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Title:

**Increasing Awareness of Recycling Programs for
Elementary Aged Children through Interactive Multimedia**

by

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DEDICATION

To my family:

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They have given me great amounts of
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INTRODUCTION

The purpose of this thesis is to create an effective interactive multimedia training method for elementary aged children, on recycling awareness. The age group chosen for this project is children 8 to 11. This report will focus on the goals and objectives of the project, the areas being researched and the procedure, along with the outcome of the project.

In children's psychology, understanding of different stages of intellectual development of a child is critical. According to Piaget, "concrete operational thought is made up of operations-mental actions that allow children to do mentally what they had done physically before. Concrete operations are also mental actions that are reversible....Thus, a concrete operation is a reversible mental action on real, concrete objects."¹ The age group of children chosen for this project is in the period of concrete operational development. They operate on the basis of what they can see and feel. They go much more with intuition or perception. For the children, it's hard to understand things that they can't visualize.

¹John W. Santrock, Children (Iowa: Brown & Benchmark Publishers, 1997), 381.

A goal of this project was to be sure that children would be able to understand easily. This project, however, should emphasize concrete objects (i.e. pictures, drawings, texts) to provide the children with a better understanding of recycling through interactive multimedia. In addition, in the nature of interaction with this age group of children, the real issue lies in how to communicate effectively to develop their awareness and their respect for the natural environment.

Therefore, this interactive multimedia project must be kept simple in functionality, consistent in feedback and varied in the use of multimedia. The method also needs to include a sense of humor, build confidence, and educational vision.

The objective of this project is to design an effective multimodal interface for a children's interactive multimedia computer game that employs simple texts, pictures, graphics, sound and animation. By simply pointing and clicking on particular hot spots with a computer mouse, graphics and sound come alive on a computer screen.

The significance of this project is to develop the children's awareness and their respect for the natural environment through interaction with a computer.

RESEARCH

As part of the research process for the project, it was necessary to identify the areas being analyzed and presented throughout the project. A list of articles, books, and journals were gathered for review in the areas of recycling, interactive multimedia design and children's psychology.

- Recycling

It is true that the world is running out of garbage dumps. This has come about because people have been wasteful. Everyday, we waste wood products, metals, glass, and plastics. Where do all the materials and energy come from to make things that we need for our everyday life? What happens to all the trees and wildlife that must be removed to build shopping centers, malls, and apartment complexes? The good news is that people are changing. They are reusing things they used to throw away. Using products over again is called recycling. Recycling saves not only materials and energy, but also space in landfills.

Recycling, however, can only offer a partial solution. In fact, other related new programs are also needed if we are not to be overwhelmed by a flood of refuse. The recycling and other related new programs have to be developed in the most effective way -- by environmental education which has already been directed towards both adults and children. For children, the method of this education needs to focus more on their interest, rather than occasional environment activities.

Books and articles:

Charlotte Wilcox (1988) - Trash!, Minneapolis, Carolrhoda Books Inc. This book discusses the importance of recycling on environmental and conservation issues. It says that trash, sometimes called solid waste, must be taken away from where people live because it can be harmful to people and to the environment. And the best way of dealing with trash is recycling, a process which begins at home. This book presents a fascinating look at the story of trash including trash pick-up, landfills, recycling method, etc.

Evan & Janet Hadingham (1989) - Garbage!, New York, Simon & Schuster Inc.

This book covers different types of recycling patterns in different times and places in the world with pictures and illustrations. From the historical living pattern changes in Greenland to the "Kids Against Pollution" campaign in the U.S.

Joanna Foster (1991) - Cartons, cans, and orange peels, New York, Clarion Books

This book explains why garbage has become a serious problem and explores how we can make better use of what we've been wasting. It also looks at what we put into the wastebasket without thinking: batteries or cleaners that are hazardous waste; unwanted clothes could be reused; packaging and disposables that may not be necessary.

Kathy Ross (1995) - Every Day is Earth Day, Brookfield, The Millbrook Press

This book tells us that we need to stop wasting our natural resources, and we need to protect the living space of our vanishing wild animals. We also need to stop polluting our air, land and water and to work hard to clean up those places that are already polluted. Earth Day is a good time to learn about the many things we can do to help Earth be a healthy place for all living things.

