the path' into a long one like this 'They strode along the winding sandy path'	Did you use lots of dialogue here? Did the travellers tell each other funny stories about other adventures they have had? Could you improve this part?
Key (magician)				
Tell me more about the magician!	What is the magician like? Does the magician put them up for the night in his castle? What's the castle like? Was he pleased to see them or not? Perhaps he is helpful? Perhaps he casts a spell?	Tall, long black cloak trailing behind, enormous floppy cone shaped hat, dusty ancient looking book, shelves laden with jars and potions	Try one of these sentence starters Strangely, Oddly enough, Almost certainly, At that moment, One moment next minute Out of the blue moved by itself	Have you made the magician sound powerful and mysterious? Do unexpected things happen when the magician is around
Last				
You've got to the last part of your story already! The travellers need to return safely and give the stone to the King!	Is there a heroes welcome (a party?) for the travellers when they arrive back at the palace? How ill is the King? Will the stone work? How will it do this?	ill, feverish, temperature, pain anxious, fragile, weak, pale, collapsed, revived, recovered, happy, smiled, jubilant, danced, rewarded, congratulated	Your last sentence is the most important one! Perhaps you could end with describing what is happening right now as the story comes to a close	Check your first paragraph Does your last one fit in with what you wrote there?

Figure C.1 continued.

Story stage and guiding prompt	Ideas help	Character help	Camera help
Crow with cheese			
The first character to be introduced is the Crow She's holding a piece of cheese in her beak, and she's looking forward to eating it	Where is the action taking place? Can you set the scene before the Crow appears?	How does the Crow feel about having the cheese? Does she look forward to eating it? How can you show this in her expression and what she does? Is she excited hopping about? For example, does she rub her hands (or wings!) together?	Your first picture could show a forest, or the tree where the Crow is sitting Once you've show that you could use another picture to focus in on the Crow and her cheese Or you could use more pictures to focus in on the cheese and the Crow separately Perhaps your last picture could show the Fox appearing
Crow is conned			
This is the part where the Fox pretends to admire the Crow	What does the Fox pretend that he likes about the Crow? Her tail? Her wings? Her beak?	What expression does the Fox have while he's praising the Crow? Does he gesture grandly, or point at anything? How does the Crow react?	Try to make a picture which shows both the Crow and the Fox Perhaps we could be looking up at the Crow over the Fox's shoulder, or down at the Fox over the Crow's shoulder For another picture perhaps you could focus in on some part of the Crow which the Fox is praising
The Fox gets the cheese			
There are two important bits to the story here the Crow dropping the cheese when she opens her mouth, and the Fox getting the cheese Think about how you'll show these two events happening You also need to bring the story to a close after the Fox has succeeded	Is the Crow sad angry, or something else? How does the Fox feel about getting the cheese?	How do both characters react to the cheese falling to the ground? What expressions and gestures do you think they'll use?	The moment when the Crow opens her mouth and drops the cheese is an important one in the story Perhaps you could really focus in on this moment Maybe you could make a sequence showing each character in turn as they watch the cheese fall What's the last picture you'll show in the story? The Fox, walking away happily? The Crow? Something else?

Figure C.2: Visual storytelling prompts designed for the fable of the Fox and the Crow

Appendix D

Notes on Software Development

Development of the visual storytelling software, given the working title of 'Morphenstein', began in September 2003, and continued alongside other work up until approximately September 2005. The software was written in Java and required the investigator to write a little over 20,000 lines of code in all (comments included, blank lines omitted), comprising 126 class files which extend those provided as part of the Java distribution A full installation of the final main study software occupies about 90MB of hard disk space, the classes mentioned above comprise about 2MB of this. Of the remainder, 74MB is used in a local installation of the Java runtime environment and three additional libraries: the Java Architecture for XML Binding (JAXB), used to define an XML file format which the software uses when saving and loading character skeletons, character drawings, character models, visual storytelling prompts and entire cartoon stories, the Java 3D library, used not for 3D rendering but for its useful representations of 3D vectors and transform matrices, and the Java Advanced Imaging (JAI) library, used to compute the perspective transformations on bitmaps which allows them to be rotated and drawn out of the plane of the page The remainder of the space goes to images and character files The following sections provide more detail about the software and its development process

D.1 Lead-Up to First Pilot Study

Initial activity centred on implementing the enhanced-frontal-orientation approach and testing its feasibility, first informally and, subsequently, in the first pilot study. This work resulted in the development of three tools.

- Skeleton creation tool

  It was first necessary to implement classes to create, represent, manipulate and store the skeletons used within characters. A skeleton is represented as a series of bones connected by spherical joints, which may themselves be characterised by three joint angles which may be combined together in a joint matrix. Each joint has a place in a conceptual tree structure which specifies how changes in one joint propagate down to further bones and joints - the so-called kinematic chain which results, for example, in a character's entire leg raising when the hip joint angles change.

  The skeleton creation tool requires skeletons to be built by specifying the coordinates of the endpoints of each bone, and then the order in which they are connected; from this the kinematic chain is inferred. Skeletons can be created in any configuration, although all those built for 2D character drawings were chosen to lie entirely within the screen's x-y plane, mirroring the 2D nature of the characters they bind to.

  When a skeleton is initialised in this 2D way, the spherical joint angles are initialised such that each bone's y-z plane coincides with the screen's x-y plane. When the vector control points of a 2D character drawing are bound to such a skeleton, then, each point has an x-coordinate of zero in the reference frame of its 'owning bone'. Intuitively, one might expect that the bones of a skeleton initialised to lie in the screen's x-y plane would have **their** x-y planes aligned coincident with the screen; it is important to realise that in practice the parallel plane is actually each bone's y-z plane. This potentially confusing result arises from the restrictions placed on the orientation of joint coordinate systems imposed by the Denavit-Hartenberg representation

(Spong and Vidyasagar, 1989).

- Vector-based character drawing tool
  The decision to implement a bespoke drawing tool was taken in preference to importing vector images produced with an external tool mainly so as to avoid having to support a potentially more complicated file format; it was judged that a custom format could be made simpler than any external one, reducing the number of features necessary to support. The sketching tool which resulted is based on drawing cubic bezier curves and snapping them together to create a line drawing, then specifying coloured areas by manually selecting the curves on their boundaries and choosing a colour.

- Tool to 'bind' drawings to skeletons
  Skeleton creation and vector drawing occur independently within the respective tools; when creating a character it is easiest to first draw the image, then to use this to manually determine coordinates for the corresponding skeleton. When artwork and skeleton have been independently made, the two files are loaded into a binding tool. Binding involves manually selecting each curve in the drawing and manually specifying which bone wields each of the four control points When this has been done, the tool merges the data from the two files into a third model file.

Progression to this point involved the introduction of the JAXB library to enable skeleton, character drawing and character model files formats to be defined, and the Java 3D classes useful for representing 3D vectors and transforms. At this stage, it was considered that skeleton posing and character warping represented the most important user interface aspects to address. Concerning skeleton posing, one easy approach involves mapping two of the joint angles to the x-y movements of, say, a left-button mouse drag, and having the third joint angle controlled some other way, for example via a right-button mouse drag if this is available However, when joints are manipulated in this way, their rotation does not bear a clear relation to mouse

motion, and informal tests of such an approach quickly showed that unexpected results could often occur, such as a left-to-right drag making the joint move in the opposite direction. Instead, it was desired to have the bone's endpoint follow mouse drags on-screen, so that bones might be positioned by using the mouse to point straight to their desired position. This was accomplished using the following procedure.

1. A mouse drag is applied to the handle attached to the endpoint of a particular target bone. Take the on-screen destination point specified by the mouse drag, and calculate the ray in space representing all 3D points which lie on this screen point.

2 Determine whether the target bone, whose origin and length are fixed, can move its endpoint to intersect this ray If this is possible, there are at most two orientations which accomplish it: one in which the endpoint appears to move further into the screen away from the viewer, and one towards the viewer. Choose the orientation which moves the endpoint nearer the viewer. Else, if the bone endpoint cannot intersect the ray, choose the bone's orientation to minimise the distance between its endpoint and the ray.

3. There now exist the bone's initial reference frame, containing the vector $\vec{b}$ along which the bone's length points, and the destination vector $\vec{b'}$ specified by the new bone endpoint location Rotate the bone's initial reference frame by the angle between $\vec{b}$ and $\vec{b'}$ along the axis specified by the cross product $\vec{b} \times \vec{b'}$. This yields a new joint matrix, from which the three joint angles may be computed

The $\vec{b} \times \vec{b'}$ rotation above cannot be used to twist the bone about its axis, so in order to allow the joint to be manipulated fully, a second manipulation mode is supplied which directly controls this twist angle. It is mediated by a secondary 'twist handle' which appears as a circular offshoot of the joint endpoint handle when the mouse hovers over it The bone twist is altered by dragging this secondary handle in a circular orbit around the main handle;

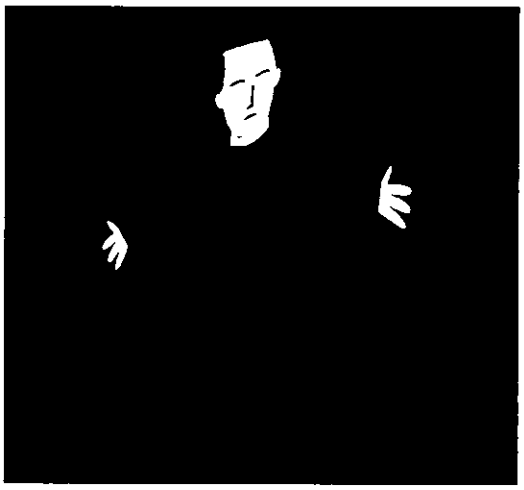


Figure D 1: A pose made by one of the Visitor sub-study participants illustrating how the character's right leg has been made to recede into the screen

it was intended that this circular orbit should reflect the circular twist of the bone.

The arbitrary choice noted above, of choosing the bone endpoint orientation closest to the viewer, is not as problematic as it might seem Practically, it means that one cannot, for example, tip a front-on character's leg backwards by manipulating only one joint. However, by manipulating a combination of joints in series, limbs may be made to recede into the screen, for example by twisting a character round, dragging their leg forwards, then twisting them back round again; one such example, taken from a participant in the Visitor sub-study, is shown in Figure D 1.

When a basic skeleton posing interface had been developed, a 'bendy man' proof of concept application was written which displayed the simple figure used in Figure 4 1, with posable skeleton overlaid and no other controls except the option to omit drawing the skeleton, so that poses might better be seen. The investigator experimented with the posing interface, for example producing the poses used in Figure 4.1. Others were shown the proof of concept, and a number of the investigator's younger extended

family members were encouraged to try it out. The feedback received from this small-scale pre-pilot testing motivated the conclusion that the enhanced-frontal-orientation approach merited continued development, and so the first pilot study was planned. In turn, this required character warping facilities to be developed.

Character warping is a case of having the user move the vector control points of the drawing. Again, mouse dragging was chosen because it represented the most obvious and intuitive-seeming interaction mechanism. The simplest approach to character warping would simply apply the two-dimensional translation of the mouse drag to the selected control point, whose coordinates in its bone's reference frame would change so as to ensure that the point's on-screen location follows the mouse exactly However, under such a system, control points can very easily become pulled out of their owning bone's y-z plane (as noted above, it is the bone's y-z plane, **not** its x-y plane, which initially lies coincident with the screen's x-y plane). This results in the character no longer being 'flat' even when the skeleton's configuration is made so. In order to maintain character flatness, then, the translation vector applied to the control point is clipped to remove any x-component in its bone's coordinate frame.

Character posing and warping were precisely those features tested in the first pilot study, and once they had been found adequate, attention shifted to implementing the full software proposal. As noted in Chapter 4, the three tools above were judged to be suitable only for the investigator's use, and the creation of more accessible equivalents was assigned lower priority than the development of software to enable students to make cartoon stories using enhanced-frontal-orientation characters The first attempt at such software is discussed next

D.2 Notes on Pilot Study 2 Software

In order to incorporate posable, warpable characters into a software framework for making cartoon stories, the 'stage view' and 'shot view' were implemented. The idea of displaying separate screens for stage and shot came

directly from HARRY's multiple stage screens; the intention was that story stage navigation and picture sequencing could occur within the stage view, and individual shot manipulation could be separately dealt with in the shot view. The camera model described in Chapter 4 was implemented as part of the shot view screen, which also necessitated the introduction of the JAI library to allow clipart images to be imported into scenes alongside characters.

Intended to provide a fixed reference point between stage view and shot view, the left-hand bar, indicated in Figure D.2, was designed to house:

- those controls which were judged equally relevant to stage view and shot view, namely save and open;
- buttons which have analogous function but different actual behaviour, although as undo/redo was not implemented at the stage view screen the delete shot/delete artwork button is the only one to which this actually applies,
- mode navigation buttons, namely the switch to stage view, switch to shot view and type text buttons.

The create new shot button does not fit into any of these categories, in practice it was placed in the left-hand bar purely because this represented the most convenient location.

When designing the shot view controls, individual buttons were grouped so as to reflect the logical relationship between them. A particularly strong distinction arose between the artwork-related controls, namely the warp character, pose skeleton, change character colours buttons, the layer forwards/layer back buttons, the depth forwards/depth back buttons, and the add character or clipart and set background buttons, and the camera-related controls, those being the camera translation buttons, the zoom in/out/reset buttons, and the tilt up/down/reset buttons This led to the idea of having separate tabs for artwork-related controls and camera-related ones.

