10. Tap the **cut button** followed by tapping the **paste button**. This demonstrates a cut- 
paste situation.

11. Tap the **delete button**. The object is permanently deleted.

12. Tap the **grid toggle button**. Tap the **expand grid button**. Tap the **shrink grid button**. Notice that the grid size changes.

13. Select and move an object. Now tap the **snap to grid toggle button**. Move the object again. The object no longer stays on the grid automatically. I highly recommend keeping snap to grid enabled at all times. Shrink or expand the grid for finer control over objects.

14. Draw a line. Once the line is recognized, tap the **toggle arrow heads button** and draw another line. There will be an arrow at the end of the line. The versions of Picasso that are used in the experiments do not have the ability to toggle the arrow heads of a previously drawn line.

15. Tap the **toggle automatic labeling button**. Draw a rectangle and notice that the text label dialog box appears. Using Graffiti, write “LABEL” and then tap the “OK” button in the text label dialog box. While automatic labeling is enabled, every drawn shape prompts for a label.

16. There are two modes to the editor. One is shape mode and one is text mode. Text mode was used when you were learning Graffiti earlier. Tap the **text mode button** to switch to text mode.

17. Tap anywhere on the screen and notice that the cursor appears there. Using Graffiti, write “WORD”.

18. Tap on the text and notice that you can select and move it. You can resize the text, but don’t do it since it causes problems and currently serves no purpose. In this version of the editor, you can’t go back and edit the text in a text object. Once you tap in the
drawing window, the text object can't be altered. Also, don't label text objects. There would be two text strings displayed.

19. Go back to shape mode by tapping on the **shape mode button**. I recommend that you do all editing in shape mode since select all and deselect all taps are available only in this mode.

**B.3.5 Learning the Pen/Voice Version of Picasso**

1. Quickly read through the pen/voice modality instructions.

2. Draw a medium size rectangle somewhere on the screen.

3. Draw a medium size ellipse somewhere on the screen.

4. Say **"rectangle"**. Notice that the last drawn shape (the ellipse) now is a rectangle.

5. Say **"ellipse"**. Say **"triangle"**. Say **"diamond"**. The change shape commands are a quick way to fix rectangles, ellipses, triangles, and diamonds that were mis-recognized by the shape recognizer.

6. Select the two objects. Say **"group"**.

7. Tap outside of the objects for a deselect all. Tap inside one of the objects. Notice that both objects were selected as a group.

8. Say **"ungroup"** and then tap inside one of the objects. Notice that only the tapped object was deselected because of the ungroup.

9. Say **"copy"** followed by saying **"paste"** twice. This demonstrates a copy-paste situation.

10. Say **"cut"** followed saying **"paste"**. This demonstrates a cut-paste situation.
11. Say "delete". The object is permanently deleted.

12. Say "grid". Say "expand". Say "shrink". Notice that the grid size changes.

13. Select and move an object. Say "snap to grid". Move the object again. The object no longer stays on the grid automatically. I highly recommend keeping snap to grid enabled at all times. Shrink or expand the grid for finer control over objects.

14. Draw a line. Once the line is recognized, say "arrows" and draw another line. There will be an arrow at the end of the line. The versions of Picasso that are used in the experiments do not have the ability to toggle the arrow heads of a previously drawn line.

15. Say "object labeling". Draw a rectangle and notice that the text label dialog box appears. Say "LL" "AA" "BB" "EE" "LL" and then say "OK". While automatic labeling is enabled, every drawn shape prompts for a label.

16. There are two modes to the editor. One is shape mode and one is text mode. Text mode was used when you were learning Graffiti earlier. Say "text" to switch to text mode.

17. Tap anywhere on the screen and notice that the cursor appears there. Say "WW" "slash" "back" "OO" "RR" "DD". The slash and back demonstrates fixing an error.

18. Tap on the text and notice that you can select and move it. You can resize the text, but don’t do it since it causes problems and currently serves no purpose. In this version of the editor, you can’t go back and edit the text in a text object. Once you tap in the drawing window, the text object can’t be altered. Also, don’t label text objects. There would be two text strings displayed.

