

DESIGN OF A TOUCH SCREEN MICROWAVE OVEN FOR OLDER CONSUMERS

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The purpose of this study was to add to the knowledge of older consumers and their use of electronic products. The work involved redesigning a microwave oven by employing a touch screen interface. This provided a simpler panel with limited choices, step-by-step prompts and larger controls and displays. The design was tested for usability with 8 people over 60 and 8 under 60, in comparison to an existing microwave oven. Participants of all ages completed 4 out of 5 sample tasks faster with the touch screen model. The touch screen model was rated easier to learn and use on all tasks. This paper discusses the redesign of the microwave, the usability test, and final design recommendations.

INTRODUCTION

A microwave oven interface was redesigned and tested, in an effort to improve the usability of the oven for all consumers, and older consumers in particular. This work was part of a Master's thesis at Tufts University. The thesis research began with a literature search on various aspects of aging, including sociology and aging, psychology and aging, physiology and aging, and human factors and aging. Next, a survey of over 100 people, half over 60 and half under 60 years of age, was conducted (Loring, 1993). The results of the first phases provided guidelines for redesigning a common household product, the microwave oven.

DESIGN REQUIREMENTS

The microwave redesign started with a list of design requirements that would make the product easier for older consumers to use. The list was based on surveys (Ward, 1991; Loring, 1993), consumer magazines (Consumers Union, 1991), and references on designing for older consumers (Pirkel, 1989; Pirkel, 1994).

Physical Attributes and Desired Features

- Medium size
- Counter-top placement
- See-through door
- Five power levels
- A button to heat 1 minute on highest power
- A button to automatically reheat a plate of leftovers
- Cooking time chart
- Dark labels on a light background for maximum contrast
- Limited features - only those commonly used
- Limited number of controls

Usability Attributes for Older Consumers

- Cross-sensory redundant cues
- Large visual displays
- Visual feedback
- Audible feedback
- Large controls
- Sufficient space between controls
- Easy manipulation of controls
- Built-in memory aids
- Appropriate use of color
- Large handle-type door opener
- Easy installation and set-up
- Well-written, easy to understand, uncomplicated instructions

THE TOUCH SCREEN INTERFACE

It became apparent that a touch screen interface would be an ideal way to accommodate all of the design requirements, since it has a number of important features:

- It can walk the user through a sequence of steps, reducing memory requirements.
- The interface changes for each step in a task, eliminating the need for a large array of buttons. It presents the user only with the options appropriate for the task at hand, as recommended in the human factors literature (Dumas, 1988).
- Because only the buttons necessary for a certain task are displayed, the buttons can be larger and more widely spaced, making them easy targets.
- It provides touch controls, eliminating the need to turn, twist or pull, which can be difficult with stiffened fingers.
- A touch screen can be installed over a graphics display, which can provide visual feedback,

adjustable font sizes, easy-to-read fonts, and can make use of icons and color.

- It can provide instructions as part of the interface. People in the surveys strongly conveyed the need for easy-to-follow, step-by-step, instructions.

Creating a Prototype

An iterative approach was followed in creating and refining a touch screen design. The functionality of the prototype was determined by user needs defined by the research. The menus were hierarchical; selection of a button produced additional buttons appropriate for that choice. The top line of the display prompted the user for the desired input or provided status feedback. A paper prototype of the interface was created first and tested informally in walk-throughs with three co-workers under 60 years of age. The selection of people under 60 was purely for expedience. The three people were given the list of tasks and asked to point to the buttons on the paper to indicate which buttons they would choose to complete the tasks. Based on the feedback from these walk-throughs, the design was refined to eliminate unnecessary steps and improve the wording, and an interactive prototype was created.

The interactive prototype was created using Allegiant Technologies SuperCard™ software running on an Apple® Macintosh Quadra™ computer. The interactive prototype also was tested informally and revised as it was being developed. Figure 1 shows an image of the prototype. The image shows the edge of the window (black) and the door handle on the left and the touch screen main menu on the right. The main menu consists of four buttons below and a display above. Although auditory feedback was planned as part of the interface, it was not feasible in the SuperCard prototype because it slowed the computer processing speed and therefore introduced an unacceptable lag in response time.