The save, open, add character or clipart, and set background buttons made use of standard Java-supplied save/open dialogue boxes, which conform

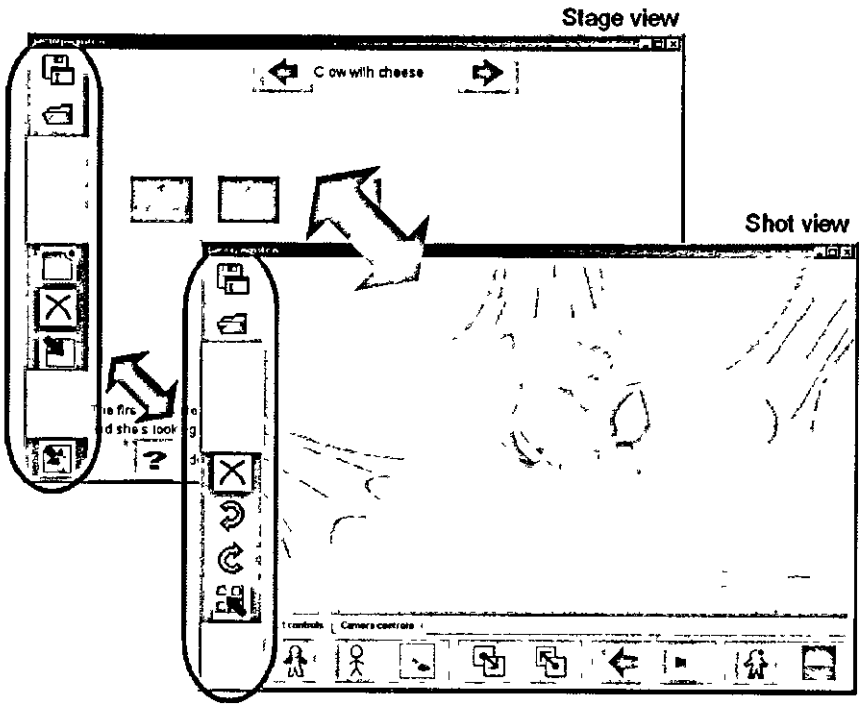


Figure D 2. The left-hand bar designed to provide a fixed reference point between screens.

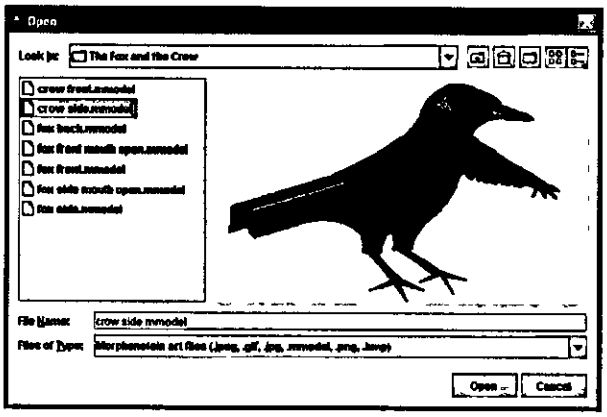


Figure D.3 The dialogue box displayed when the add character/clipart or set background button is activated; the two buttons bring up a dialogue box rooted in different locations appropriate to characters and clipart or background images.

to a given platform's general file open/save behaviour The add character or clipart and set background actions were, however, also customised so that the dialogue boxes contained a preview pane. As shown in Figure D.3, This displays a simple preview when a character or image file is single-clicked, so that the user gets visual feedback allowing them to see whether the file they have selected represents the one they had in mind before they actually load it.

D.3 Notes on Main Study Software

In moving from the second pilot study stage to the main study software, it was judged that the interface would be simplified if the stage view and shot view could be combined into one screen; as noted in Chapter 5, the stage view's partitioning of story stages between screens did not seem helpful, so the need for a separate stage view screen was drawn into question. A second desire was to allow all controls to fit onto the screen at once, avoiding tabbed control panels. Doing so would reduce the number of mouse actions necessary to accomplish a task, and based on the investigator's general experiences as

a software user this seemed a reasonable goal to pursue.

In order to allow all functions to fit onto one screen, it was necessary to find an arrangement of controls which would allow the shot view area to be as large as possible so as to make characters as easy to manipulate as possible, it was also desired to maintain the functional grouping of buttons so that logically related functions were spatially near. In the end, the decision was taken to group the camera controls at the upper right of the screen, the art controls below, and to collapse the visual storytelling prompts into the button at the bottom right. Within these groups, alternate or opposite actions, such as zoom in/zoom out/reset zoom, or load artwork or clipart/set background, were arranged in horizontal rows.

The second pilot study software's 'scale selected character' buttons were removed from the art control panel; it was decided that this function could be provided within the shot view as a control attached to the selected character or piece of clipart. Thus the 'scaling handles' depicted in Figure D.4 were introduced.

A number of functions provided by the stage view, namely the creation, deletion, sequencing of shots, and their selection for display and editing in the shot view area, were combined into the left-to-right sequence bar Deletion of entire shots was deliberately placed inside a right-click menu activated when a particular shot in the sequence bar is clicked on, the intention here was to make this potentially destructive option hard to reach by accident.

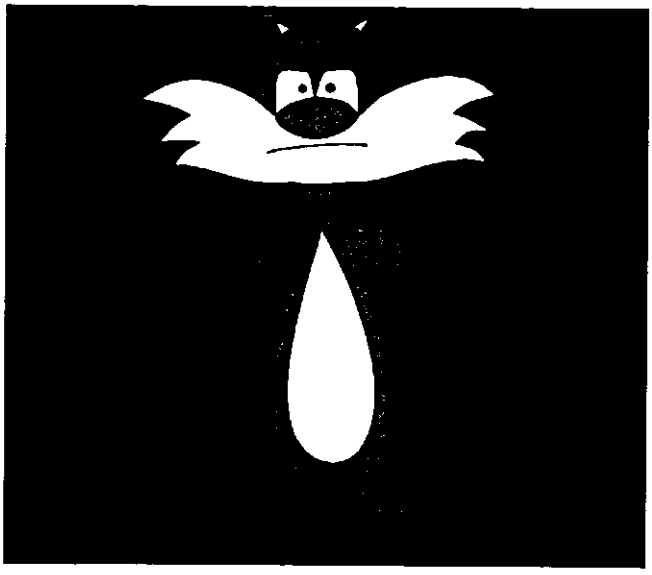
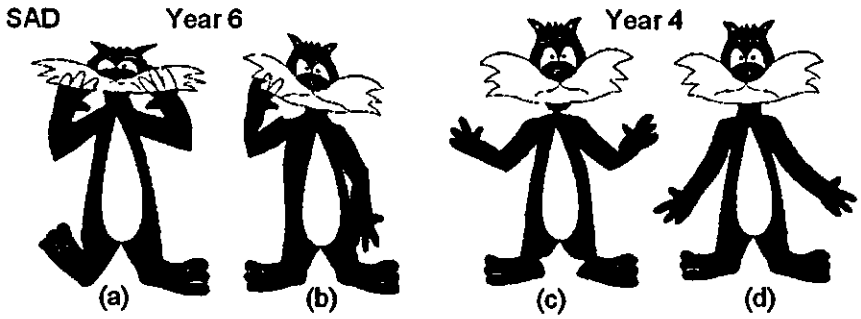


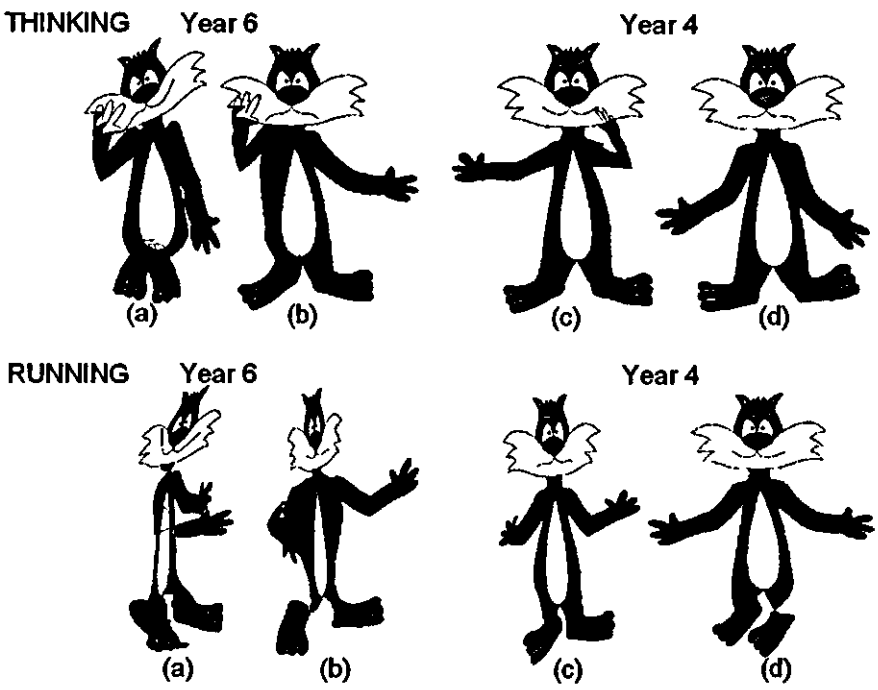
Figure D 4· A character may be resized via the green triangular scaling handles, seen in each corner. When a character in the shot view is clicked on, the green rectangle is drawn around them to indicate that they are currently selected, and the scaling handles are drawn on top of this The scaling handles may then be dragged to resize the character. Technical restrictions resulted in only aspect-ratio-preserving scales being applied; attempts to implement horizontal- or vertical-only scaling disrupted the character posing calculations and were thus left out.

Appendix E

Remaining Images From Pilot Study 1

For completeness, the images produced by participants in response to the keywords sad, thinking and running are provided here. The scared and 'extra time' images are presented in Chapter 5.




THINKING
Year 6
Year 4
(a)
(b)
(c)
(d)
RUNNING
Year 6
Year 4
(a)
(b)
(c)
(d)

Appendix F

Pilot Study 2 Story Coding

This section shows the complete text produced by all participants in the second pilot study, after simple spellchecking. Those sentences fragments judged by the investigator to have a significant visual component are marked in red.

Control group

Participant 1, Crow narrates

1 day and in a tree and I saw a big piece of cheese it was 5 foot 100.

Crow narrates

There I was sitting on a branch all by myself,then I heard a rustle just below me I looked down and there was my worst enemy the fox. The fox said ,"ooh good old crow." and I said "ooh good old fox " Fox says "if you want to be my friend just give me a piece of that cheese, instead of worst enemies"I was thinking, yes? no? yes? no?The cheese was in my beak and my breath could not get through it so the fox couldn't hear my mouth speaking I was saying "no way mate, no way way mate." Then I heard the fox saying Everybody in my town says what beautiful black feathers you have, your so fast at races you're always first you're faster than lightning and how good you are at everything

Fox narrates

I said to the crow, "what beautiful singing everybody talks about in my town Why won't you sing for me?" She opened her mouth to sing and the cheese broke in half. One piece of the cheese fell down to the ground and I said "Can I have that half of the cheese?" and the crow said "yes " It was yummy.

Participant 2, Crow narrates

As I was relaxing in my tree a movement suddenly startled me Out of the corner of my eye a figure emerged swiftly and elegantly from behind the tree. It was a fox! I sensed trouble The fox crept closer to my tree unaware that I was watching him As he glanced upwards fear flooded over me. "Hello dear crow what a fine piece of cheese you have there" he said. I quickly decided in head I wouldn't let the fox go anywhere near my cheese Cunningly he tried again to trick me "Your feathers shine so beautifully in the sun." he exclaimed I needed to fly away and speedily. But it was too hot to fly. Next he spoke some more "You should be proud of your wonderful orange beak" Hastily I turned away trying my best to ignore him and hoping he'd go But he wasn't going to give up "Your claws grip onto that branch so strongly." My anger eased slightly as I fell onto his trap

Fox narrates

Suddenly I had a cunning idea "I've heard that you have the most beautiful voice in the whole forest, but I won't believe that until I hear your magnificent voice." I said The crow hesitated for a moment and then began to open her mouth That cheese is mine I thought. She began to sing the most awful tune but I wasn't concentrating properly. The cheese fell from the crows mouth and dropped onto the ground I sprinted across to where the cheese had landed, picked it up and ran off I devoured the cheese and lay down to rest.

Participant 3, Crow narrates·

There I was ready to eat my gorgeous piece of cheese when a little red thing with a long white tail zoomed past at lightspeed speed. It was night so I could not see what it was I was scared so I hid on a high branch Suddenly it appeared down on the floor near the tree. I thought he would attack me. "I'll be your friend if you give a bit of that cheese a " I shook my head thinking no chance mate Then he started being nice to me to make me like him "How nice your feathers are I wish I was a bird as beautiful as you. That would be amazing.

Crow narrates

"How nice your voice must be, can hear it"

I thought . haw haw, I have got a nice I think I'll shall show him So I opened my mouth and the cheese fell out and as soon as it fell to the ground the fox ate it.

Participant 4, Crow narrates:

One day I woke up and I thought to myself those tree's are really nice and healthy and it was very light and the weather was really nice it felt like summer and it was summer it felt really hot boy I was nearly going to blow up but I thought I might be ok so I went to explore the forest and on the way I saw another bird eating something but I don't know what he was eating

Crow narrates:

I was sitting on a branch and suddenly I seen a fox uh oh oh drats he has seen me. My cheese not your's I said. And the fox said why can't I have some cheese I won't eat any more wild creatures or animals it's your choice cheese or animals getting eaten up

Fox narrates.

Oh!!! Crow your voice is beautiful and wonderful and your voice is more of a singing voice why thanks. You would make it to the final of x-factor but sing me another song and I will see if I think you would but sorry must go and hunt some rats, mice

Participant 5, Crow narrates

One day I woke up an saw lots of ducks and frogs. Then in a tree I saw a orchid with silver petals and another one with gold petals but the thing that caught my eye the most is that I saw a gigantic piece of cheese (double Gloucester) and it was just as handsome as Gerald

Fox narrates:

I said how wonderful the crows voice would be so she fell for my plan and she opened her mouth and ping! The cheese fell out and in my mouth yum! yum! So I said thanks and legged it

Participant 6, Crow narrates.