19. Go back to shape mode by saying "shape". I recommend that you do all editing in shape mode since select all and deselect all taps are available only in this mode.

20. Say "object labeling" to go back to non-automatic labeling.
21. Draw a line and say "select". The line, which is the most recently drawn shape, is selected. Say "deselect". The line is then deselected. Saying select after drawing a shape is a good way to do quick selection. Use deselect to undo the select.

22. Draw a line and say "label". The line, which is the most recently drawn shape, will prompt for a label. Saying label after drawing a shape is a good way to quickly label a new object when automatic labeling is not enabled. Say "cancel" to exit the label dialog box.

23. Say "microphone". The microphone will turn off, and you can speak without speech recognition occurring.
B.4 Editor Reference Sheets

B.4.1 Pen Modality Instructions

The following text describes the buttons on the button bar. (HIGHLIGHT) means that selection or enabling will highlight the button. Graffiti will be available for use in this modality. Picasso starts out in shape mode with all toggles off except for snap to grid.

- Delete selected objects.
- Cut selected objects.
- Copy selected objects.
- Paste objects.

- Group selected objects.
- Ungroup selected objects.

- Change last drawn shape to a rectangle.
- Change last drawn shape to an ellipse.
- Change last drawn shape to a triangle.
- Change last drawn shape to a diamond.

- Change to shape mode for shape recognition (HIGHLIGHT).
- Change to text mode for text entry (HIGHLIGHT).

- Toggles arrow heads on/off for future lines that are drawn (HIGHLIGHT).
- Toggles automatic labeling on/off for future shapes that are drawn (HIGHLIGHT).

- Toggles grid on/off (HIGHLIGHT).
- Toggles snap to grid on/off (HIGHLIGHT).
- Expands the size of the grid squares by a factor of 2.
- Shrinks the size of the grid squares by a factor of 2.
B.4.2 Pen/Voice Modality Instructions

The following text describes the words for voice recognition. Picasso starts out in shape mode with all toggles off except for snap-to-grid. The microphone defaults to off.

Delete - Delete selected objects.
Cut - Cut selected objects.
Copy - Copy selected objects.
Paste - Paste objects.

Select All - Selects all objects on the screen.
Deselect All - Deselects all objects on the screen.
Select - Selects the last drawn object.
Deselect - Deselects the last drawn object.

Label - Labels the last drawn object.
Object Labeling - Toggles automatic labeling on/off for future shapes that are drawn.

Shape - Change to shape mode for shape recognition.
Text - Change to text mode for text entry.

Rectangle - Change last drawn shape to a rectangle.
Ellipse - Change last drawn shape to an ellipse.
Triangle - Change last drawn shape to a triangle.
Diamond - Change last drawn shape to a diamond.

Arrows - Toggles arrow heads for future lines that are drawn on/off.

Grid - Toggles grid on/off.
Snap To Grid - Toggles snap to grid on/off
Expand - Expands the size of the grid squares by a factor of 2.
Shrink - Shrinks the size of the grid squares by a factor of 2.
**Group** - Group selected objects.

**Ungroup** - Ungroup selected objects.

**OK** - Activates the OK button during label entry.

**Cancel** - Activates the cancel button during label entry.

**AA to ZZ** - Enters the appropriate letter during text entry.

**0 to 9** - Enters the appropriate digit during text entry.

**Space** - Enters a space during text entry.

**Back** - Enters a backspace during text entry.

**Slash** - Enters a forward slash during text entry.

**Question** - Enters a question mark during text entry.

**Microphone** (Voice or button) - The button toggles the microphone on/off. The speech command can only turn the microphone off.

Note: Turn the microphone off before asking questions or making vocal comments.

**B.4.3 Graffiti Reference Card**

![Graffiti Reference Card]

**FIGURE B-1. Graffiti Reference Card**
B.5 Experiment Diagram Tasks

B.5.1 Petri Net Diagram

In this task, I am interested in the editing abilities of the graphics editor. Use copy and paste for the circles. Use copy and paste for the lines where convenient also. Use text mode, rather than text labels, to enter the text in this document. Also, keep the layout of close to the layout of the original petri net. I highly recommend shrinking the grid size before drawing the connecting lines with arrow heads.

