

# **Copier Redesign**

Carnegie Mellon University  
05-413: Human Factors  
Anthony Zhang

# [introduction]

Generally, machines are made to make tasks easier. However, a lot of them have gotten hard to manage. A blatant example of this can be seen in the copier. For the most part, copiers are easy to work. Just by pressing a few buttons, you can tell the machine to copy papers or book pages in a number of different ways. Despite this, many people get confused with any task more complicated than making one copy of a single-sided paper. The interfaces on copier machines are generally excessively complicated and very hard to understand.

As a student at Carnegie Mellon, I have decided to concentrate specifically on redesigning the copiers found at Hunt Library (Canon ImageRunner 3305). These copiers have a number of usability issues and from user testing, it has become obvious that first-time users rarely succeed on accomplishing their desired goal. For the analysis as well as the redesign, I decided to focus on the tasks that I considered to be the most important. Although these tasks are arguably the simplest, none of the users tested were able to accomplish them successfully.

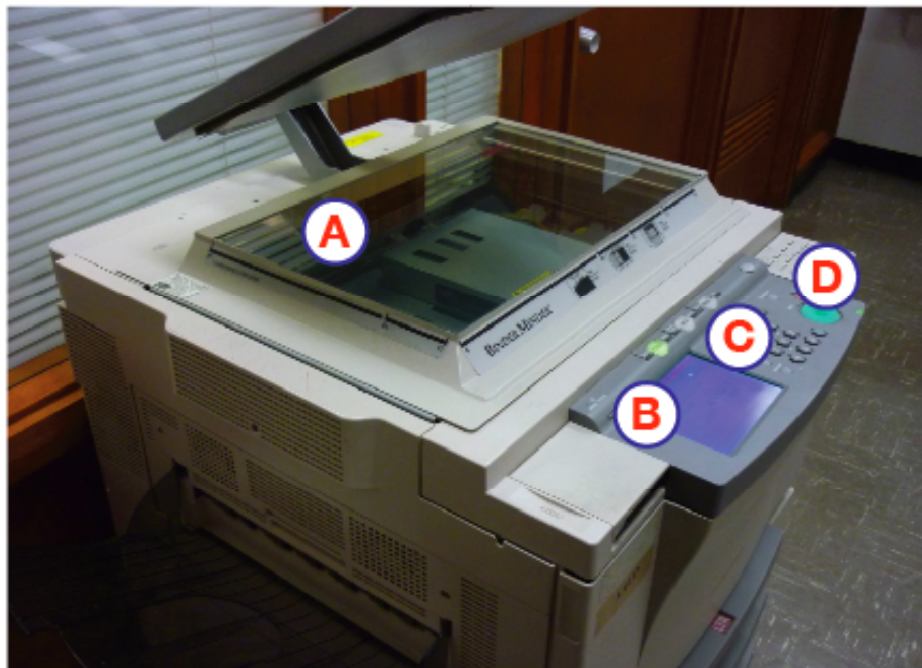
- Copying single-sided sheets into double-sided sheets.
- Printing multiple copies
- Changing the zoom of the copy

# [task analysis]

In order to test for the above three tasks, I picked out a random book found in Hunt and instructed users to, “Print pages 120-121 on one side of a page and pages 122-123 on the other side of that page. Print two copies of this at 90% zoom”. These instructions explicitly dealt with all three of the above functions. Below is the correct list of steps to complete the task.

## Copier

Figure 1



- A** Scanner Screen
- B** (Touch) Screen
- C** Keypad
- D** 'Start' Button

1. Insert coins into copy machine.
2. Place book (pages 120-121) along the left edge of the scanner screen (Figure 1, A) so that the book is sideways and both pages of the open book are touching the left edge.
3. Close the copier's cover.