I woke up one morning and I saw a large piece of cheese on the floor. I thought it was a yellow petal at first but then a the corner of my eye I saw a fat, greedy fox. After I told my friends in the snowy cold forest My closest friend was Shabba the dog who saw me walking to his tree and came out and said "what do you want at this time or morning well I thought I saw a piece of cheese but I was not convinced it was a piece of cheese".

Crow narrates:

I saw a big orange thing in the corner of my eye on the branch I was sitting on behind a large tree. Then I thought he wanted to be friends with me but I was wrong he wanted to get the cheese from me Quickly I grabbed the cheese and hid the cheese in the tree Mmm I smell cheese I think said the fox. Tut he fox muttered to himself if you want to be my friend just give me half of the cheese and we can be best friends not worst enemies, then I put the cheese from the tree to my beak so I tried to fly away but the cheese was to heavy for me so I stayed in the tree I the fox who wants the cheese tried to flutter the crow to drop the cheese I can have it, so I said to the crow do you want to be my friend said the fox, but he was to clever for me. The crow put the cheese in the hole in the and said to mister fox "I will only be your friend if you do not take the cheese of me ok said the fox but he muttered in his breath not.

Fox narrates

Oh crow you have a beautiful voice all my fox friends said you can sing like Britney Spears, so the crow picked up the cheese and flew away to the fox friends den hang on said the fox why don't you sing for me now so I don't have to here you again I crow sang and the cheese fell out of my mouth and the fox quickly grabbed the cheese and ran away. I went back to my tree sobbing.

Experimental group

Participant 1 (neither character chosen to narrate):

The Crow stared at the fox. It looked like the fox was planning something.

Participant 2, Crow narrates:

Theirs that horrible fox That horrible old grouch, what's he playing at? The fox started admiring me - what a gentleman! He said what a good figure I've got then he said "your looks are as good as your singing Can you sing me one song?" I opened my mouth and then the cheese fell out then he said "don't speak with your mouth full!"

Fox narrates

I am spying on the crow because she has got cheese what I want

Participant 3, Crow narrates:

SLURP! Ooh this cheese looks so yummy but I must save it till later otherwise I will be starving later I still can't believe I found this lovely piece of cheese on the dirty floor.

Crow narrates:

"That foolish fox he thinks he can have my nice juicy chunk of cheese well he can think again Oh it smells so nice but I must save it for later or I won't have anything to eat later just as long as the wretched fox doesn't get it." It's all mine, I'm not going to give that fox even a crumb

Crow narrates:

Look at that fat stupid ugly fox dribbling with his mouth open he's such a pig. How dare he think he can have my nice chunk of cheese. He looks so ugly I don't even feel sorry for him It's his fault he hasn't got any nice lovely cheese he should look harder next time.

Crow narrates:

"WOW I can see Nottingham from here." oh look theres that stupid fox again he looks like he is thinking of a plan to get my cheese,well I am not falling for it he must think I'm stupid

Crow narrates:

"Oh look he knows I've seen him know."

Participant 4, Crow narrates.

This is the most cheesiest cheese in the world, I can't believe I found it here!

Fox narrates

I have just walk by and smelt some lovely cheese, and followed the trail and found Mrs crow holding it in her mouth "that smells lovely" I said I asked Mrs crow if I could have a piece but she shook her head

Fox narrates.

I looked in to her eyes and thought that she wound not give me the cheese so I thought of I plan to get it.

Fox narrates·

I racked by brain and I thought of some plans not 1 not 2 but 3 plans just in case one of them did not work

Fox narrates

Oh dear crow your looking extra splendid today With your extra silky smooth feathers. Your wings are flapping extra gracefully today!!!!!!!!

Crow narrates:

Please could you impress me by sing with your lovely voice PLEASE!!!!!! said fox Well if you insist "LALALALALALALALA" OH no my cheese lovely cheese has gone.

Fox narrates.

Yes I have got my cheese I knew my plan would work YES!!!!!

Participant 5, Crow narrates·

I found this amazing cheese in someones back garden, I don't know why anyone would throw this big piece of beautiful, fabulous, juicy cheese away. They must be mad.

Fox narrates

"I cant wait to get my paws on that piece of scrummy cheese. it looks delicious"

"I can't believe that foolish crow thinks she can keep hold of that piece of cheese when theres foxes that a starving out here!"

Fox narrates·

"MM.M.M.M that beautiful piece of cheese..will soon be mine!!" "I can taste it in my mouth already!!"

Participant 5 (continued), Fox narrates.
"How silky and smooth your feathers are looking today, how bright your eyes are, how elegantly you move. I'm sure you voice is absolutely lovely!"
Crow narrates:
"That fox is right I do have an amazing voice" I thought to myself," in fact I am going to sing now" LAAAAAHHHHHH" "oh no my beautiful cheese is gone"
Fox narrates·
"My plan has worked, I have got my chops round this lovely piece of cheese, and I bet that crow is starving now!!!!"

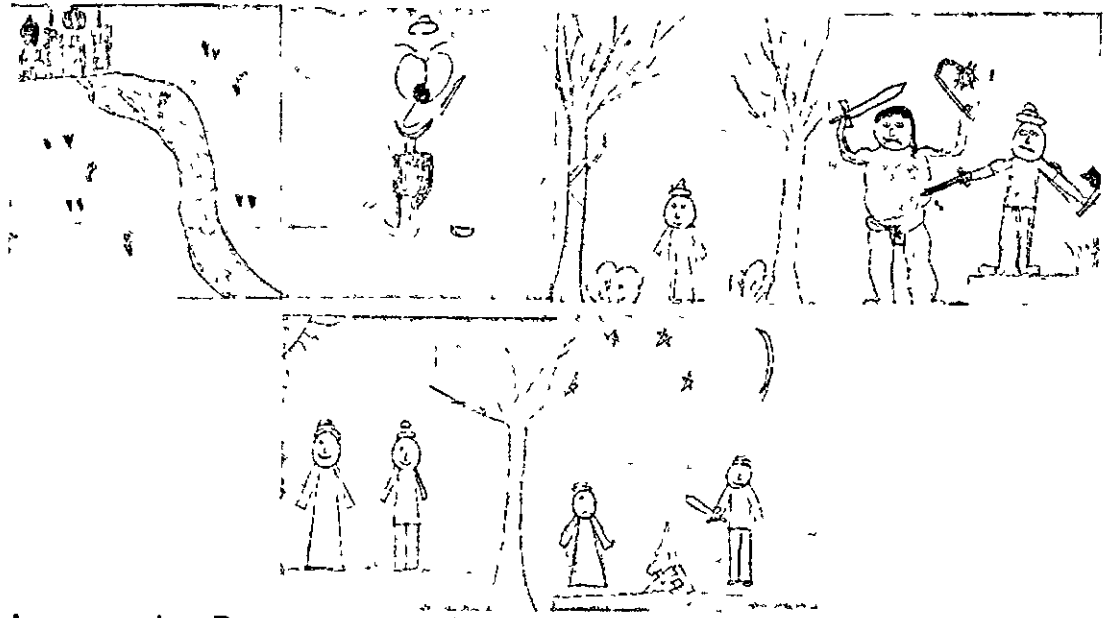
Participant 6, Fox narrates:
Mmm I wonder what that smell is I think I'll go for a wander around I think the crow needs some help eating that cheese

Appendix G

Main Study Second Story Samples

Here, nine participants' cartoon stories and those same participants' resulting written stories are provided to supplement the analyses presented in Chapter 6; three each from the Ramayana sub-study control and experimental groups respectively, and three from the Visitor sub-study experimental group. The intention is to give a feel for how the intervention-stage product, that is the cartoon story, fed on to each second story The Visitor sub-study control group is not included because it was not possible to access this group's intervention-stage story plans.

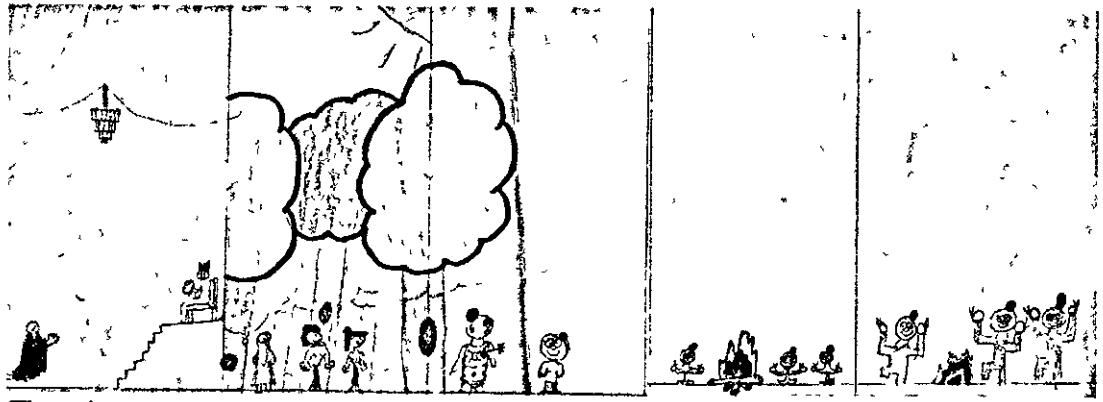
Ramayana sub-study, sample control story 1:



Long ago prince Rama got sent to exile he did not live alone he lived with Sita his wife and his brother. A holy man went for help he went to the kings palace for help about the demand.

Prince Rama and Sita were walking throw the forest the demon was hiding he saw Sita and wanted here has one of his many wives. Prince Rama saw the demon the demon cast a spell to follow her Rama had a fight with the demon Rama killed the demon. The he went back and sat around a lovely flaming hot fire with the holy men and sung some songs with the holy men. They needed to no about the demon so the holy man went to find out

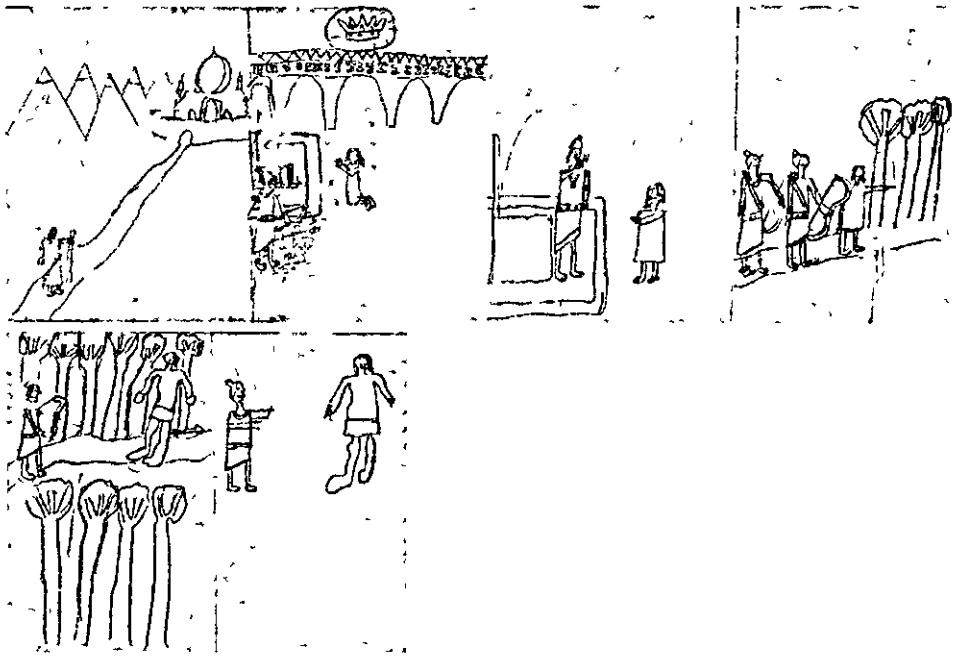
Ramayana sub-study, sample control story 2:



The wise man went over to the palace in a swift way to ask for his help. Rama and Lakshmana walked quietly into the woods to see want the could find the wise man was talking to them on the way there about what he wanted them for. He said...

"I am sorry to rush you but I have a problem", and then out jumped the demon "see this is my problem". Rama carried his bow and arrows everywhere and shot the demon. The wise man started to meditate and show them, around a fire.