USABILITY TEST OBJECTIVES AND PROCEDURE

The touch screen design was usability tested with 16 consumers: 8 people under 60 and 8 people over 60. Their characteristics are shown in Table 1. People varied in their level of computer experience and number of self-reported physical limitations. Younger participants were acquaintances and older participants were recruited at a local Council on Aging lunch program. Participants were offered a \$5.00 gift certificate for a local grocery store as an incentive.

Figure 1: The Prototype's Main Menu

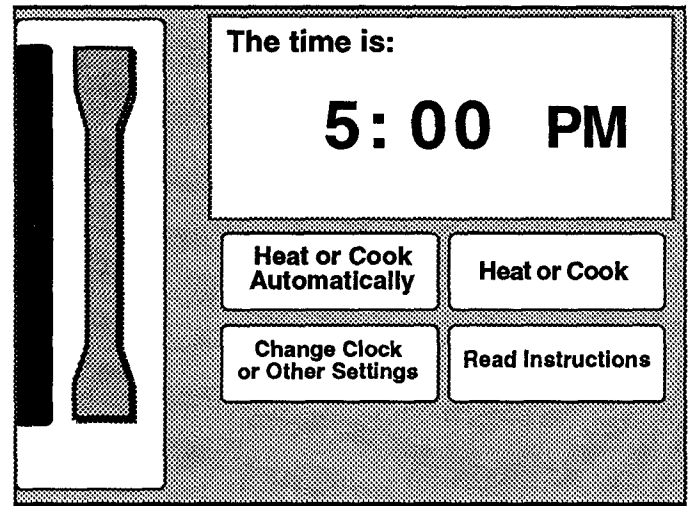


Table 1: Participant Demographics

Part. #	Sex	Age	Computer Exper.	Limitations
1	M	31	Novice	None
2	M	35	Intermed.	None
3	F	23	Expert	None
4	M	33	Intermed.	None
5	M	25	Intermed.	None
6	M	24	Expert	None
7	F	29	Intermed.	None
8	F	56	Novice	None
9	F	78	None	Vision, Hearing, Mobility
10	F	73	None	Vision
11	M	70	None	Vision, Hearing
12	F	60	Intermed.	Vision
13	M	74	None	Vision
14	M	72	None	Vision
15	F	68	Novice	None
16	M	64	Expert	Vision

There were three objectives for this usability test:

- to determine if the touch screen prototype design was easier for people to use than an existing microwave oven with similar functionality
- to determine if there was a difference in perceived usability between older and younger people
- to gather suggestions for improving the touch screen design.

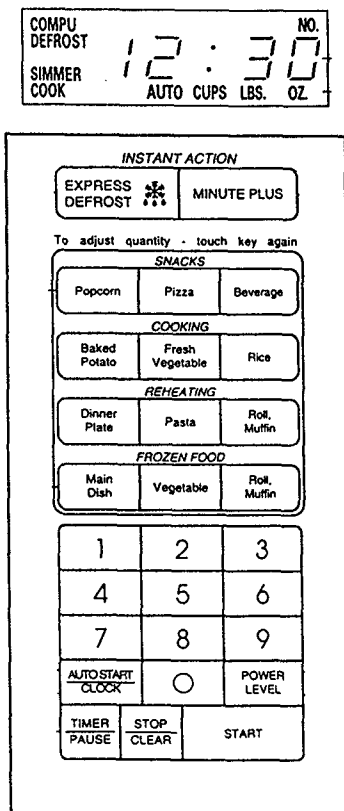
The touch screen prototype was evaluated against the Sharp Model #R-3A54. This microwave was chosen

because it was a mid-size model with functions comparable to those in the touch screen model. Figure 2 shows the Sharp's controls and display.