Geoff Scott (1993) - "Turn on to the three R's today", *Current Health* 2, October, pp. 24-26

This article talks about the way we handle our trash at home. And the best way we have to do this is to reduce, reuse and recycle.

- Interactive Multimedia Design

For years, computers were not always friendly companion for the majority of the baby boom generation. Only a small group of people were able to interact with computer systems. But computers are now an unavoidable mass consumer product for the majority of population in the computerized world driven by the information super highway. As a result, interaction with computers has become a very considerable research subject over the last decade. The developers have to embrace theories of human behavior and media as presentation tool, as well as principles of computer systems design. Easy-to-learn and easy-to-use computer systems are demanded by users these days. The easy interaction can also provide a very powerful effect in delivering campaign messages successfully when it comes to education. Since many users can't be trained ideally, computer applications have to be designed intuitively so that users can simply walk up to the system and use it. In that sense, multimedia provides designers with the ability to incorporate graphics, sound and animations. With the multimedia presentation, users can be more effective the first time, with less confusion.

Interactive multimedia computer games have great advantages in learning for children. When children play, their resistance to learning goes down and their willingness to try in spite of making mistakes goes up. Computer-based training for children is now regarded as one of the best ways to accomplish educational tasks, utilizing multimedia technologies.

Books and articles:

Ronald M. Baecker [with] Jonathan Grudin... (1995) - Readings in human-computer interaction: toward the year 2,000, San Francisco, Morgan Kaufmann Publishers Inc.

This book discusses computer systems that are found throughout our society. School children, scholars, secretaries, bank tellers, middle managers, executives, nurses, factory workers, animators, printers, architects and planners are all discovering that computers are changing roles and expectations, enhancing some careers, trivializing or eliminating others. And some computer systems run with little or no intervention, but most are interactive-they have human users who are engaged in computer-assisted tasks. The human-computer interface, also called the user interface, is often the single most important factor in the success or failure of an interactive system or application.

Jenny Preece [with] Yvonne Rogers... (1994) - Human-computer interaction, Reading, Addison-Wesley Publishing Company, Inc.

This book discusses human-computer interaction, which has advanced phenomenally over the last ten years. Research into all aspects of HCI has extended our understanding of what it means to interact with technology and how to put this understanding to practical use in the design and evaluation of products.

Allison Druin [with] Cynthia Solomon (1996) - Designing multimedia environments for children, John Wiley & Sons, Inc.

This book with the included CD-ROM explores not only the educational approach each multimedia environment takes, but also the impact each has had on children and on the design of environments for children.

- Children's Psychology

This interactive multimedia project should direct the children to do more with concrete objects on the computer screen instead of having them read hypothetical or unimaginable instructions. For example, it is better for children to remember that plastics recycling by showing an illustration showing fish dying because people threw plastics into the water, and rings get around the fishes' necks. This is one of the most critical points that this project should emphasize. When the children do things that they are able to learn and understand, they can transfer the situation from the virtual world to real life.

Consistent feedback is also essential in this project because the children's behavior is prompted or guided and reinforced by the feedback, until it occurs frequently. The children should know how successfully they are in playing the game.

Books and articles:

Henry L. Roediger III [with] Elizabeth Deutsch Capaldi... (1991) - Psychology, Harper Collins Publishers

The part III (Learning, memory, and cognition) of the book talks conditioning and learning with the experimentations of Ivan P. Pavlov's (1849-1936) classical conditioning which can be applied to this project. It implies that a response resulting from learning is a relatively permanent change in behavior, produced by experience. Reinforcement as a rewards for the children can also increase the children's interest in recycling.

John D. & Janice I. Baldwin (1981) - Behavior principles in everyday life, Englewood Cliffs, New Jersey, Prentice-Hall, Inc.

This book discusses the basic behavior principles developed in laboratory research that can be of great assistance in understanding and explaining human behavior in natural settings.

John W. Santrock (1997) - Children, Brown & Benchmark Publishers

In middle and late childhood, children become more aware of the push for intellectual competence and achievement than earlier in their development. Chapter 13 (Cognitive development in middle and late childhood) of the book covers children's cognitive development in middle and late childhood with Piaget's theory and concrete operational thought.