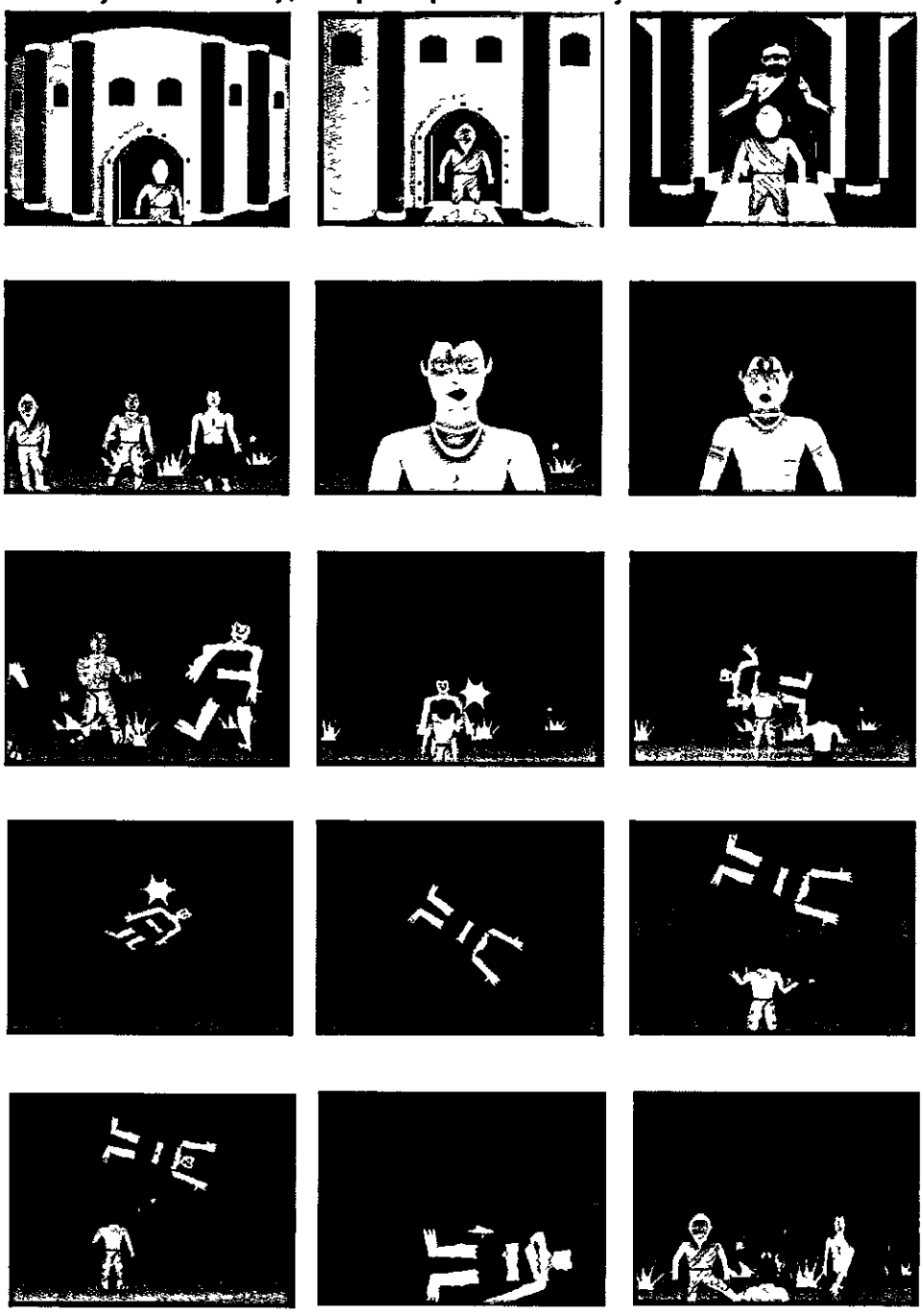
Ramayana sub-study, sample control story 3:



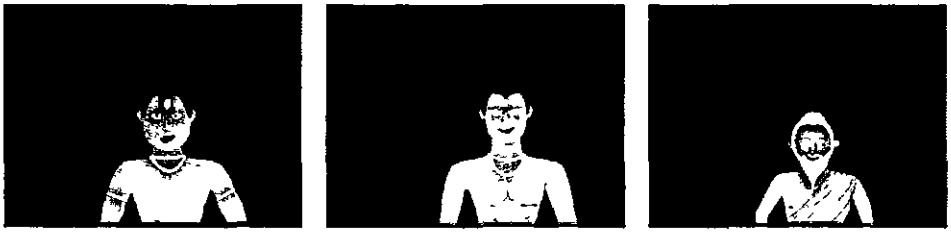
Once, along time ago in India, a holy man was travelling to a place for help. When the holy man got there he said to the king I hear you have two sons who our very good at fight for I have travelled here to ask help for the demon are attacking us. The king new that the holy men needed help so he agreed to send his sons Rama and Lakshmana to help.

So they set off with the holy man leading the way. They travelled for awhile before the got to the forest they were getting nearer to the place where the holy men stay. So they carried on walking until they were expecting a she demon. Suddenly the she demon jumped out.

Ramayana sub-study, sample experimental story 1:



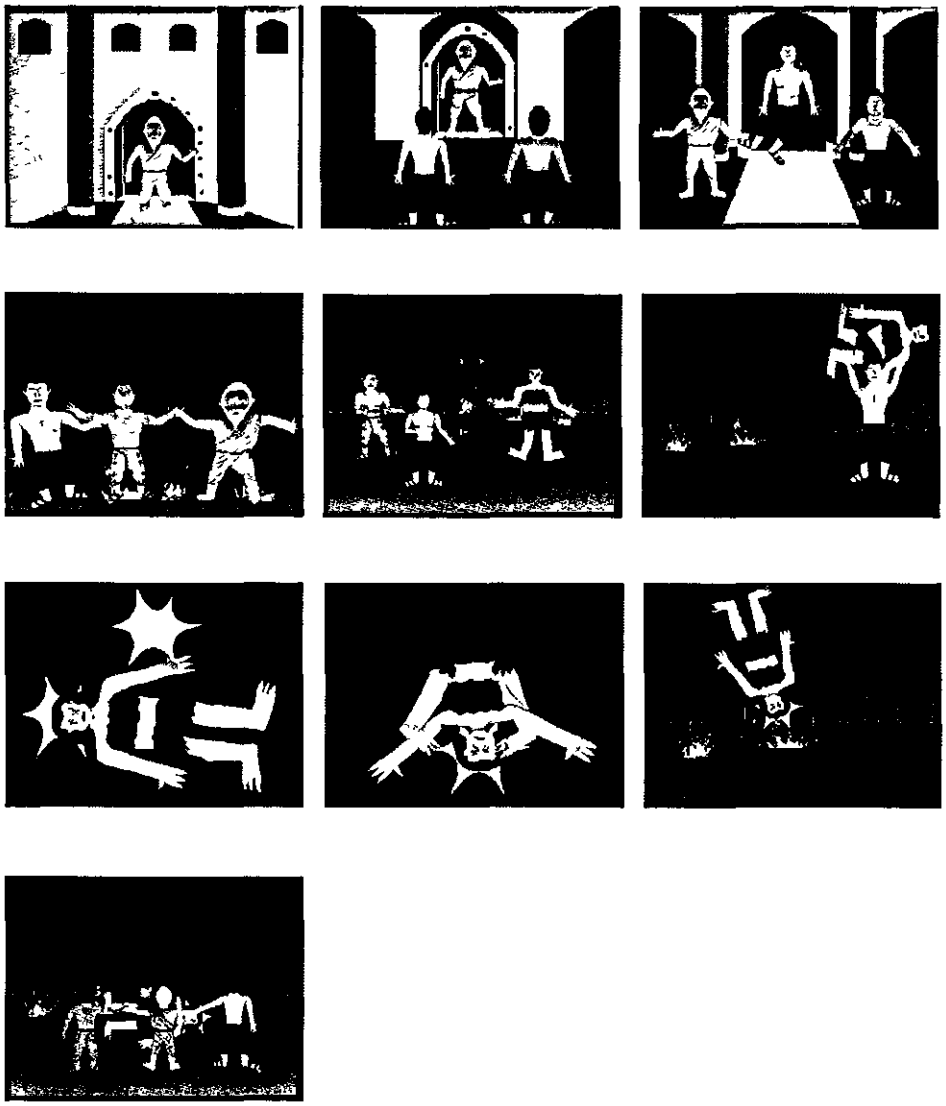
Ramayana sub-study, sample experimental story 1 (continued):



The holy man walked into King Dasaratha's palace. The palace was a glistening orange colour with purple diamonds around the door. The holy man was looking up at king Dasaratha. for he was sitting on a red velvet throne. King Dasaratha looked very happy to see the holy man, "Oh its been a long time since you were here last" chuckled the king. "you see" explained the holy man "I'm taking Rama and Lakshmana to the forest to try and find the demon, but I've forgotten the way". The king told the holy man the way to the forest. "good luck" called the king. The holy man collected Rama and Lakshmana and took the two brothers the forest. "Remember" whispered the holy man. "the demon could be anywhere so keep quit".

Suddenly out of nowhere a loud crashing noise came towards the two brothers and the holy man. A sudden panic came over the holy man and he hid behind the tree. The enormous demon moved slowly towards Rama, Rama got his hand out and whacked the demons gruesome face it felt like a porcupines spike quickly pricked her. After that Rama got the demon in his hands and gave all his strength to lift the demon up and throw her in the air, she was like a rocket shooting up and banged into a planet and shot back down again as soon as Rama saw the demon coming back down he quickly got his arrow out and shot the demon to make sure she was definitely dead. the holy man and Lakshmana saw this glorious moment and celebrated it by sitting round the fire.

Ramayana sub-study, sample experimental story 2:



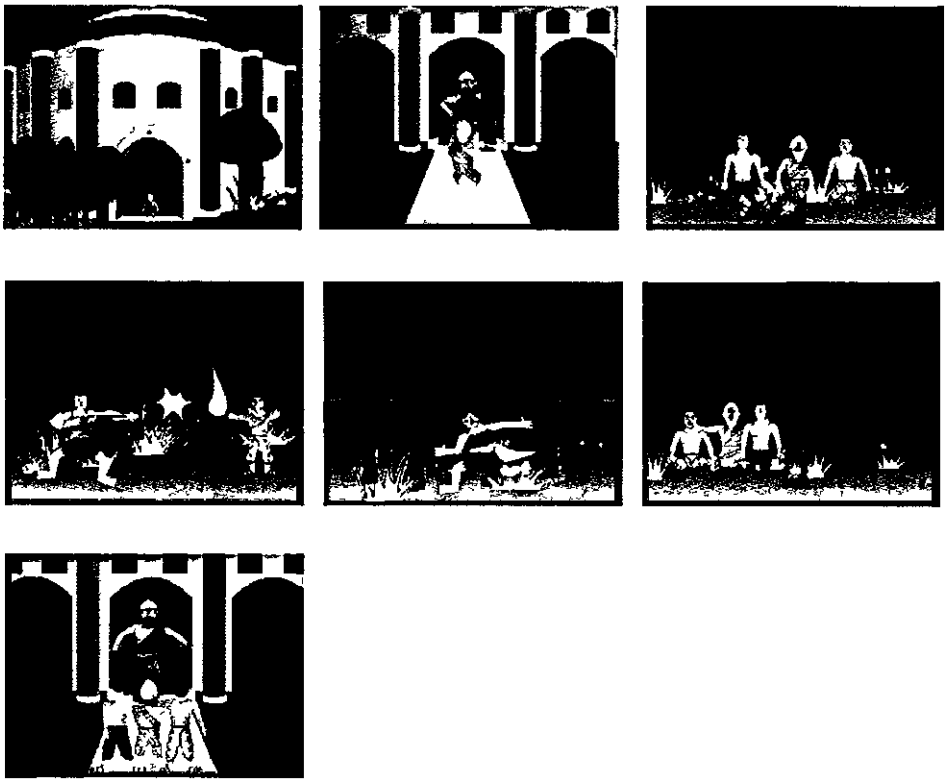
Ramayana sub-study, sample experimental story 2 (continued):

A long time ago a man called the Holy man walks into king Dasaratha's Place. The Holy man wanted some help to catch a demon. So king Dasaratha talked to the Holy man. "Can I have some help caching the demon" the Holy man asked. "Sure I can ask Rama and Lakshmana to help you king Dasaratha told him, "Rama and Lakshmana will meet you in a palace near here because they live in a forest. "How will they know to meet me", the Holy man asked again. "I have powers to contact them", the king answered.

So the Holy man set off to find another palace. It took him quite a long time to get there it was a lovely work the wind brushing against his face. The trees were a dark green colour on every tree. finally he got there the palace a pinky colour with a gold spotted platform to walk through. Rama and Lakshmana were waiting for him, just as the king had told him. Rama had a blue body with blue trousers and no top on. Lakshmana had blue and dark blue trousers on and sandals. His hair was brown as well. "You need some help caching a demon" Lakshmana asked "Yes please" the Holy man answered. "Lets go and sleep in the forest for a night and then go" Rama told them. So Rama, Lakshmana and the Holy man set off to the forest. The three of them had grate time dancing and sitting by the campfire. The next day they set off looking for the demon in the forest. Eventually they found her wandering around in the forest. "Let's get her", they all yelled.

They had an arrow fight with a fire in the middle. The demon got caught so many times she got weak, so Lakshmana picked the demon up and through her in the end. She did roly polies in the air and down she went. When she got down she was dead. They were so happy.