The Sharp microwave was set up next to the computer which ran the touch screen prototype. At the start of the test the basic features of each design, such as the location of controls and displays, were explained, but step-by-step instructions were not provided. Participants performed five timed tasks, using both the touch screen prototype and the Sharp microwave. The tasks were:

1. Set the clock to read the current time.
2. Heat a cup of water for 2 minutes at the highest setting.
3. Heat a pastry for 45 seconds at the lowest setting.
4. Thaw a pound of hamburger based on its weight. Let the oven choose the time and the power level.
5. Reheat a plate of leftovers. Let the oven choose the time and the power level.

Figure 2: The Sharp's Controls and Display



Because costs prohibited equipping the computer display with an actual touch screen, test participants touched the computer display with their fingers and the test administrator moved the mouse to click on the

buttons. This arrangement worked well; participants rarely noticed the cursor moving.

The order of presentation of the designs was varied. After each task, participants rated the usability of each design and made comments. Finally, participants completed a usability questionnaire and were interviewed about their experiences.

TEST RESULTS

Task Times

Only correctly completed tasks were included in the results; incorrectly completed and incomplete tasks were omitted. Often participants, particularly the older people, could not complete all the tasks. If participants were unable to complete a task in 5 minutes the task was considered incomplete, and the participants were instructed to give the task a rating and move on. The mean task times (in seconds) for all the participants are shown in Figure 3. People completed tasks faster with the touch screen model on 4 out of 5 tasks. When divided by age group (under 60 versus over 60), both groups' times were faster with the touch screen model for all tasks, but the older group's times varied more widely from task to task (see Figure 4). The variability within the older group may be due to the fact that many older participants were not able to complete tasks using the existing microwave, so the sample sizes for each task are small. Note that one in the older group was able to complete Task 3 with the existing microwave.

Usability Ratings

Participants of all ages rated the touch screen model easier to use on all five tasks. Figure 5 shows the mean usability ratings for each task. The overall mean ease of use rating for the touch screen model was 4.08, while the overall rating for the existing microwave was 3.28. When broken down by age group (see Figure 6), the group under 60 gave the touch screen model a mean rating of 4.35 and the existing microwave a mean rating of only 2.70. The group over 60 gave the touch screen model a lower mean rating than the group under 60 (3.79), but was almost identical to the younger group in their rating of the existing microwave (2.69).