PROCEDURE

This interactive multimedia game CD-ROM was created on a Power Macintosh 7600/120 with Sony Trinitron Multiscan 15sx, keyboard, mouse, and supporting equipment (Macintosh microphone, Iomega Zip drive, Global Village modem, JBL portable speakers, Microtek flatbed scanner, Kodak CD writer). System software 7.5.3 was used with other software packages as follows:

- Adobe PhotoShop
- Adobe Illustrator
- Adobe After Effects
- Adobe Premiere
- Macromedia Director
- DeBabelizer
- SoundEdit 16
- Strata StudioPro
- Silicon Graphics' Alias/wavefront with Indigo 2/Impact 1000

What makes children recycle with confidence? What makes children believe recycling is a valuable thing to do? Parents and teachers can play a critical role in helping children to be aware of environmental issues including recycling. They should direct children to visualize how important recycling is in daily life. Ideally, parents and teachers should participate when the planning starts for designing educational interactive multimedia projects. A little extra attention paid to children can make all the difference in child's motivation and self-confidence.

In designing the gaming strategies, a variety of approaches have been taken regarding the characteristics of multimedia techniques. Based on the research, computer games have great advantages in learning for children. They can develop skills through the games that encourage quick thinking and thoughtful approach. By clicking a simple icon, word or picture, recycling begins at home in a simple but effective way, in which children can perform with confidence.

A flow chart was created to give an outline of how the game will play. After the creation of the flow chart, main characters, sounds, and other details were generated.

This interactive multimedia project, titled *Recycling Match 500*, is a large (416.5 Megabytes) interactive multimedia project containing QuickTime movies, sounds and drawings. All the movies and sounds were digitized, edited and compressed for importing to Macromedia Director. More than 80% of graphics were created in Adobe Illustrator and retouched in Adobe Photoshop for final use in Macromedia Director.

The *Recycling Match 500* consists of two games. The first game examines recyclable items in our everyday life to show children how to separate papers from containers with the proper recycling bins. By presenting such popular items as table-top cartons, corrugated cardboard, drink boxes, glass jars, metal cans, newspapers, plastics containers, magazines and catalogs, and brown paper bags with supporting sounds and graphics, recycling experience begins in a virtual interface.

In the second game, the three recycling campaign key words -- reduce, reuse and recycle -- appear on three screens with a missing part in each word. And there are three more screens that contain all the missing parts of the words. The words should be matched to the missing parts to be completed.

In designing the interactivity of each screen, ease of pointing and dragging were considerations, as well as intuition. The children also can point and click on buttons either to browse through the games or to jump directly into the games using a mouse.

The first game starts with a three-dimensional animation (Figure 1) showing a frog getting closed up in a window which later turns into a part of the logo symbol of the project. The animation was created in Silicon Graphics using Alias/wavefront. Characters and buttons were used with the sounds in the main page (Figure 2) to add interest for children, in the virtual gaming environment. Corresponding pages were created to represent each of the following sections - Title (Figure 3), Registration 1 (Figure 4), Registration 2 (Figure 5), Game 1 interface (Figure 6), Game 2 interface (Figure 7), Reward 1 (Figure 8), Reward 2 (Figure 9), Quit (Figure 10) and Credits (Figure 11).

The still cast members were imported into Macromedia Director as a Photoshop file rather than PICT or something else in order to keep a great deal of flexibility in manipulation. The animations, however, were created in Macromedia Director either in PICT sequence or were imported as QuickTime movies with proper settings.

Users also watch a two-dimensional animation (Figure 12) after the first three-dimensional animation (Figure 1). In the two-dimensional animation, the words "Don't Trash! Recycle" appeared once and users would go to the registration stage. In the text field for the player registration page, any character from the keyboard must be typed (Figure 4) to go forward, then users must choose one from the three Warner Brothers' famous cartoon characters (Bugs Bunny, Taz, Tom -- Figure 13) to end the registration stage.

As Game 1 goes, users would get 100 points each time by choosing the right answer (Figure 14); but if they choose the wrong one, they would lose the chance to play. Only if users get 1200 points in Game 1, would they be allowed to play Game 2 as a bonus round.

The two reward screens (Figure 8, 9) contain one of the three cartoon characters that was chosen by the player, and a statement in voice and text form as feedback for users.

Users would be allowed to choose either quit or replay the games by clicking the corresponding buttons in the Quit screen (Figure 10). This quit screen was designed to give users an opportunity to start again until they decide not to do so.