## Main Menu Screen

Figure 2

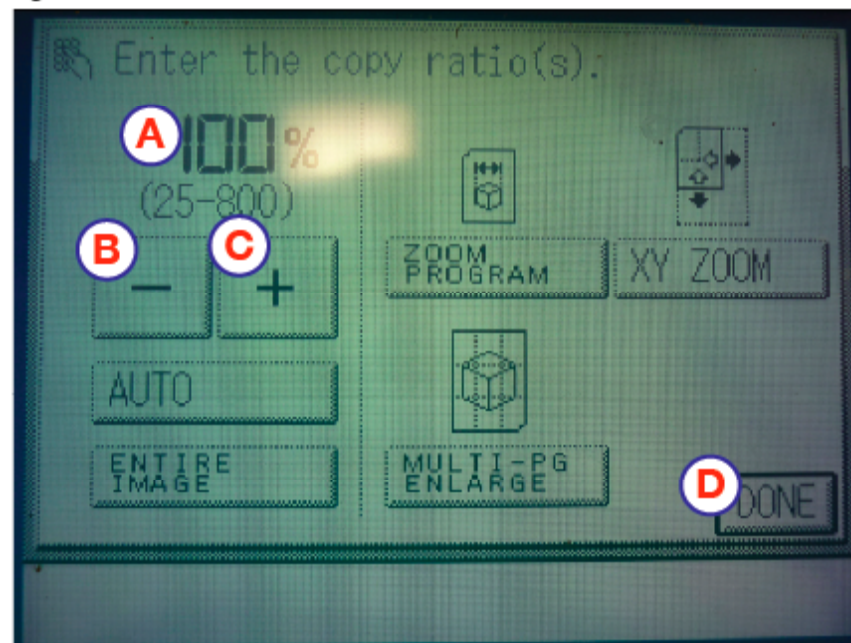


- A** Zoom Percentage Display
- B** Zoom Menu Button
- C** Number of Copies Display
- D** Two-Sided Menu Button
- E** Special Features Button

4. Hit the "2" button on the keypad to set the number of copies to 2.

## Zoom Menu

Figure 3

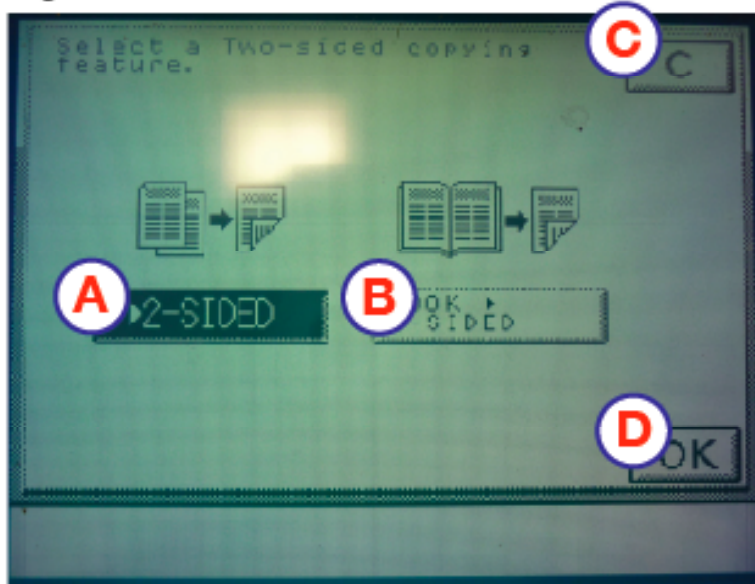


- A** Zoom Percentage
- B** Decreases Zoom
- C** Increases Zoom
- D** 'Done' Button (returns to main menu)

5. Hit the "ZOOM" button (Figure 3, B) on the Main Menu.
6. Option 1: Tap or hold the minus button until you reach 90% (figure 3: B).  
Option 2: Enter "90" on the keypad to the right.
7. Hit "DONE" (figure 3: D).
8. After returning to the main menu page, hit the "TWO-SIDED" button (figure 2: D).

# Two-Sided Menu

Figure 4



- A** Changes to 2-sided mode
- B** Splits the scan in half (one half per side).
- C** Clears option to 1-sided
- D** 'OK' Button (returns to main menu)

9. Select "1 → 2-Sided (figure 4: A).
10. Hit "OK" (figure 4: D).

# Keypad

Figure 5



- A** Numpad used to directly enter numbers.
- B** Clears any relevant options on current screen.
- C** Starts the copying process

11. Hit the green "Start" button on the keypad (figure 5: C).
12. Wait for it to scan (pages 120-121).
13. Open the cover and turn to pages 122-123, place book back on copier in the same way as before.
14. Hit "Start" again (figure 5: C).
15. Hit "Done".