Figure 3: Task Times for All Participants

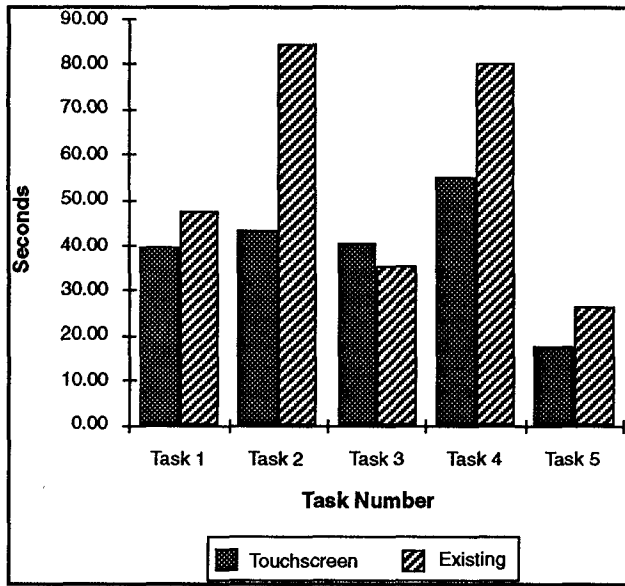


Figure 5: Usability Ratings by Task

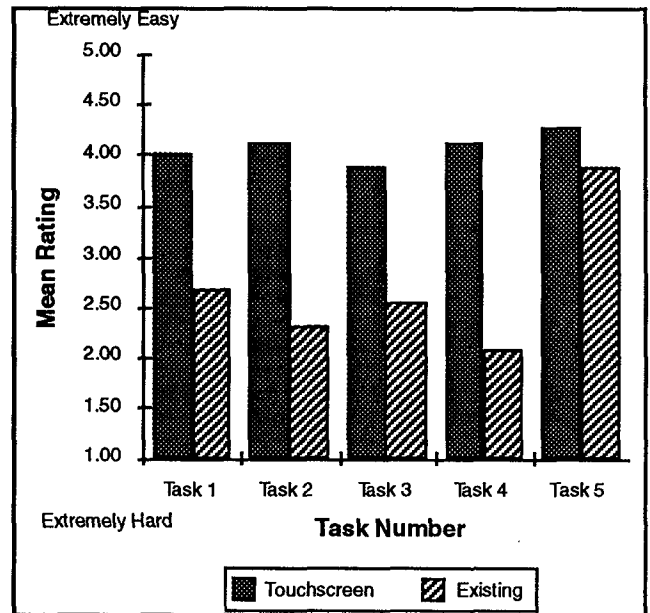


Figure 4: Task Times for Participants Over 60

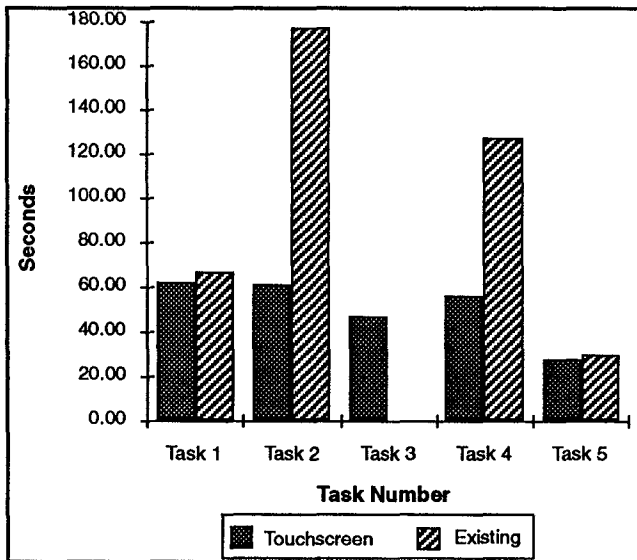
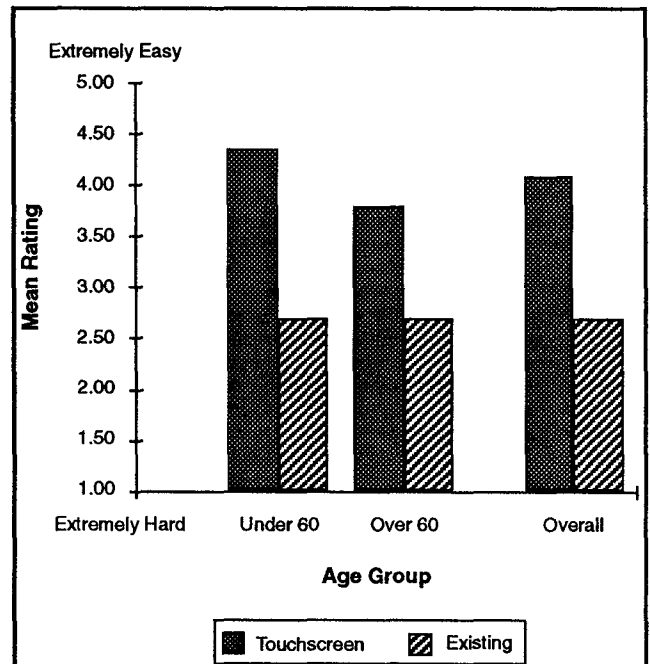