A few key colors, background shapes and sounds were used for the interface to maintain a sense of consistency and to avoid confusion. For example, background colors were chosen to represent space because space often creates an attractive virtual gaming environment with simple but effective characters for children. In order to keep their expectations, sophisticated space sound effects were also required with the visual factors. Once children get confused what to do or where they are in the middle of the game, they lose their desire to play. All still graphics, sound, text and animations were put together in Macromedia Director for playing.

As this interactive multimedia game is just a prototype, the parent tips and technical support information section have not been completed. Parent tips and technical support information are basically heavily text-based and technically complicated; supporting systems and graphics are added for better understanding.

R E S U L T S

Every screen of *Recycling Match 500* conveys a real taste of interactive multimedia game playing with recycling. Ik-Dong Yu implies here that the early recycling experience can make children become more active participants in recycling campaigns. Throughout this project, players ask "Why?" to their parents and teachers and come up with imaginative answers. They can share their thoughts and ideas, and they are motivated while they play.

This project was completed as anticipated, fulfilling all the goals and objectives stated in the beginning. A number of children from different categories -- boy, girl, inner city, suburb, and computer-privileged/under privileged environment -- were tested, and many valuable comments and feedback resulted.

Boys more than girls liked the friendly characters and sound effects. Both inner city and suburban children could play the game at first encounter, whether they were computer-privileged or not. Most suburban children could play faster, and with more enthusiasm.

The "registration" section appeared to be the most enjoyable process for the players. Children liked to play the first game more than the second because they could get a great deal of interaction as they moved the mouse. The animations were also a popular section; children were always fascinated watching them.

No serious problems were encountered during the process of creating and testing this project. One of the hardest parts of the whole process was writing the Lingo script for the game. The advice of teachers and friends was of great benefit in achieving the goal at a satisfactory level.

After the first prototype was created, user testing was done as soon as possible for improvement. Several attempts were made in setting a computer lab time, using the facilities and booking the target-aged children from elementary schools. Due to the time constraint, it wasn't easy to coordinate schedules for testing, so user testing was performed on an individual basis.

There were areas found which required improvement. A sound control button was needed throughout the project. Since this project has a relatively long "intro" section, a button to escape the "intro" was in demand. Over all, the second game needs to be instructed clear and played faster so that players continued to be interested. Clear ending was also needed in the second game.

In the "main" menu, it might have been good to have a button for a simple "help" section for first-time computer users. The first-time computer users would be able to click on the button to get the idea of how to play the game from the beginning. Sometimes users were confused with dead characters in the "main." The buttons on the upper left and right-hand side, appropriate functions need to be assigned for them.

Improvement has to be made in the "credit" section; the animated credit list could be smoother in moving and with more exciting sound effects. The "feedback" section might also needs to be more friendly and descriptive to enforce children's motivation. Users should get registered name and character anytime in return until they choose to register with a new name and character.

With the assistance of thesis advisors, problems were analyzed and solved in an ideal way. The final form of the project was stored in a CD-ROM with the playback speed at 2X. For the final process, a Kodak 2X CD-writer was used, with the application program CD Toaster.

S U M M A R Y

By integrating interactive multimedia technology with computer games, a new learning experience can begin at home, school or library. Parents and teachers as well as children can take advantages of great learning opportunities.

For an educational campaign for this age group of children, the success or failure of an interactive multimedia project depends on the way it is communicated. As mentioned in the introduction, the age group of children chosen for this project is in the concrete operational period. More precisely, they are going from the concrete operational to the formal level of logic. In general terms, they operate on the basis of what they can see and feel.

Because the target-aged children have their own characteristics of learning, all the graphics and sound display should involve thorough research. User-friendly interface design with keen intuitiveness can increase the user performance.

Designing an interactive multimedia project is truly challenging not only for graphic designers but programmers, researchers and others. When it comes to children's games for educational purposes, as it is stated in the introduction, the program will need to contain a sense of humor, confidence and vision.