# [predicted problems]

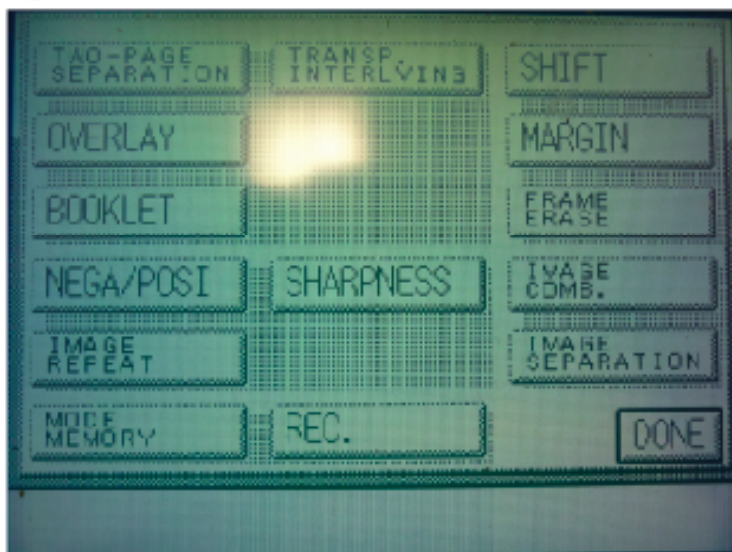
*Negative Transfer (WLLB 191):* Users will probably place the book in the incorrect orientation because they are used to placing books right side up (not sideways).

Because this is the orientation books are generally used and seen in, this will likely transfer over and cause users to try to copy the book in this same orientation.

*Consistency (Number of Copies):* Because all other settings are changed via the touch screen, users would think that *all* settings could be changed this way. However, setting the number of copies does not use the touch screen at all and is done purely through the keypad.

## Special Features Menu

Figure 6



*Option Fatigue / Information Overload:* There is so much information and so many options on each screen of the interface. This can especially get confusing if users do

not really know what they're looking for and wonder into the "special features" page (figure 6). The number of options there could really confuse a user and lead them to an incorrect action or just slow them down tremendously.

*Match between system and the real world* (Jakob Nielsen): A lot of the words, phrases and/or icons are simply unclear. For example, the main menu alone has six arguably unclear buttons that say "E", "R", "DIR", as well as three buttons under the brightness bar that just have icons on them (refer to figure 2). Other screens have many more unclear words and phrases (especially if you go into the special features). All of these things make understanding how the system works a difficult task and could easily confuse the user.

*Help and documentation / Error Prevention* (Jakob Nielsen): All of these confusing phrases could potentially be okay if there was an easily accessible page for help and documentation. For example, if a small help bubble could pop up next to each item (if you clicked a help icon or something) using the interface would be much easier. It would also decrease the chance of the user making an unintentional decision or action (error prevention).

# [user studies]

## **User Study #1:**

*Name:* Dan Ladenheim

*Age:* 20

*Gender:* Male

*Experience with Copiers:* None/minimal

*Setting:* Well-lit library, relatively quiet, no major distractions/pressure.

*Notes:*

- Hears beep when he inserts a coin to the machine.
- Does not know how much each copy costs.
- Puts book on copier in the wrong orientation.
- In the zoom selection screen, he taps the “-” button (figure 3: B) instead of holding it - inefficient.
  - He eventually just uses the keypad, after stating, “this is annoying”.
- To change the number of copies, he tries hitting the large “1” (figure 2: C), then realizes it does not do anything.
  - Afterward, he enters the number via keypad.
- In the two-sided selection screen, he selects “book → 2 sided” (figure 4: B) option instead of the correct option “1 sided → 2 sided” (figure 4: A).
  - When asked why he chose the wrong option, he said it was because it had the word ‘book’ in it and that was what the task had him dealing with.
- After finishing changing the settings, he tries to hit ‘start’ but the button is not sensitive enough to the touch and does not register.
  - He tries pressing it harder and it works.

## **User Study #2:**

*Name:* Kate Yan

*Age:* 20

*Gender:* Female

*Experience with Copiers:* Some experience via jobs and internships

*Setting:* Well-lit library, relatively quiet, no major distractions/pressure.

