

Master Informatique - Université Paris-Sud
Fundamentals of Human-Computer Interaction
2015-2016 - Assignment #3 - answers

Modeling interaction: Color selection

The Keystroke model is used to compare the times to execute interactive tasks by decomposing them into actions called “operators”. In this exercise, we consider the following two operators:

<i>Name</i>	<i>Description</i>	<i>Time</i>
$P_{D,W}$	Point or drag-and-drop	Fitts' Law (see table)
K	Type a key or push a button	100ms

The time in milliseconds to reach a target of size W at distance D is given by the table below. D/W is the ratio of target distance to target size; MT is the movement time in milliseconds, computed as $MT = 100 + 150 \log_2(1 + D/W)$.

<i>D/W</i>	4	5	6	8	10	15	20	30	40	50
<i>MT</i>	450	490	520	580	620	700	760	840	900	950

For the rest of the exercise, when you describe an interaction, make sure to explain what each operator corresponds to and to specify the distance and width used for each P operator.

We consider an interface for editing drawings made of geometric shapes (circles, rectangles, etc.). A shape is selected by clicking within it. Multiple shapes can be selected by clicking the first one and shift-clicking the rest.

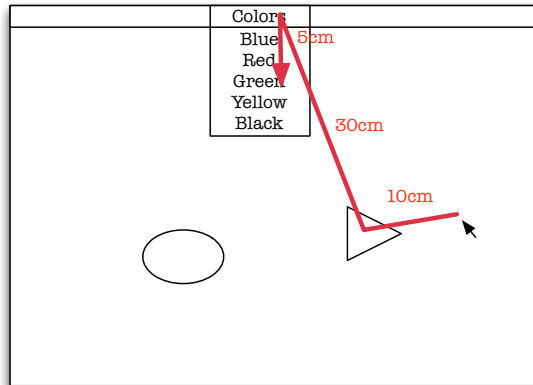
1. The following interactions are available to change the color of an object:
 - a) Select one or more shapes, then select a color in the Colors menu from the menu bar;
 - b) Right-click on a shape to display a contextual menu and select a color in the Colors sub-menu;
 - c) Select a color in the color palette on the left of the screen, then apply the color to one or more shapes by clicking on each shape.

The layout of the display is as follows:

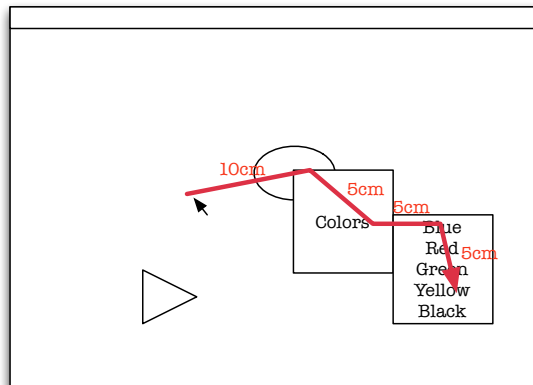
- The height of each menu item is 1cm, the width is 3cm;
- The height of a menu is 10cm on average and the target item is in the middle of the menu;
- The size of each color palette item is 1cm;
- The menu bar is 30cm away from the shapes;
- The color palette is 30cm away from the shapes;
- The shapes are 2cm wide on average, and are 10cm apart on average.

1a. The cursor is 10cm away from the closest shape and 30cm away from the menu bar and the color palette. Draw the content of the display and show the trajectory of the cursor for each of the above three techniques.

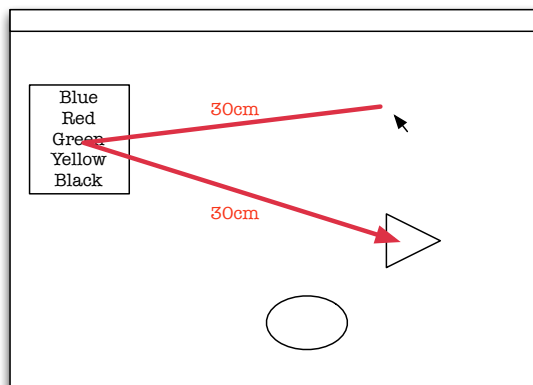
MenuBar



ContextMenu



Palette



1b. Calculate the time to change the color of one shape with each of the above techniques. Which technique is fastest?