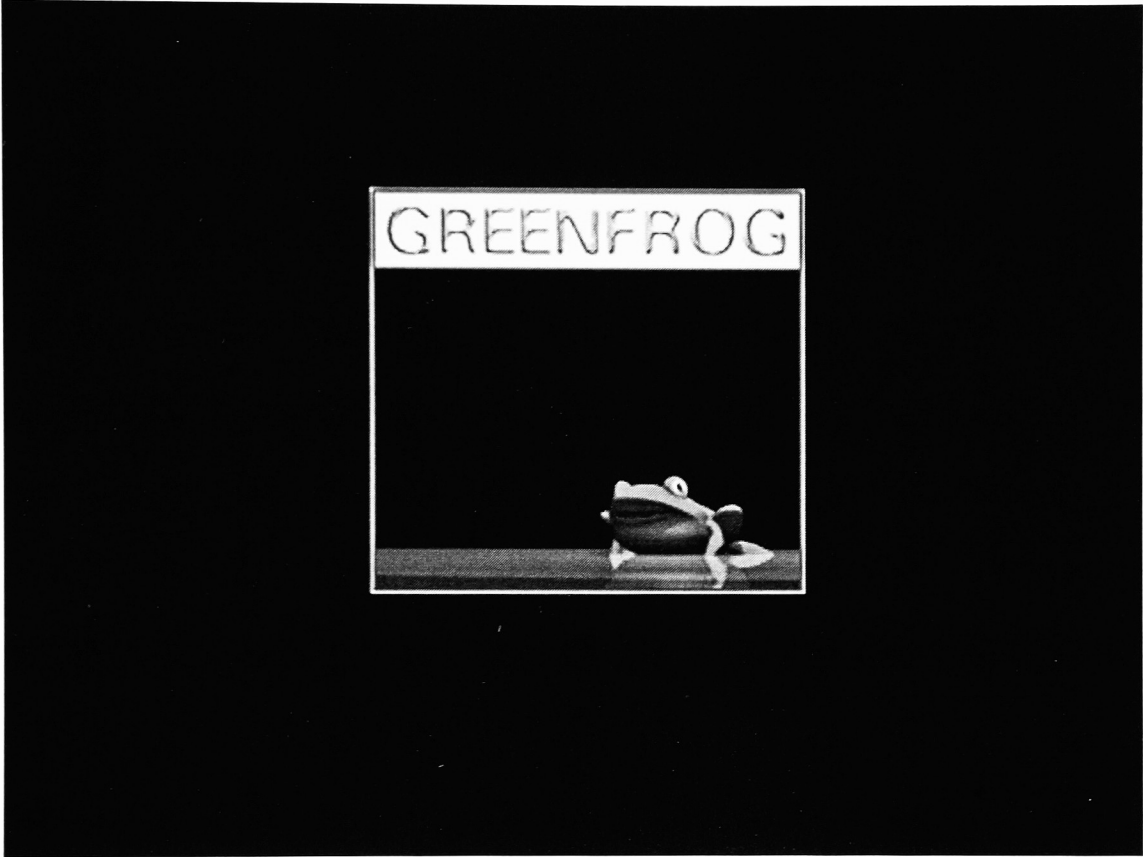


Figure 1 (Introductory Animation)



Figure 2 (Main Page)



Figure 3 (Title Page)



Figure 4 (Registration 1)



Figure 5 (Registration 2)



Figure 6 (Game 1)