*Notes:*

- Puts book in copier in wrong orientation.
- “I’ll do the zoom part first, because that’s the easiest.”
- In the zoom selection screen, she taps the “-” button (figure 3: B) instead of holding it - inefficient.
- After finishing, user tries to find the double-sided option.
- Does not know what all the buttons on the main screen do.
  - Evidence: after observing the user click around, I asked, “what are you doing?” The user responds, “I don’t know what all these buttons do, I’m trying to find a menu button”

- “Special features...?” – user then clicks that option.
- After searching through the options in “Special Features”, the user finds an option called that has the phrase ‘double-sided’ in it and is relatively confident that is what you need to change. “I found it!”
  - I intervened at this point because I wanted to test the user on the two-sided selection screen.
- After pointing the user in the right direction, the user selects “book → two-sided”.
  - I asked her why she chose that option and she gave the same reasoning as Dan – “because we’re using a book”.
- Presses the ‘2’ key on the keypad to print two copies.
  - I was surprised she did that without hesitation so I asked her, “how’d you know to do that?” She responded saying that she learned from previous experiences and that she did not know how to do it the first time.
- User shows the same struggle to hit the ‘start’ button as Dan.

### **User Study #3:**

*Name:* Quinn Weismann

*Age:* 20

*Gender:* Male

*Experience with Copiers:* Minimal

*Setting:* Well-lit library, relatively quiet, no major distractions/pressure.

*Notes:*

- Puts book in copier in wrong orientation.
- In the zoom selection screen, user taps the “-” button (figure 3: B) instead of holding it - inefficient.
- After exiting the zoom selection screen, the user hits the “paper selection” button.
  - Because this action seemed random and confusing, I asked about it. The user says that he wanted to check if the paper size was correct.
- After returning to the main menu, the user hits the “text-only” button.
  - Once again, I ask why. The user responds with “I don’t know”.
- User then attempts to find the double-sided feature and wanders into the “special feature” options.
- User finds an option called “Two Page Separation” and thinks this is it.
- User returns to the main page and states “I don’t know what a lot of these options are, like... what’s ‘R’ and ‘E’?” (Referring to two buttons labeled with just an “R” and an “E”).
- User forgets that he has to make two copies. I remind him before he hits “start”.
- User cannot figure out how to make multiple copies.
  - Does not appear to recognize the large “1” in the main screen as a display for the number of copies.
  - “There’s nothing here to change that! Shouldn’t that be like the most important option on this screen?”

# [human factors]

*Affordance / Efficiency of Use:* All three users tapped the “-“ button ten times until they got to 90%. None of them realized that you could hold the button to go much faster. One user (Dan) realized that he could simply use the keypad to directly input the percentage zoom. Because there is no affordance on the button implying that it could be held to go faster and because most buttons (in the real world) do not have a second function if it is pressed (negative transfer), users don’t realize that this is an option.

*Discriminability:* If two signals are really similar, users become more likely to confuse the two of them. (WLLB 188) The copier has a few settings that deal with printing double-sided. The desired one can be found on the main screen and from the user tests, I noted that there are at least two other options in the “special features” menu that have the phrase “double-sided” in them. The desired action and these “special feature” options have similar names and the copier does not clearly highlight the difference between these three options. If the copier emphasized the difference or possibly explained the specifics behind each function, there would not be a problem. From the user studies, two out of three users chose the wrong “double-sided” option.

*Recognition vs. Recall* (Jakob Nielsen): The system should minimize the user’s memory load by making objects, options and purpose clear. As noted many times earlier, the copier interface does not do a good job in documenting its buttons and functions. However, a particularly strong example of this that I found in the user study was that it

did not label the number that represented the number of copies it was going to print (figure 2: C). The interface simply says “1”. One user (Quinn) could not find where the number of copies was being displayed / where that option could be changed. He had completely overlooked the “1” because it was not labeled at all. This is a huge problem because knowing how to change the number of copies is arguably the most important function of a copier.

*Framing / Expectancies:* One really obvious problem was in the two-sided selection screen. When confronted with choosing between “1 → 2-sided” and “book → 2-sided”, all three users chose the wrong selection, “book → 2-sided”. This is most likely because we were using a book in this task and once users saw the word “book”, they assumed and expected that this must be the desired option. The framing / wording of this option will probably confuse anyone that is trying to copy a book where they desire both pages of the open book to appear on one side of a piece of paper.