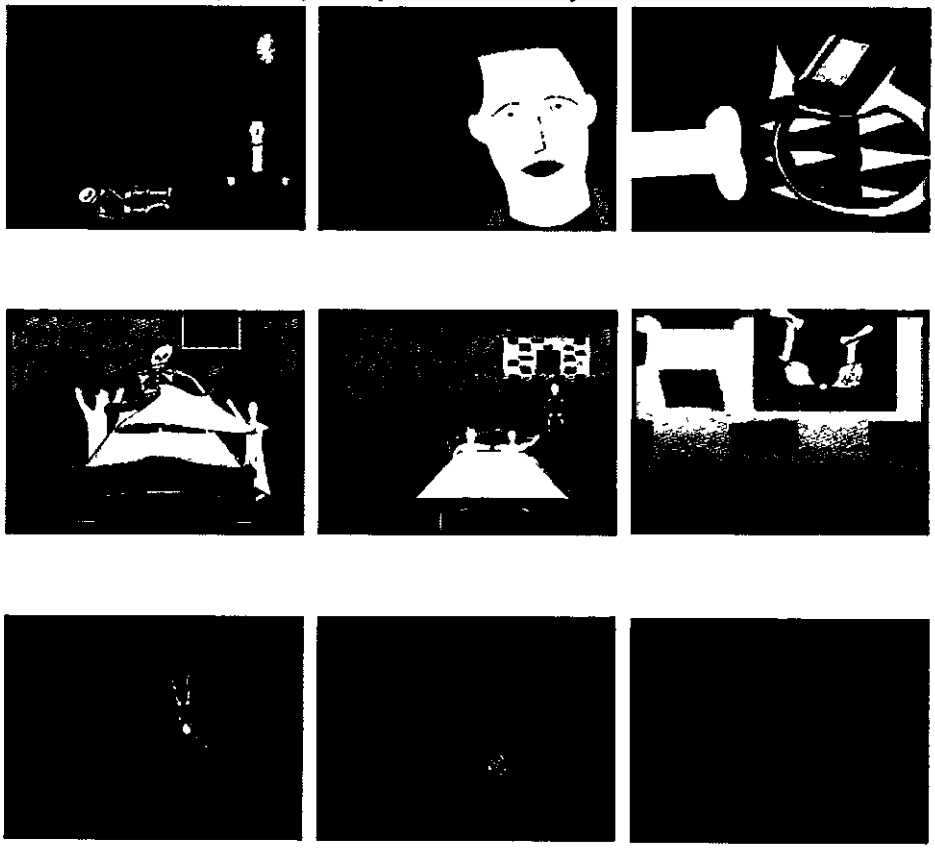
Ramayana sub-study, sample experimental story 3:



One sunny morning around 700 years ago. A wise man was travelling trying to find King Dasaratha's palace, when he found the palace he went inside to ask King Dasaratha if his son's Rama and Lakshmana would come with him to destroy the she demon. The king wasn't so shore about this at first, but when the old man got down on two knees and pleaded he quickly said "yes"! When king Dasaratha came back with Rama and Lakshmana, they set off quicker than you could say Ramayana. two hours later... when they were at the forest they sat down and made a fire.

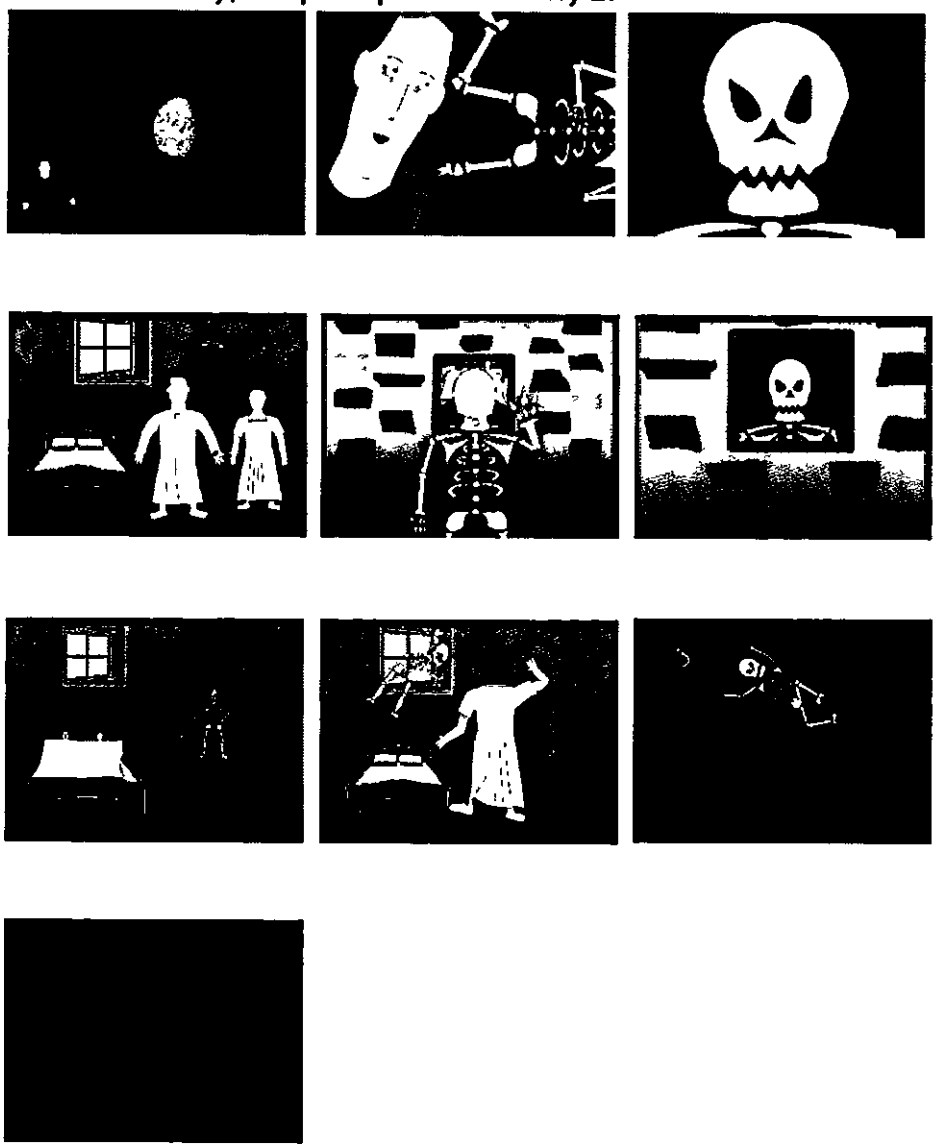
Suddenly they hired rustling in the trees and then jump out the she demon with his bow and arrow. Rama quickly dodged the arrow withdrew his fire bow and arrow, and before the she demon could fire another arrow Rama fired a fire arrow at his bum and said "bullseye". The she demon was running away with his bum on fire but he didn't last long splat! he was dead. The wise man Rama and Lakshmana were sitting round the fire and the wise man thought them the sacred song. meanwhile... king Dasaratha was getting angry. But then the three of them burst through the door singing. everybody was happy now.

Visitor sub-study, sample experimental story 1:



A man was walking home past the cemetery. He saw a skeleton on the floor. He jumped in the air. There was a ring on its hand. He took the ring to his wife. The skeleton opened the door. He said "Give me my ring". The man said "Throw the ring out the window". The woman threw it out the window. The skeleton jumped after the ring. He clattered off the end of the cliff.

Visitor sub-study, sample experimental story 2:



Visitor sub-study, sample experimental story 2 (continued):

One day a man was walking alone past the church, the moon low in the night sky.

He was walking when he saw a skeleton with a gold shining ring on its bony finger. Startled he took the ring. When he looked more closely at the skeleton he could see that it looked angry.

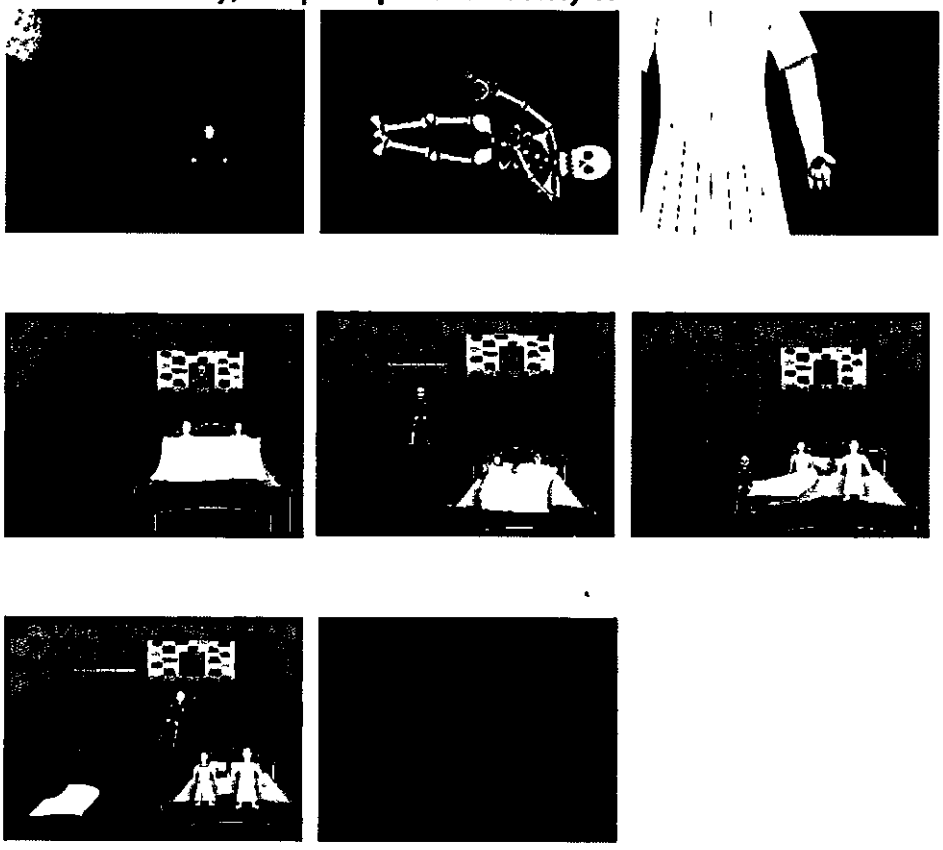
When he got home he gave his wife the ring, she said "Oh where did you get it?" "That doesn't matter", he said, as slipped off to bed.

That night the skeleton arose, went over to their window and whispered "Give me my ring!" They opened their eyes. "What did it say?" asked his wife. "Don't worry it will soon go away" replied the man. But it didn't, it came into the room. "I'm coming!" it said. "Throw the ring, throw the ring!" ordered the man. Struggling to get it off, she threw the precious ring away.

The skeleton leaped out of the window, clatter, clatter, down the hill. It launched itself off the cliff, sparkling by the moonlight.

Darkness, silence, it was now alright.

Visitor sub-study, sample experimental story 3:



It was black so dark that it seemed like day would never come. If it hadn't been for the moon you wouldn't have been able to see. A man was walking home through a graveyard. "Oh my" said the man as he found a skeleton and saw the ring gleaming in the moon. The man approached the skeleton, swept up the ring and ran home. The man gave his wife the ring. "Oh it's so beautiful!", she exclaimed, "where did you get it from?" The man said nothing. She asked again and again but still the man said nothing. "Give me my ring" squealed a voice. "What was that, what did it say?" shrieked the woman "Don't worry it will soon go away" said the man softly. "Give me my ring I want it back" snapped the skeleton. "What was that what did it say?" screamed the woman. "Don't worry dear it will soon go away" said the man. "I want my ring! I'll drag you out of bed by the hair!" screamed the skeleton. "I want my ring" yelled the skeleton. "Throw the ring away" screamed the man. "OK!" shouted the woman. She threw the ring through the window and jumped after it and it was gone...

Appendix H

Main Study CHECK TEXT Details

This section tabulates the raw CHECK TEXT results for all stories in the main study The group means used in the t-tests are presented to two decimal places in bold at the bottom of each row. After each sub-study's table, a graphical summary of those differences significant at the 0 05 level is presented, these are anticipated in the tables by the shading of the appropriate columns. If only one group in a column is shaded, this means that a longitudinal effect occurred in that group but not the other; if both groups are shaded then either a longitudinal effect occurred in both groups or a cross-sectional difference was found; further details must be sought from the ensuing graphs. Within these, for each measure, two sub-graphs are displayed which compare the control and experimental groups' first stories and second stories. In each of these sub-graphs, the control group is represented by a green bar and the experimental group by a blue bar, and the scores for the second stories are presented 'behind' those for the first stories The numerical value of each bar, which is that group's average score for the given CHECK TEXT measure, is shown, to three significant figures, below its bar. The first-story and second-story differences are summarised at the left of each graph, and the improvement or degradation effect is summarised above the bars, each gives the p-value reported by each t-test in brackets, to two decimal places.

CHECK TEXT: RAMAYANA FIRST STORIES

	Total number of words	Variety of words	The connective 'and'	Common connectives	Simple sentence starters
Control	150	63%	4.0%	3.3%	33 3%
	184	74%	4.9%	0 5%	33.3%
	83	64%	4.8%	1.2%	0 0%
	112	69%	4.5%	2.7%	14.3%
	123	63%	5.7%	3.3%	0.0%
	31	74%	3.2%	0.0%	0 0%
	156	70%	5 8%	1 9%	28 6%
	74	72%	4.1%	1 4%	66 7%
	138	68%	0.7%	0.7%	10 0%
	116.78	**68.56%**	**4.2%**	**1.67%**	**20.69%**
Experimental	136	66%	2 2%	0 0%	36 4%
	144	68%	5 6%	0 0%	66.7%
	121	64%	3 3%	0 0%	40.0%
	147	60%	2 0%	1 4%	76 5%
	161	67%	3.1%	0.6%	25 0%
	113	57%	3 5%	0.9%	55.6%
	149	65%	6 0%	0 0%	62.5%
	244	70%	4 9%	0 8%	50 0%
	107	73%	3 7%	1.9%	50 0%
	146.89	**65.56%**	**3.8%**	**0.62%**	**51.41%**

CHECK TEXT: RAMAYANA FIRST STORIES (CONTINUED)