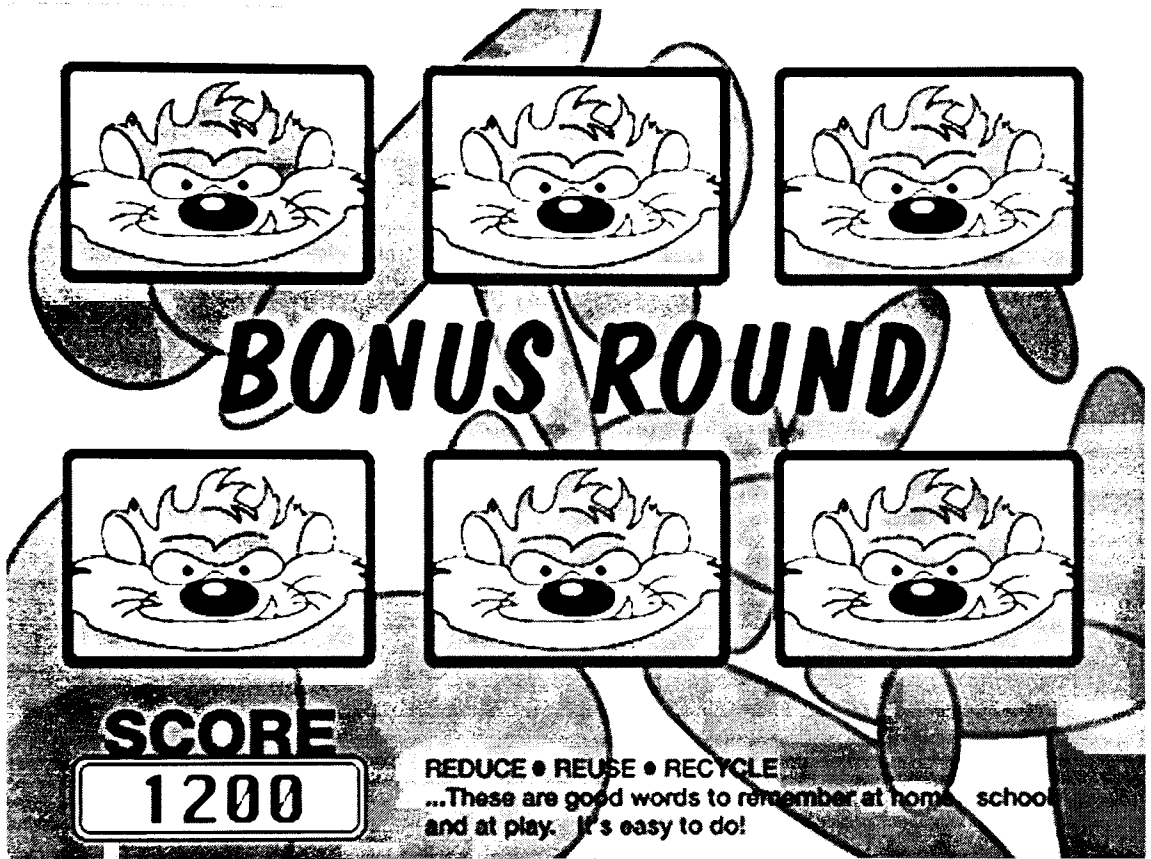


Figure 7 (Game 2)



Figure 8 (Reward 1)



Figure 9 (Reward 2)



Figure 10 (Quit Page)