Menu Bar:

Select a shape at 10cm: $P_{10,2} K_{click}$

Click menu bar at 30cm: $P_{30,5} K_{click}$

Click menu item at 5cm: $P_{5,1} K_{click}$

Total menu bar = 1800ms

Context Menu:
Select a shape at 10cm: $P_{10,2} K_{click}$
Select in submenu: $K_{click} P_{5,1} P_{5,1} P_{5,1} K_{click}$
Total context menu = 2260ms

Fixed Palette:
Select tool in palette at 30cm: $P_{30,1} K_{click}$
Click shape at 30cm to apply tool: $P_{30,2} K_{click}$
Total fixed palette = 1740ms

The fixed palette is faster, but close to the menubar.
The context menu is slower, which is counter-intuitive.
This is because of the submenu.

1c. Calculate the time to assign the same color to 5 shapes with each of the above techniques. Which technique is fastest? Compare with the results of 1b.

Menu Bar with 5 items SAME color
Select first shape at 10cm: $P_{10,2} K_{click}$
Hit the Control key: $K_{control}$
Select four more shape at 10cm: 4 times ($P_{10,2} K_{click}$)
Click menu bar item: $P_{30,5} K_{click} P_{5,1} K_{click}$
Total menu bar same color = 4260ms

Context Menu with 5 items SAME color
Select the shape and context menu item 5 times:
Select shape: $P_{10,2} K_{click}$
Select context menu: $K_{click} P_{5,1} P_{5,1} P_{5,1} K_{click}$
Total context menu same color = 11300ms

Fixed Palette with 5 items SAME color
Select tool in palette at 30cm: $P_{30,1} K_{click}$
Click first shape at 30 cm to apply tool: $P_{30,2} K_{click}$
Click four other shapes at 10cm: 4 times ($P_{10,2} K_{click}$)
Total fixed palette same color = 4200ms

Here again, the fixed palette wins, and is very close to the menu bar. The context menu is very slow due to the need to apply it separately to each shape.

1d. Calculate the time to assign a different color to 5 shapes with each of the above techniques. Which technique is fastest? Compare with the results of 1c.

Menu Bar with 5 items DIFFERENT color
Select the first shape at 10cm: $P_{10,2} K_{click}$
Select the menu bar item: $P_{30,5} K_{click} P_{5,1} K_{click}$
For each of the other 4 shapes:
Select shape at 30cm: $P_{30,5} K_{click}$
Select menu item in menu par: $P_{30,5} K_{click} P_{5,1} K_{click}$
Total menu bar different colors = 9840ms

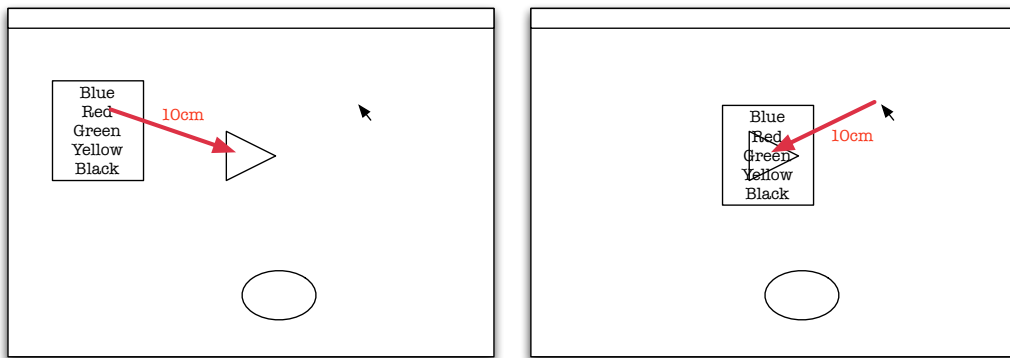
Context Menu with 5 items DIFFERENT color
5 times:
Select shape at 10cm: $P_{10,2} K_{click}$
Select context menu item: $K_{click} P_{5,1} P_{5,1} P_{5,1} K_{click}$
Total context menu different colors = 11300ms

Fixed Palette with 5 items DIFFERENT color
 5 times:
 Select color in palette at 30cm: $P_{30,1} K_{click}$
 Select shape at 30cm: $P_{30,2} K_{click}$
 Total fixed palette different colors = 8700ms

The fixed palette still wins. The menu bar is quite a bit slower. The context menu is still slowest because of the cost of selecting in the submenu, but the differences are smaller.

2. We want to create a color instrument that is efficient in all the above scenarios. First we use a toolglass, i.e. a semi-transparent floating palette manipulated with the non-dominant hand. The toolglass contains the color swatches. To apply a color to a shape, the user moves the toolglass over the shape with the non-dominant hand so that the desired color swatch is over the shape, then moves the cursor with the dominant hand over the color swatch to “click-through” it.