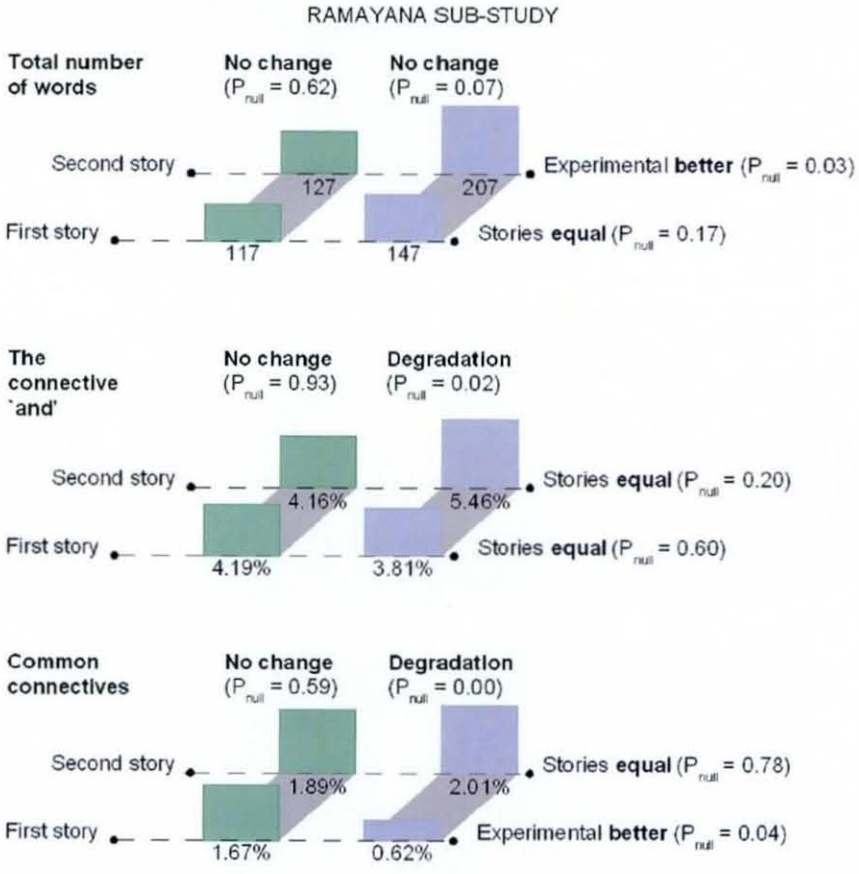
	Average sentence length	Word length	Common verbs	Use of adverbs	Common words	Commas
	16 7	20 7%	4 7%	0.0%	12 0%	0.12
	15.3	23.4%	5 4%	0.5%	10 9%	0 38
	20 8	15 7%	7 2%	1 2%	13 3%	0.00
	16 0	18 8%	3.6%	0 0%	10.7%	0.00
Control	17.6	10 6%	4.9%	0.8%	13.8%	0.11
	15.5	16.1%	9.7%	0 0%	12 9%	0 00
	22.3	15.4%	6 4%	0.0%	14.1%	0 27
	12.3	20.3%	8.1%	4.1%	13 5%	0 00
	13.8	23 9%	7 2%	0 0%	8 70%	0.00
	16.70	**18.32%**	**6.36%**	**0.73%**	**12.21%**	**0.10**
	12.4	19 9%	3 7%	0.0%	5 9%	0 32
	16 0	20.1%	2 8%	0.7%	8.3%	0 13
	24.2	21 5%	5.0%	0 0%	8 3%	0 00
	8 60	19 0%	4 8%	0 0%	8 2%	0 23
Experimental	13.4	22 4%	2.5%	1 9%	6 2%	0 22
	12 6	15 0%	7.1%	0.0%	11.5%	0 00
	18 6	15 4%	3 4%	0 0%	9 4%	0 05
	20.3	19.7%	3 7%	0 4%	9 4%	1 00
	26.8	20 6%	6 5%	0 0%	12.1%	0.00
	16.99	**19.29%**	**4.39%**	**0.33%**	**8.81%**	**0.22**

CHECK TEXT: RAMAYANA SECOND STORIES

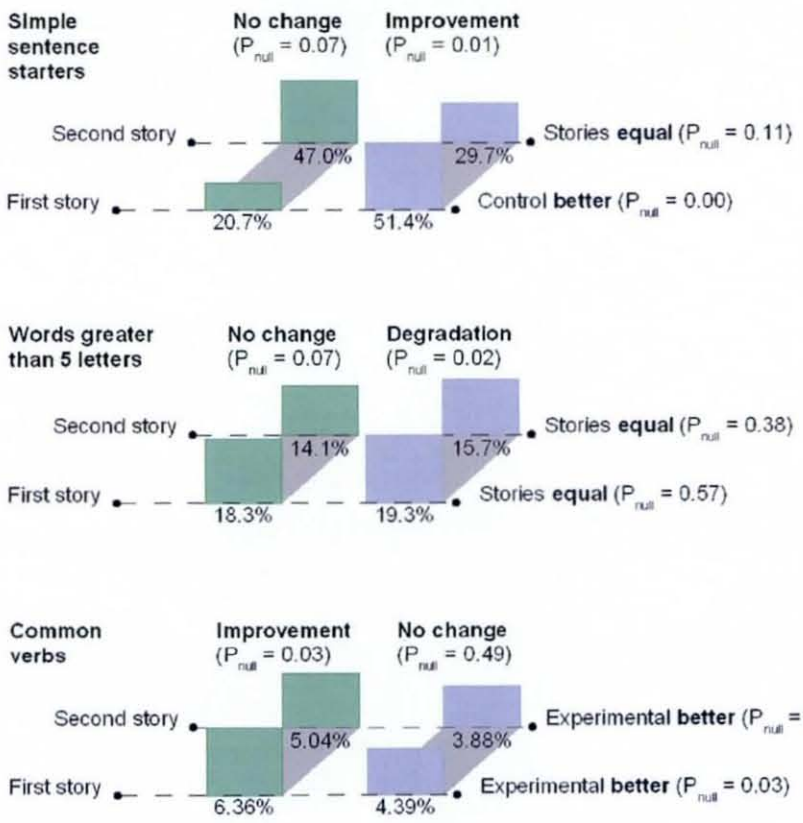
	Total number of words	Variety of words	The connective 'and'	Common connectives	Simple sentence starters
Control	159	69%	3.1%	3 8%	46.2%
	157	60%	5.7%	0.6%	50.0%
	143	60%	5 6%	1.4%	71 4%
	92	45%	6.5%	2 2%	66.7%
	97	64%	5.2%	2.1%	80.0%
	163	68%	1.8%	2.5%	0 0%
	84	71%	4 8%	1 2%	50 0%
	127	60%	3.9%	0.8%	25.0%
	125	64%	0.8%	2 4%	33.3%
	127.44	**62.33%**	**4.16%**	**1.89%**	**46.96%**
Experimental	275	61%	5 1%	0 7%	31 3%
	214	69%	5 6%	2 3%	36 4%
	74	66%	5 4%	2 7%	0 0%
	336	53%	3 6%	2.4%	37 0%
	285	69%	2 1%	2 8%	19 2%
	215	73%	5.1%	2.8%	20.0%
	133	57%	9 8%	0 8%	20.0%
	208	63%	4 8%	1 9%	53 8%
	119	46%	7 6%	1 7%	50 0%
	206.56	**61.89%**	**5.46%**	**2.01%**	**29.74%**

CHECK TEXT: RAMAYANA SECOND STORIES (CONTINUED)

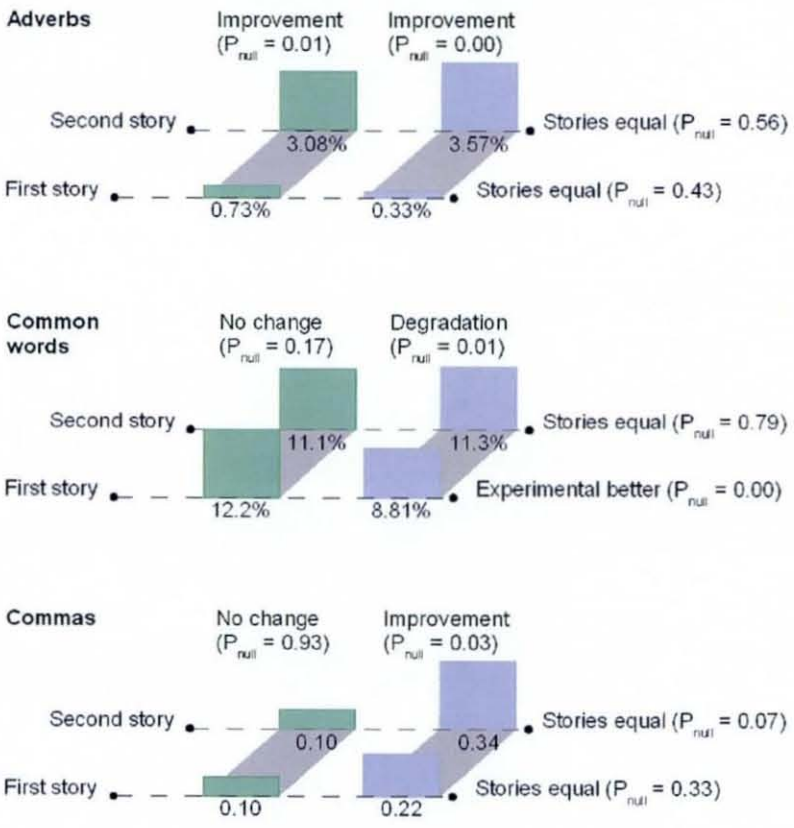
	Average sentence length	Word length	Common verbs	Use of adverbs	Common words	Commas
Control	12.2	20 1%	4 4%	4 4%	11.3%	0 32
	15.7	16 6%	5.1%	3.8%	11.5%	0 19
	20.4	13 3%	5 6%	0.0%	12.6%	0 00
	15 3	5.40%	5 4%	4.3%	14.1%	0 00
	19 4	14 4%	3.1%	1.0%	10 3%	0.10
	23.3	16.0%	6 7%	3.1%	11.0%	0.00
	14	16.7%	4 8%	2.4%	10 7%	0.14
	31 8	11.0%	5.5%	3.9%	10 2%	0 00
	20 8	13 6%	4.8%	4 8%	8 0%	0.10
	19.21	**14.12%**	**5.04%**	**3.08%**	**11.08%**	**0.10**
Experimental	17.2	19 6%	3.3%	5.5%	9.1%	0 23
	19 5	15.9%	2.8%	3 3%	10 7%	0 36
	24 7	12.2%	5.4%	0 0%	13.5%	0 04
	12.4	12 5%	3.9%	3 6%	9 8%	0 56
	11	18.2%	5.3%	4 2%	10 2%	0 37
	14.3	15.8%	5.1%	1.4%	13.0%	0 28
	26.6	12 8%	4.5%	3.8%	15 0%	0 08
	16	21.2%	2 9%	5.3%	9 6%	1.11
	19 8	13 4%	1.7%	5 0%	10 9%	0 00
	17.94	**15.73%**	**3.88%**	**3.57%**	**11.31%**	**0.34**


RAMAYANA SUB-STUDY
Total number of words
No change (P_{null} = 0.62)
No change (P_{null} = 0.07)
Second story
First story
127
117
207
147
Experimental better (P_{null} = 0.03)
Stories equal (P_{null} = 0.17)
The connective 'and'
No change (P_{null} = 0.93)
Degradation (P_{null} = 0.02)
Second story
First story
4.16%
4.19%
5.46%
3.81%
Stories equal (P_{null} = 0.20)
Stories equal (P_{null} = 0.60)
Common connectives
No change (P_{null} = 0.59)
Degradation (P_{null} = 0.00)
Second story
First story
1.89%
1.67%
2.01%
0.62%
Stories equal (P_{null} = 0.78)
Experimental better (P_{null} = 0.04)

RAMAYANA SUB-STUDY (continued)



RAMAYANA SUB-STUDY (continued)



CHECK TEXT: VISITOR FIRST STORIES

	Total number of words	Variety of words	The connective 'and'	Common connectives	Simple sentence starters
Control	109	64%	7 3%	4 6%	57.1%
	183	57%	8 7%	2.2%	33.3%
	135	52%	3 7%	3.0%	33.3%
	325	58%	3 4%	2.5%	31.3%
	112	60%	8 0%	1.8%	60 0%
	246	61%	1 6%	1.2%	55.6%
	54	72%	3 7%	1.9%	0 0%
	81	60%	2 5%	1 2%	66.7%
	73	63%	2 7%	0 0%	28.6%
	175	59%	5 1%	2 9%	40 0%
	149.30	**60.60%**	**4.67%**	**2.13%**	**40.59%**
Experimental	297	59%	1 3%	0.7%	65 2%
	142	58%	3 5%	0.0%	53.3%
	92	64%	5 4%	2.2%	57.1%
	54	67%	7 4%	0.0%	20 0%
	40	78%	5 0%	0 0%	40.0%
	132	65%	3 0%	3 8%	71.4%
	233	69%	1.3%	0.9%	16 7%
	269	72%	5 6%	0.7%	75.0%
	312	47%	8 7%	3 2%	12.5%
	13	85%	0 0%	0 0%	50 0%
	158.40	**66.40%**	**4.12%**	**1.15%**	**46.12%**

CHECK TEXT: VISITOR FIRST STORIES (CONTINUED)