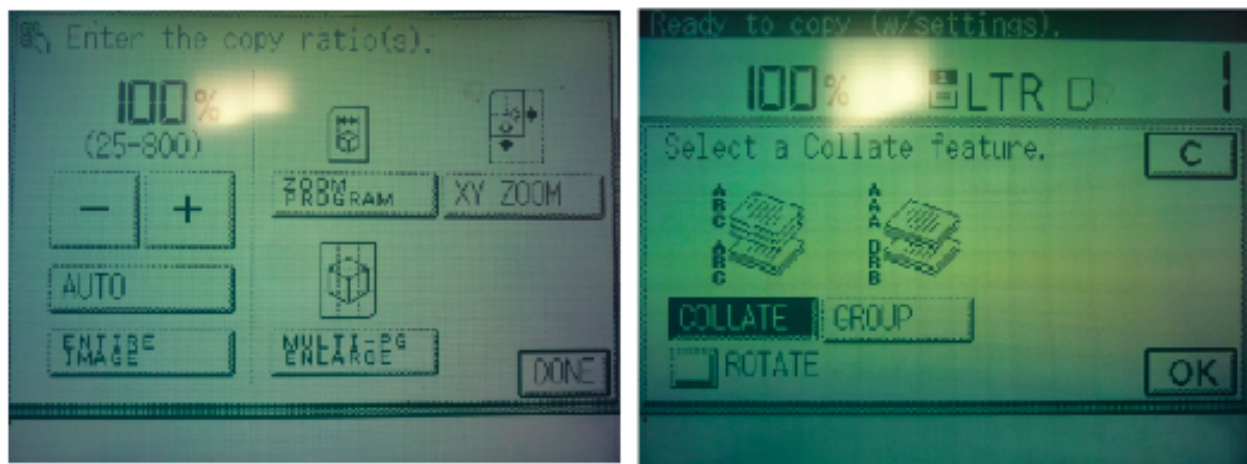
*Clutter / Visual Search (WLLB 190):* Many of the screens on the copier (especially the main screen) were very cluttered and had a lot of information on it. This made searching the screen for a desired button time-consuming and very hard to do. This can be seen in all three user studies. All three users showed signs of struggle when searching the screen and attempting to find the correct option to choose.

*Consistency (Between Screens):* Between different screens within the interface, similar pages would constantly be laid out differently. It was a very minor issue as it did not

cause any problems for any users but it is an important design factor to note. Had similar pages been shown similarly, perhaps users would be able to recognize right away what functions were meant for what pages. In figure 7, we see the zoom menu and the “collate” menu. Both are “setting screens” and yet they have no conformity in buttons, layout or information displayed.

## Screen Comparisons

Figure 7



All of the Human Factors principles that I listed prior to the user studies are also valid. Each principle listed above made an appearance in the user studies. Below is a recount of the human factor principles I predicted to see prior to the user studies and a tally of how many times they did appear.

*Negative Transfer (Book Orientation) – All 3 users*

*Consistency (Number of Copies) – 2 out of 3 users*

*Option Fatigue / Information Overload – 2 out of 3 users*

*Match between system and the real world – 2 out of 3 users*

*Help and documentation / Error Prevention – All 3 users*



# [redesign]

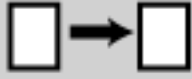
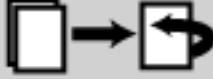


The primary goal of this design is to simplify the aesthetic and make it obvious as to how to go through the interface. I noted every major conflict and problem found in the previous design and I worked hard to address them all in the redesign. I wanted to make sure that any first time user can easily and successfully achieve their task. With this goal in mind, there were a few things I wanted to make certain.

<b>Current Settings:</b>	<b>Advanced Settings</b>
<b>Number of Copies: 1</b>	?
<b>Zoom: 100%</b>	?
<b>Brightness: 100%</b>	?
<b>Collate: No</b>	?
<b>Paper Tray: A</b>	?
<b>Duplex: 1 sided -&gt; 1 sided</b>	?
<b>Clear / Reset</b>	<b>confirm</b>

*Reduce Clutter and Information Overload:* One of the major problems with the previous design was that it was cluttered with information and rarely used options. This made it

hard for users to find the option they wanted. In order to avoid this, I made my design as simple and minimalistic as I could. However, in the process, I did cut out many of the less popular functions of the copier. Since my design is so simple and concise, the legibility of the display is great and clutter and information overload are reduced, allowing users to easily find what they are looking for and minimize the number of errors.