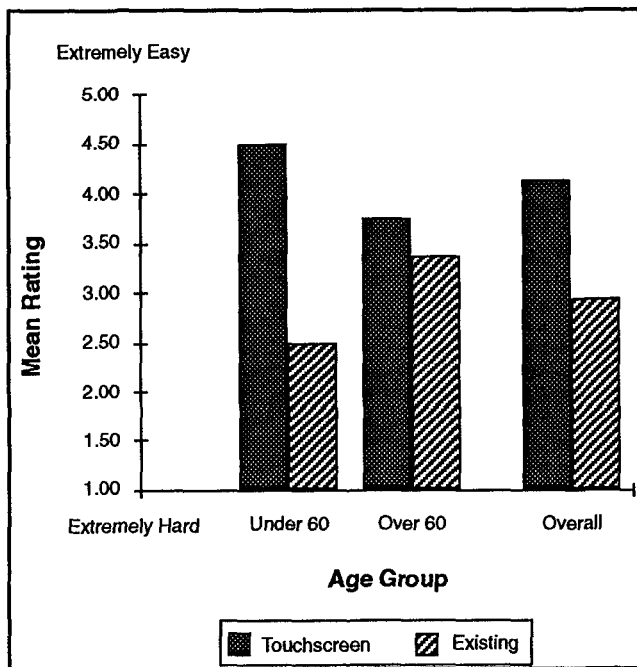
Figure 6: Usability Ratings by Age Group



Ease of Learning Ratings

Participants rated the computer model as easier to learn than the existing microwave. Figure 7 shows the mean ease of learning ratings for the two designs. It is interesting that the younger participants felt there was a substantial difference in the ease of learning between the two, while the older group perceived less of a difference.

Figure 7: Ease of Learning Ratings by Age Group



THE REVISED DESIGN

People reported that the touch screen interface was simpler to use and easier to read, and they preferred the limited number of choices at the top level. Comments included "It tells you what to do," and "I just needed to push on the screen to start to operate. It's especially good for elders." As with any iterative design, however, the touch screen model could be improved. Some design improvements would include:

- Revising the main menu, replacing the 'Read Instructions' button with the '1 Minute on High' button, which had been on a lower level menu.
- Change the button labels from "Heat or Cook" to "Heat" and the "Heat or Cook Automatically" to "Defrost or Reheat," since people did not perceive a difference between "Heat" and "Cook," and were looking for a "Defrost" option.
- Reduce button presses where possible.

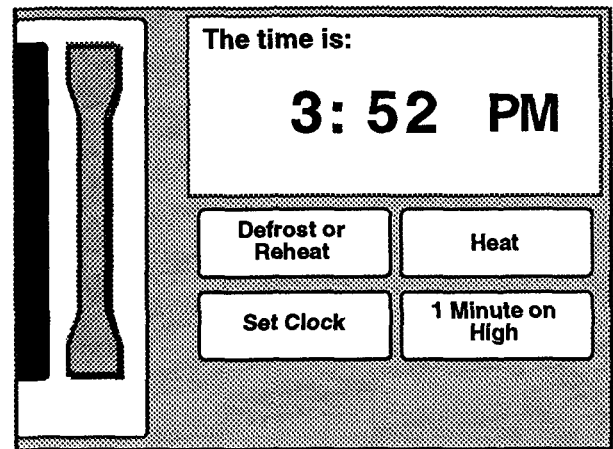
The main menu of the final design is shown in Figure 8.

CONCLUSIONS

Older consumers traditionally have been left out of the product design process, but in this study they were an integral part of it. Design requirements were developed based on research into the needs of older consumers, and these requirements pointed to a touch screen interface to solve many of the usability shortcomings of existing products. The result was a microwave oven

design that users of all ages, and particularly those over 60, found easier to learn and use than an existing oven.

Figure 8: Final Touch Screen Prototype's Main Menu



Recommendations for Further Work

The final design should be tested with younger and older people to ensure it is usable for consumers of all ages. The test should use an actual touch screen installed on an actual microwave oven (rather than a computer model) to eliminate the bias that the presence of a computer can introduce. The final design should also include auditory feedback not present in the design tested here, and should be tested with its documentation, since the documentation is an important part of any product.

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