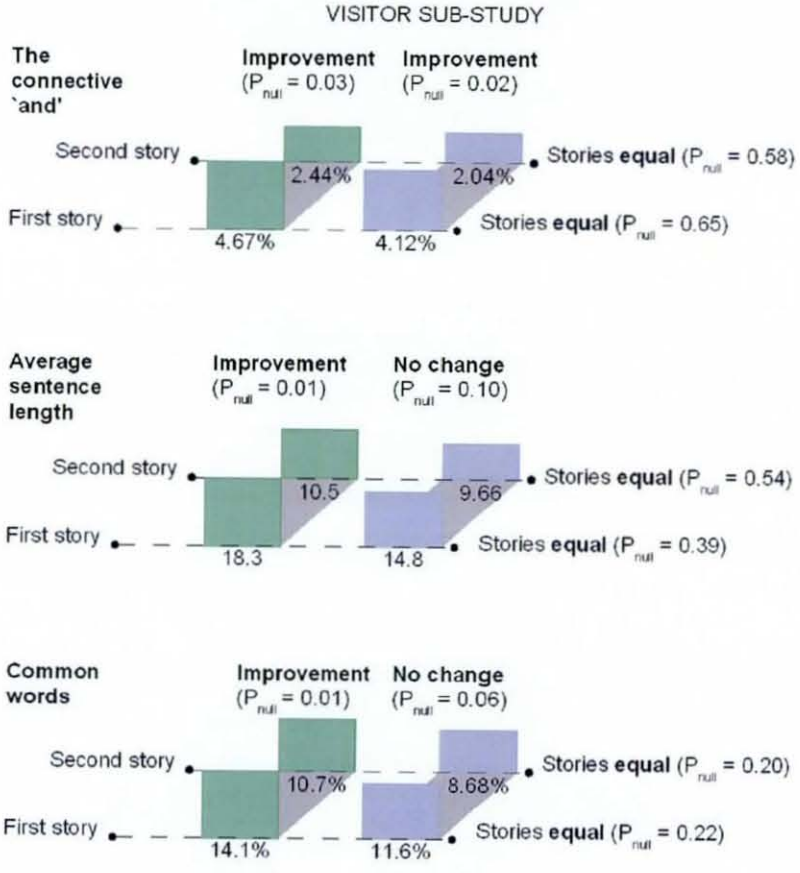
	Average sentence length	Word length	Common verbs	Use of adverbs	Common words	Commas
Control	15 6	12 8%	4 6%	0 9%	16 5%	0.00
	20 3	14 8%	4.4%	1.6%	15 3%	0.00
	22.5	12.6%	6.7%	0 7%	13 3%	0.00
	20.3	17 2%	8.6%	1 5%	14.5%	0 10
	22 4	17.9%	8.9%	0.0%	18 8%	0.13
	9.1	12.6%	6.5%	0 0%	9 3%	1 25
	18.0	18.5%	11.1%	0 0%	16 7%	0.00
	9 0	18 5%	4 9%	0 0%	8 6%	0.11
	10 4	11 0%	9.6%	1 4%	12 3%	0.00
	35 0	16 6%	7 4%	1.7%	15 4%	0 03
	18.26	**15.25%**	**7.27%**	**0.78%**	**14.07%**	**0.16**
Experimental	12 9	16 8%	5.1%	1.7%	7.1%	0 56
	9 5	14 8%	6.3%	0.7%	9 9%	0.21
	13 1	13 0%	4.3%	0 0%	12 0%	0.08
	10.8	24.1%	13%	0 0%	20 4%	0 09
	8.0	17.5%	5 0%	2 5%	10.0%	0 13
	18 9	18 9%	5 3%	0 0%	12.1%	0 21
	12 9	10 7%	2 6%	0 0%	4.7%	0 00
	16 8	15 2%	4 8%	0 4%	11.2%	1.11
	39 0	8 3%	8 7%	0 0%	20 5%	0 15
	6 5	15 4%	7 7%	0 0%	7.7%	0 00
	14.84	**15.47%**	**6.28%**	**0.53%**	**11.56%**	**0.25**

CHECK TEXT· VISITOR SECOND STORIES

	Total number of words	Variety of words	The connective 'and'	Common connectives	Simple sentence starters
Control	138	63%	1.4%	0.70	40 9%
	57	56%	1 8%	1 8	77.8%
	162	66%	0 6%	1.2	28.6%
	222	66%	3 6%	0 0	36 4%
	143	66%	4 2%	1.4	25.0%
	182	59%	0 5%	1.1	45 0%
	202	69%	5 0%	2.5	23.1%
	206	61%	1.9%	2 4	47.8%
	170	73%	2.9%	1.2	53.3%
	204	73%	2 5%	4 9	27.8%
	168.60	**65.20%**	**2.44%**	**1.72%**	**40.57%**
Experimental	179	69%	0 6%	0 6	15 0%
	212	66%	4 2%	1.4	40.9%
	164	71%	1 8%	1 2	29.4%
	139	66%	2 2%	2.2	57.1%
	216	69%	3 2%	1 9	50 0%
	186	69%	0.5%	0 0	27.8%
	208	63%	2.4%	1 4	27.3%
	134	67%	0.7%	0.0	42.9%
	124	58%	4 8%	5.6	25 0%
	75	56%	0 0%	0.0	81 8%
	163.70	**65.40%**	**2.04%**	**1.43%**	**39.72%**

CHECK TEXT: VISITOR SECOND STORIES (CONTINUED)

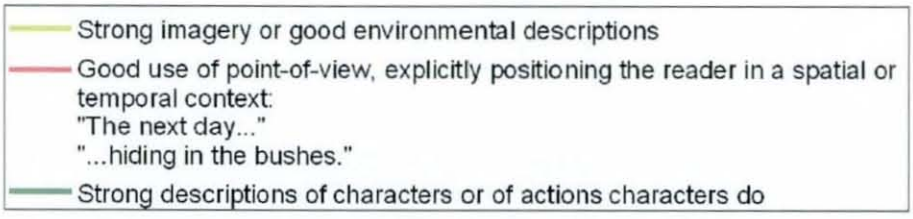
	Average sentence length	Word length	Common verbs	Use of adverbs	Common words	Commas
Control	6 3	17.4%	8 0%	0 0%	10.1%	0 63
	6 3	10.5%	3 5%	0 0%	7.0%	0 16
	7.7	15 4%	6.2%	0.6%	8 0%	0.00
	10.1	14 0%	5.0%	0 5%	8 6%	0 20
	17.9	20.3%	7.7%	0.7%	13 3%	0.17
	9.1	16.5%	11.0%	1.6%	12.6%	0 67
	15 5	12.4%	5.9%	1.5%	13 4%	0 00
	9.0	18.0%	4.4%	1.9%	8.7%	0 67
	11.3	14.1%	7 6%	0.6%	11.8%	0 36
	11 3	14 2%	5 9%	1 5%	13.2%	0 36
	10.45	**15.28%**	**6.52%**	**0.89%**	**10.67%**	**0.32**
Experimental	9.0	16 8%	5.6%	0 6%	6.7%	1 25
	9 6	17.9%	4.2%	2 4%	9.9%	0 63
	9 6	17.1%	3.7%	1 8%	6 7%	0 53
	9.9	11 5%	6 5%	0.0%	10 8%	0 30
	12.0	16 7%	6.0%	0.5%	11.1%	0.59
	10 3	13 4%	3 8%	0 0%	4 3%	0 29
	9.5	10 6%	5 3%	0.5%	9 1%	0 42
	9 6	16 4%	4 5%	0 0%	5 2%	0 42
	10 3	13.7%	7.3%	0 8%	17 7%	0 00
	6 8	9 3%	5 3%	0 0%	5.3%	0 00
	9.66	**14.34%**	**5.22%**	**0.66%**	**8.68%**	**0.44**


VISITOR SUB-STUDY
The connective `and'
Improvement (P_{null} = 0.03)
Improvement (P_{null} = 0.02)
Second story
First story
2.44%
4.67%
2.04%
4.12%
Stories equal (P_{null} = 0.58)
Stories equal (P_{null} = 0.65)
Average sentence length
Improvement (P_{null} = 0.01)
No change (P_{null} = 0.10)
Second story
First story
10.5
18.3
9.66
14.8
Stories equal (P_{null} = 0.54)
Stories equal (P_{null} = 0.39)
Common words
Improvement (P_{null} = 0.01)
No change (P_{null} = 0.06)
Second story
First story
10.7%
14.1%
8.68%
11.6%
Stories equal (P_{null} = 0.20)
Stories equal (P_{null} = 0.22)

Appendix I

Teacher-Coded Main Study Stories

Presented here are four samples of the coding applied to the main study stories by an experienced teacher. 56 stories were coded in total, representing first and second stories from 7 participants randomly selected from each of the four groups. The stories were spellchecked before coding, although incorrect words were not replaced.



Rama the beautiful prince with gleaming eye's was about to marry the love of his dreams Sita. Sita had gleaming blue eyes and golden skin she had dark brown hair which gleamed in the light.

After the wedding Rama jealous stepmother ordered them to be sent into exile for 14 years. They both went into exile and so did Ramas brother Lakshmana.

Then one quiet day in the forest Rama and Lakshmana went hunting after a golden deer but they didn't know that it was a trap. Ravana had heard about Sita and wanted her to be another one of his wives. Ravana saw Sita watching Rama and Lakshmana hunting a deer...

There was once some holy men who lived near the city of the Himalayas. But one day a evil she demon attacked the holy men the holy men ask for some help from the king of the Himalayas he suggested they could Rama. Rama was a man with extremely good archery skills he was said to be god himself come down from heaven in human form. So Rama went with his brother Lakshmana and the holy man lead the way. When they got there the place was deserted it looked like a ghost town then they saw it the she demon. Rama and Lakshmana took their bows out the she demon was charging towards him snarling and spitting it went for all of them they stepped to one side it stopped then went for Lakshmana Rama aimed at the she demons heart it was amazing close to hitting Lakshmana as well as the she demon. After that the holy man taught them the holy ritual.

I was on holiday in Spain. One day I was standing on a beach and I suddenly saw a glinting green bottle, I picked it up. There was a filthy scrappy screwed up piece of paper. It had a map on it. The map was a map of the island. It looked like this...

I slipped it into my pocket and went back to my parents. I didn't show them. A few years had passed I was now 19 and I had left home. I still had my map. I decided to go and find the person. I phoned my friend Joe he had a helicopter I wondered if he would take me there. He said he would. We were about to land, when we did Joe let me get out and he flew back home. This is the route I took.

One dark, gloomy night, a man was walking through the graveyard. The heard a noise. It creaked. He saw a manky skeleton. There was a ring on his finger so the man bent to look at it. He took the ring off its finger and sprinted back home to his wife "Oh where did you get that amazing ring?" she asked. He did not say a thing. They went to bed but soon there was a voice. It said "I'm coming for you, for my ring". They heard in the distance "Give me my ring". They were in bed when there was the ghost of the skeleton standing there. She threw the ring out of the window and it jumped out after the ring. It grabbed the ring then fell into the sea and he was never seen again.

Appendix J

Main Study Cartoon Story Details

In this section, the raw scores for the Ramayana sub-study cartoon comparisons are tabulated. As in Appendix H, the control and experimental group means for each measure are given in bold at the bottom of the group's row. At the very bottom of each table may be found the p-values for the associated t-tests; again, those columns whose group means are found to be significantly different at the 0 05 level are shaded An exception to the 0 05 significance level has been made in the last column of the last table, in which the pose expressiveness per shot for the control and experimental groups is compared. Here, a difference is found which is significant at the 0 055 level, and it was judged worthwhile to highlight this because such an effect is consistent with the increased variety and usage of non-default poses in the experimental group.

CAMERA LANGUAGE

	Total pictures	Long shots	Medium shots	Close-ups	Cartoon finished?	Expressiveness per shot
Control (paper)	6	1	0	0	✓	0 17
	5	1	1	0	-	0 40
	8	0	0	2	-	0 25
	8	1	0	0	✓	0.13
	2	1	0	0	-	0 50
	8	0	3	0	-	0.38
	6	1	2	0	-	0.50
	6	1	0	0	-	0.17
	3	1	0	0	-	0 33
	4	0	0	0	-	0 00
	3	1	0	0	-	0 33
	5	0	0	0	✓	0 00
	6	1	1	0	-	0 33
	6	0	0	0	✓	0 00
	6	1	0	0	✓	0 17
	6	0	0	0	✓	0 00
	5	0	0	0	✓	0 00
	5.47	**0.59**	**0.41**	**0.12**	**0.41**	**0.21**
Experimental (software)	18	2	5	0	✓	0 39
	13	1	1	2	✓	0 31
	10	0	0	0	✓	0 00
	7	1	0	0	✓	0 14
	5	1	0	0	✓	0 20
	8	2	1	0	✓	0 38
	4	0	0	0	-	0 00
	8	1	1	1	✓	0 38
	12	3	0	1	✓	0.33
	11	1	1	0	✓	0 18
	12	2	0	0	✓	0 17
	12	1	0	0	✓	0 08
	4	0	0	0	✓	0.00
	9.54	**1.15**	**0 69**	**0 31**	**0.92**	**0.20**
	P_{null}: 0 00	**P_{null}: 0.04**	**P_{null}: 0.50**	**P_{null}: 0.36**	**P_{null}: 0 00**	**P_{null}: 0.77**

	FACIAL EXPRESSION				
	Happiness	Unhappiness or discomfort	Surprise	Anger	Expressiveness per shot
Control (paper)	7	0	0	2	1 50
	4	0	3	2	1 80
	12	0	1	2	1 88
	13	0	2	1	2 00
	0	1	0	0	0 50
	0	1	0	1	0 25
	7	1	0	0	1 33
	7	0	0	2	1 50
	1	0	0	1	0 67
	4	0	0	1	1 25
	3	0	0	2	1.67
	11	0	1	0	2 40
	9	1	0	0	1 67
	7	0	0	1	1 33
	4	0	0	3	1.17
	9	0	0	1	1 67
	0	0	0	2	0 40
	5.76	**0.24**	**0.41**	**1.24**	**1.35**
Experimental (software)	10	4	0	1	0 83
	3	0	2	0	0 38
	0	0	0	1	0 10
	1	0	0	1	0 29
	6	2	0	0	1 60
	0	0	0	2	0 25
	0	2	0	0	0.50
	2	1	0	1	0 50
	1	0	0	2	0 25
	0	0	1	2	0 27
	6	0	0	0	0 50
	3	0	0	0	0 25
	0	0	0	0	0 00
	2.46	**0.69**	**0.23**	**0.77**	**0 44**
	P_{null}: 0.03	**P_{null}: 0.23**	**P_{null}: 0.53**	**P_{null}: 0.79**	**P_{null}: 0.00**