<b>Current Settings:</b>	<a href="#">Advanced Settings</a>
<b>Number of Copies: 1</b>	?
<b># of Copies:</b> <b>1</b>  	Edit number of copies using keypad or buttons
<b>Zoom: 100%</b>	?
<b>Brightness: 100%</b>	?
<b>Collate: No</b>	?
<b>Paper Tray: A</b>	?
<b>Duplex: 1 sided -&gt; 1 sided</b>	?
<a href="#">Clear / Reset</a>	<a href="#">confirm</a>

<b>Current Settings:</b>		Advanced Settings
<b>Number of Copies:</b> 1		?
<b>Zoom:</b> 100%		?
<b>Brightness:</b> 100%		?
<b>Collate:</b> No		?
<b>Paper Tray:</b> A		?
<b>Duplex:</b> 1 sided -> 1 sided		?
   	1 sided -> 1 sided              1 sided -> 2 sided              2 sided -> 1 sided              2 sided -> 2 sided	
<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
Clear / Reset		confirm

*Create a Uniform Look:* The copier's current design has a lot of issues with consistency. Many screens look different than others and this puts more weight on the user to remember how to work the interface. An interface should do the exact opposite. It should minimize the user's memory load by having a consistent and familiar screen each time. My redesign does just that. In order to change any setting, the user does the same action (click the corresponding bar) each time. When a user does this, all bars below the selected one slide down and the selected menu expands to allow the user to change the copier's settings. Every setting is changed this way and each time, only the expandable screen changes. By designing my interface in this way, consistency is very high. This in turn enforces positive transfer between each screen and serves to the

user's expectations as to how to operate the interface (WLLB 187). All of this makes it easier on the user and obvious as to how to work the machine.

*Situational/Status Awareness:* By using an accordion-style menu, I can show the user all of the six settings at once, regardless of where they are in the interface. This is a really strong aspect of the interface because it let's the user have complete control and knowledge of the settings. They know exactly how everything is set at any given time.

<b>Current Settings:</b>	<b>Advanced Settings</b>
<b>Number of Copies: 1</b>	?
The number entered into this field is the number of copies you will receive. Currently, you are getting 1 copy(s).	
<b>Zoom: 100%</b>	?
<b>Brightness: 100%</b>	?
<b>Collate: No</b>	?
<b>Paper Tray: A</b>	?
<b>Duplex: 1 sided -&gt; 1 sided</b>	?
<b>Clear / Reset</b>	<b>confirm</b>

*Help and Documentation / Error Prevention (Jakob Nielsen):* In my opinion, even the best of interfaces are useless if the user does not understand the jargon used by it.

Users should never feel lost or confused. They should always know where they are in the interface and be able to figure out what everything means. The current design of the copier has many unmarked buttons and others marked with arbitrary letters and acronyms. This leads to user confusion, delay and unintended actions. Although different terms could be used, I believe it is impossible to make sure that everyone understands every single term. That being said, I decided to implement a help page. Each setting on my copier will match with a corresponding help page. These pages can be reached by clicking the 'help' button (marked by the '?' button) on the corresponding row. By implementing this function, I do not have to worry about users not understanding my terminology; if users are lost or confused, they can get help.

# [conclusion]

Given the results from the user tests, it is obvious that copier machines have much room for improvement. Copiers are riddled with undocumented jargon, excess functionality and visual clutter. All of these factors inhibit users from succeeding in the simplest of tasks. My redesign of this interface alleviates a lot of the usability and human factors issues found through the user tests. By making a clean, simple and uniform design, users will become much more successful in finding what they are looking for and understanding how the machine works. Although there are a lot of useful machines and inventions, many are unintuitive and poorly designed. Hopefully, in the future, our knowledge of usability and human factors can improve machines like these so that we may take full advantage of what they have to offer us.

# [works cited]

Nielsen, J., and Molich, R. (1990). Heuristic evaluation of user interfaces, *Proc. ACM CHI'90 Conf.* (Seattle, WA, 1-5 April)

Wickens, Christopher D., Yili Liu, John D. Lee, and Sallie E. Gardon Becker. An Introduction to Human Factors Engineering. 2nd ed. Upper Saddle River, NJ: Pearson Education Inc., 2004. Print.