- 2a. Draw the interaction and specify any new hypothesis about the layout that you may need.



First, the user moves the toolglass (with his non-dominant hand) over the target object (left). We assume that the target object is 10cm away from the toolglass.

Second, the user moves the cursor over the toolglass and clicks through it on the target object (right). We assume that the cursor is 10cm away from the target object.

- 2b. Calculate the time to assign the same color to 5 shapes with this technique.

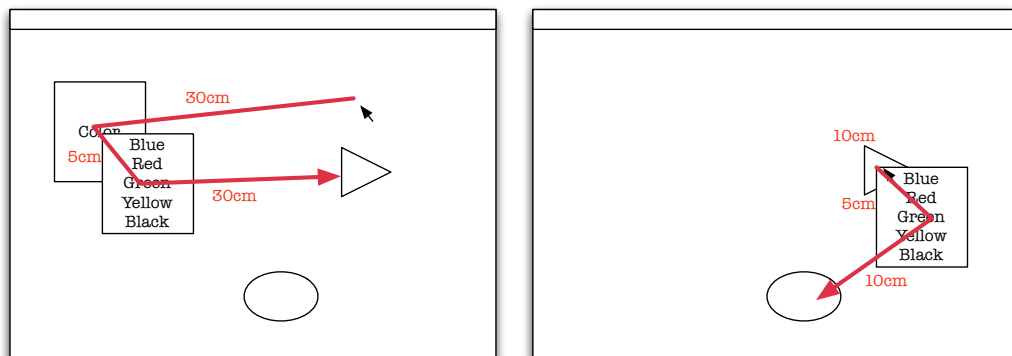
Toolglass with 5 items SAME color
 5 times:
 Move the toolglass over the shape: $P_{10,2} K_{click}$
 Move cursor to the toolglass and click: $P_{10,2} K_{click}$
 Total toolglass with same color = 5400ms

- 2c. Calculate the time to assign a different color to 5 shapes with this technique.

Toolglass with 5 items DIFFERENT color
 5 times:
 Move the toolglass over the shape: $P_{10,2} K_{click}$
 Move cursor to the toolglass and click: $P_{10,2} K_{click}$
 Total toolglass with different color = 5400ms

3. We create a second instrument to set the color. This instrument is located in the tool palette, and shows the last color that was used.
- To apply this color, simply select the tool and then click one or more shapes (as in method c).
 - To change the color used by the tool, right click while the tool is selected. This displays a palette of color swatches. Click a swatch to select that color. The palette disappears. Clicking outside the palette closes it without changing the color.

3a. Draw the interaction and specify any new hypothesis about the layout that you may need.



For the first shape (left), the user selects the color tool in the palette, changes the color, and selects the shape.

For the subsequent shapes (right), the user selects the new color in the context menu and then selects the target shape.

3b. Calculate the time to assign the same color to 5 shapes with this technique.

```
Color Palette with 5 items SAME color
Select color in palette at 30cm: P30,1 Kclick
Apply to first shape: P30,2 Kclick
Apply to other 4 shapes at 10cm: 4 times (P10,2 Kclick)
Total color palette same color = 4200ms
```

3c. Calculate the time to assign a different color to 5 shapes with this technique.

```
Color Palette with 5 items DIFFERENT color
Select color in palette at 30cm: P30,1 Kclick
Select first shape at 30cm : P30,2 Kclick
4 times:
Select the color for the next shape: Kclick P4,1
Select the shape at 10cm: P10,2 Kclick
Total color palette different color = 6850ms
```

4. Compare the results from questions 1, 2 and 3. What do you conclude?

This table summarizes the results:

	MenuBar	CtxMenu	Palette	Toolglass	ColorPalette
Same Color	4260	11300	4200	5400	4200
Diff Color	9840	11300	8700	5400	6850

When applying the same color, several techniques are similar: Palette, ColorPalette, and MenuBar. Toolglass is fairly close, and ContextMenu is very slow.

For different colors, Toolglass is fastest. ColorPalette is close, and the two other techniques (MenuBar and Palette) are a lot slower.

This shows that the most efficient technique depends on the context, and justifies the fact that an interface provides different commands to achieve the same operation.

Note that ContextMenu is always slowest, even though it is often thought to be faster than other techniques. This is because in this example the colors are in a submenu, which is slow to reach. However this is representative of a common situation: to put all the commands applicable to an object in a context menu, it often needs to be broken down in submenus.

The conclusion here is that you need to do careful analysis of representative situations to assess which method is actually most efficient in each context.