	POSE					
	Sitting	Sitting cross-legged	Kneeling	Lying down	Archery	Walking
Control (paper)	0	0	1	0	0	0
	1	0	1	1	0	0
	0	0	0	0	0	1
	0	2	0	0	1	0
	0	0	0	0	0	0
	0	0	1	0	3	2
	0	0	0	0	1	0
	0	0	1	0	0	0
	1	0	1	0	0	0
	0	0	1	0	1	0
	0	0	1	0	0	0
	1	3	1	0	0	3
	0	3	1	0	0	2
	0	0	0	0	0	0
	0	2	1	1	0	1
	0	1	1	0	1	0
	2	0	1	1	2	3
	0.29	**0 65**	**0.71**	**0.18**	**0 53**	**0.71**
Experimental (software)	3	0	0	1	2	1
	2	0	0	1	1	0
	1	0	0	1	2	0
	2	5	1	0	2	0
	1	1	0	0	2	3
	1	0	0	1	1	0
	3	0	0	0	1	0
	1	0	0	1	1	3
	1	0	0	2	0	3
	0	0	0	1	0	3
	1	3	0	1	0	3
	4	0	0	0	1	0
	1	3	0	0	0	2
	1.62	**1.62**	**0.08**	**0.69**	**1.00**	**1.38**
	P_{null}: 0.00	**P_{null}: 0.61**	**P_{null}: 0.00**	**P_{null}: 0.02**	**P_{null}: 0.14**	**P_{null}: 0.17**

POSE (CONTINUED)

	Flying or jumping	Raising arms	Touching a character	Holding own body	Pointing	Carrying objects
Control (paper)	0	0	0	0	0	1
	0	0	0	0	0	0
	0	0	0	0	0	1
	1	1	0	1	0	0
	0	0	0	1	0	0
	0	0	0	1	0	1
	0	0	0	1	0	1
	0	1	0	0	1	3
	1	0	0	0	0	0
	0	1	0	1	0	2
	0	0	0	1	0	0
	0	3	0	0	0	0
	0	1	1	0	0	0
	2	1	0	0	0	0
	0	1	0	0	0	1
	0	0	0	2	0	2
	0	1	0	1	0	2
	0 24	**0 59**	**0.06**	**0.53**	**0.06**	**0.82**
Experimental (software)	3	2	0	1	0	1
	1	2	0	1	0	1
	3	3	6	0	0	0
	0	1	4	1	0	0
	0	4	0	0	1	2
	0	3	0	0	0	1
	0	0	0	0	0	0
	1	0	0	0	0	3
	5	0	0	0	0	1
	4	3	3	0	2	1
	2	3	2	0	0	0
	4	0	2	0	0	0
	0	2	0	0	0	0
	1.77	**1.77**	**1.31**	**0.23**	**0.23**	**0.77**
	P_{null}: **0.01**	P_{null}: **0.02**	P_{null}: **0 04**	P_{null}: **0.15**	P_{null}: **0.34**	P_{null}: **0.88**

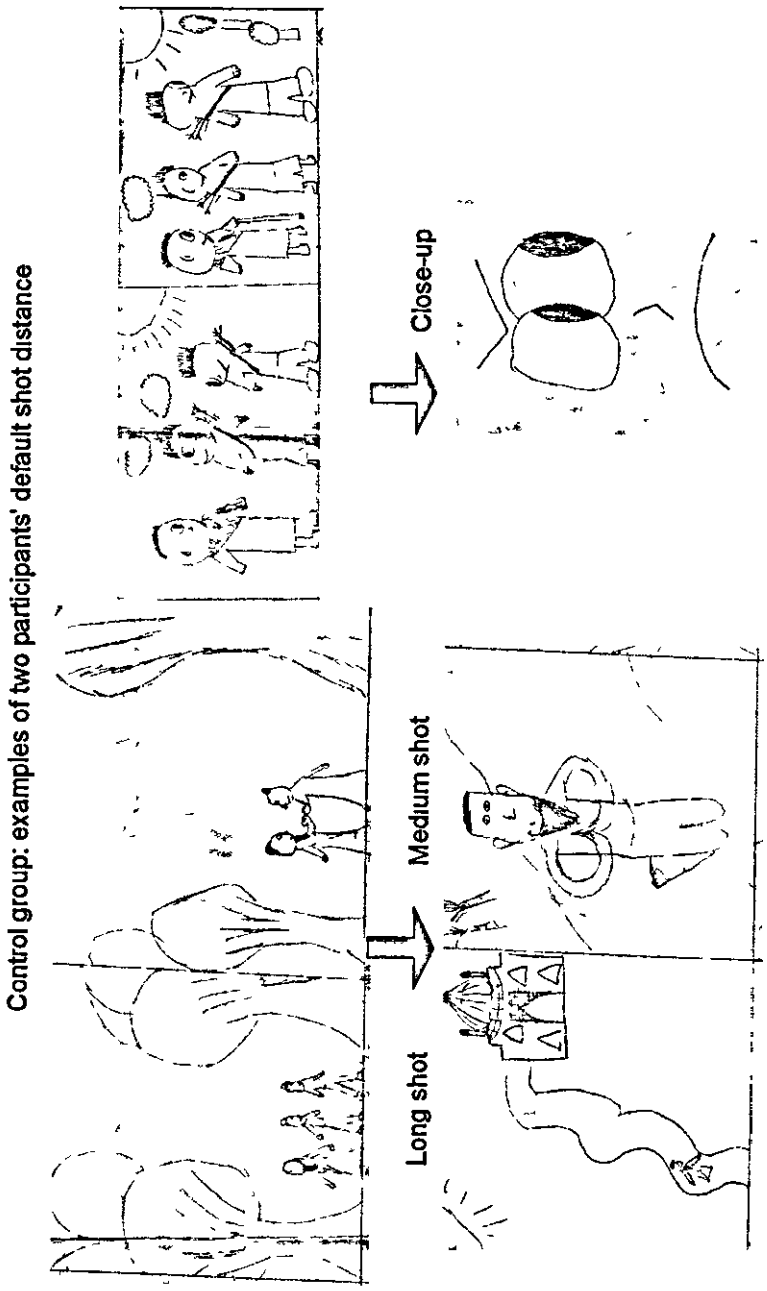
	POSE (CONTINUED)			
	Swordfighting	Bowing	Running	Picking up or throwing characters
Control (paper)	0	0	0	0
	1	0	0	0
	0	1	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
	0	0	0	0
	1	0	0	0
	0	0	0	0
	0	0	0	0
	1	0	0	0
	0	0	0	0
	0	1	0	0
	0	0	0	0
	0	0	0	0
	2	0	0	0
	0.29	**0.12**	**0.00**	**0.00**
Experimental (software)	0	0	0	1
	0	0	0	1
	0	0	0	1
	0	0	1	0
	0	0	0	0
	0	0	0	0
	0	0	0	1
	0	0	0	2
	0	0	0	1
	0	0	0	1
	0	0	0	1
	0	0	0	1
	0	0	0	0
	0.00	**0 00**	**0.08**	**0.77**
	P_{null}: 0 14	P_{null}: 0 21	P_{null}: 0.34	P_{null}: 0 00

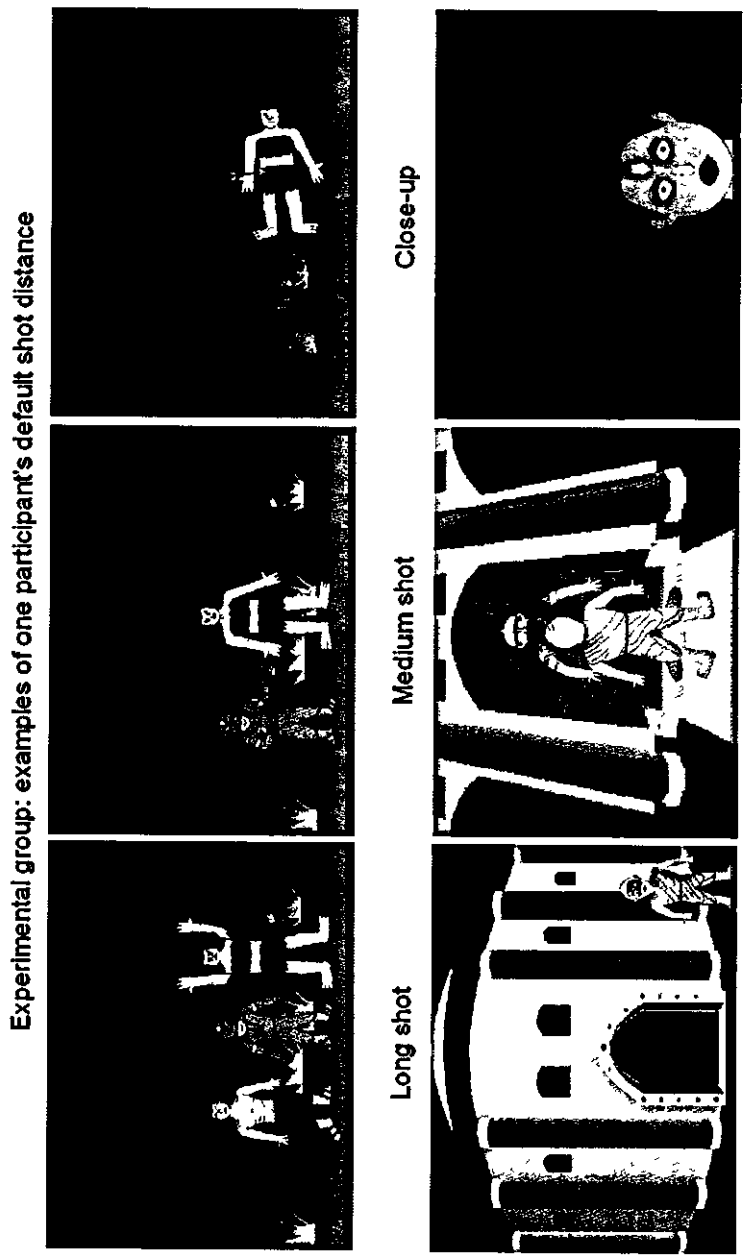
	POSE (CONTINUED)		
	Punching or kicking	Hitting the ground	Expressiveness per shot
Control (paper)	0	0	0 50
	0	0	0 60
	0	0	0.38
	0	0	0 75
	0	0	0 50
	0	0	1 00
	0	0	0 50
	0	0	1 00
	0	0	1 00
	0	0	1 50
	0	0	1 33
	0	0	2 20
	0	0	1 33
	0	0	0 67
	0	0	1 33
	0	0	1 17
	0	0	2 60
	0.00	**0.00**	**1.08**
Experimental (software)	1	0	0 89
	0	0	0 77
	0	0	1 70
	0	0	2 43
	0	0	2 80
	0	0	0 88
	0	0	1 25
	1	1	1.75
	1	1	1 25
	0	1	1 73
	0	1	1 42
	0	1	1 08
	0	0	2 00
	0.23	**0.38**	**1.53**
	P_{null}: 0 08	P_{null}: 0 02	P_{null}: 0 055

Appendix K

Cartoon Shot Distance Coding

Presented here are examples from the paper and software cartoons which indicate how the shot distance codings were arrived at. In all cartoons, participants used a 'default' shot distance, somewhere between long and medium long, in the great majority of their shots. Therefore, any shot which deviated from this clear default was coded relative to it, as one of long (that is, viewed from a greater distance than usually used by the participant), medium (viewed from a closer distance than usual) or close-up (viewed from a very much closer distance than usual). Examples follow, the paper cartoon examples reflect the fact that the majority of control group participants did not choose to use colour, although this option was available to them.


Control group: examples of two participants' default shot distance
Close-up
Medium shot
Long shot


Experimental group: examples of one participant's default shot distance
Long shot
Medium shot
Close-up

Appendix L

Visitor Sub-Study Questionnaire

This section provides the questionnaire given to Visitor sub-study participants and the responses of seven randomly selected participants.

A Questionnaire...

To help me improve the Morphenstein software, I'd be really grateful for some feedback. It's important for me to know what's good and what's bad, so do be honest!

Please try to tell me...

The best thing about the software
The most annoying thing (apart from when your work didn't save properly!)
What was hard to use?
How could that be improved?
What else would you like to be able to do with the software? (For example, would you like to make your own characters, or add text/speech bubbles, etc?)
A sentence which sums up your experience of using the software Thanks!

The best thing about the software
a) Where you can put the background on and move the things in front and behind
b) Cannot decide
c) Everything but one thing when you put things behind things
d) You can do whatever you want with the characters
e) Being able to move the skeleton and people
f) You can change the face features
g) You can create your own scenes

The most annoying thing (**apart** from when your work didn't save properly!)
a) When the skeleton spun around
b) No answer to be given
c) Everything
d) How do you get them in bed!
e) I could not get the skeleton to lie down
f) When you turned the legs they went thin
g) Having to change buttons every time

What was hard to use?
a) All of it sometimes
b) Getting the people to lie in bed
c) Nothing
d) The stretchy thing
e) Moving the skeleton
f) Making the legs stay wide and turn them
g) A lot of things such as using the people

How could that be improved?
a) I don't know
b) If you could choose different people, clothes and positions
c) If it had speech bubbles
d) When you do a close up you should be able to make the bones of the skeleton closer together
e) I don't think it does
f) Make them 3D
g) By designing/adding different clothes such as party/general/climbing and doing it in sections of moving the objects

What else would you like to be able to do with the software?
(For example, would you like to make your own characters, or add text/speech bubbles, etc?)
a) Be able to write on it
b) Make own characters, make text/speech/thought bubbles, add a button that makes them move and reenact the story like a computer film
c) Nothing
d) Copy and paste
e) I don't want it to change
f) I think you should be able to get speech bubbles and thought bubbles
g) Designing your own place, building characters

A sentence which sums up your experience of using the software
a) I think you could be able to make it easier
b) I think it will be a hit
c) It is the best thing I have ever been on
d) It was great it can be improved
e) It is really good better than some
f) It's one of the best things on the computer I have ever been on It can still get better though
g) An enjoyable fun software but can be boring