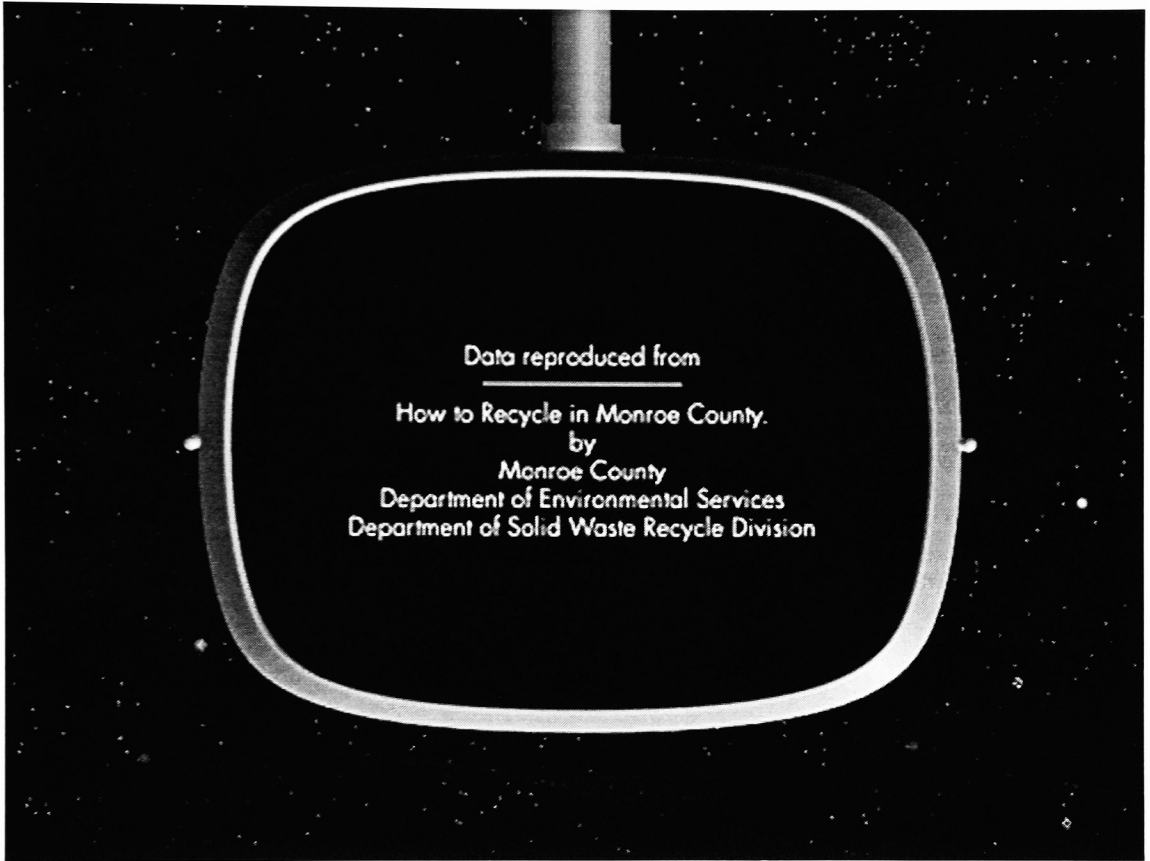


Figure 11 (Credits Page)



Figure 12 (Title Animation)

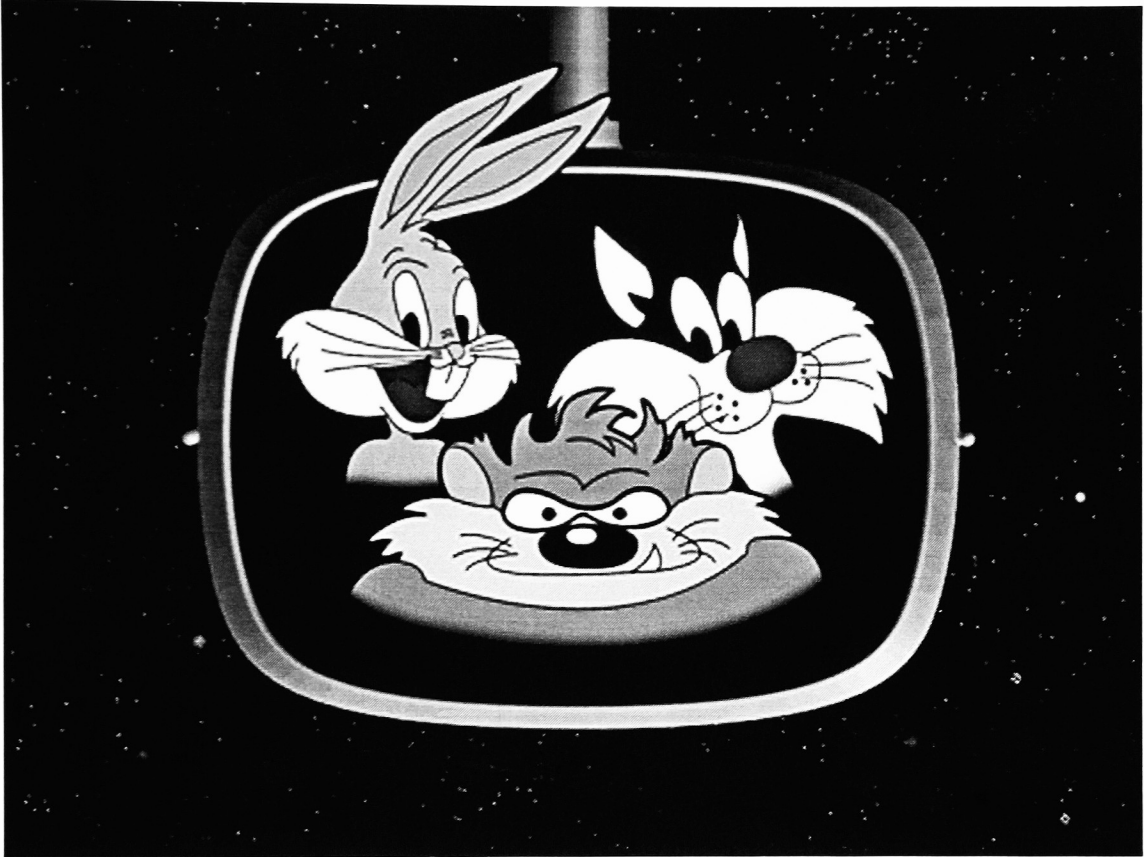


Figure 13 (Characters Page)



Figure 14

B I B L I O G R A P H Y

B I B L I O G R A P H Y

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