FIGURE B-2. The Petri Net Diagram
B.5.2 State Diagram

In this task, I am interested in the editing abilities necessary to create a quality symmetric diagram with graphics editor. Try to make this diagram as aesthetically pleasing as possible. Since this diagram is mostly symmetric it is recommended that you use copy, paste, and groupings for designing a large part of the diagram. Use labels to enter the text in this document. Don't worry about the text placement of the 0s and 1s for the line labels. Remember to use the slash with the "0/1" labels. I highly recommend shrinking the grid size before drawing the connecting lines with arrow heads.

FIGURE B-3. The State Diagram
B.5.3 Flowchart Diagram

In this task, I am interested in the text entry abilities the graphics editor. Keep the heights of the shapes constant for the different shapes. Vary the widths of the shapes so that they fit the text and look aesthetically good in the diagram. Use labels to enter the text in this document. Don’t worry about the text placement of the YES and NO for the line labels.

FIGURE B-4. The Flowchart Diagram
B.5.4 Dataflow Diagram

In this task, I am interested in the overall speed of the graphics editor. Don’t worry about box size or location. Don’t worry about if arrows are not perfectly aligned with the boxes or are not perfectly straight. The original diagram is just a reference for the final result. “Fahrenheit” and “Celsius” need to be text objects. All other text are labels.

FIGURE B-5. The Dataflow Diagram
B.6 Questionnaire

Circle the appropriate response:

1. I have had [no, a little, some, a lot of, loads of] experience using graphical editors (such as PowerPoint, Freelance Graphics, Picasso, etc.) before this experiment.

2. I [have, have not] used one of Washington University’s Pen Lab’s graphical editors (such as Hyperflow or Picasso) before this experiment.


4. I [have, have not] used a pen computer before this experiment.

5. I [have, have not] used shape recognition before this experiment.

6. I [have, have not] used handwriting character recognition before this experiment.

7. I [have, have not] used speech recognition before this experiment.

8. I thought [the pen-only, the voice/pen, neither] editor was faster to use.

9. I thought [the pen-only, the voice/pen, neither] editor was more usable over the other.

10. I thought [the pen-only, the voice/pen, neither] editor was more user-friendly (comfortable to use) than the other.

11. I preferred [the pen-only, the voice/pen, neither] editor over the other.
Short answer questions (please write as much as you can):

12. Give reasons why you circled the editor preference you did in 11.

13. Write down anything you particularly liked or disliked about either editor.

14. What do you like/dislike about using speech recognition for graphical editing?

15. Do you think this experiment fairly compared pen vs. pen/voice editors and why?

16. Give any comments about the experiment, the user interfaces, or yourself that you think might be useful for analyzing your experiment results.
B.7 Subject Testing Sheets

Subject Pen Testing Sheet

Subject:

Pen Diagram 1:

Shape Recognition Error:

Handwriting Recognition Error:

Questions Asked:

Time to Draw Diagram:

Pen Diagram 2:

Shape Recognition Error:

Handwriting Recognition Error:

Questions Asked:

Time to Draw Diagram:

FIGURE B-6. Subject Pen Testing Sheet
Subject Pen/Voice Testing Sheet

Subject:

Pen/Voice Diagram 1:

Shape Recognition Error:

Speech Recognition Used:

Speech Recognition Mis-Recognition:

Speech Recognition Non-Recognition:

Questions Asked:

Time to Draw Diagram:

Pen/Voice Diagram 2:

Shape Recognition Error:

Speech Recognition Used:

Speech Recognition Mis-Recognition:

Speech Recognition Non-Recognition:

Questions Asked:

Time to Draw Diagram:

FIGURE B-7. Subject Pen/Voice Testing Sheet
B.8 Experiment Comments

B.8.1 User Interfaces

The subjects made many positive remarks about the speech recognition. A few subjects commented about liking their hands free and most subjects said that they like the speech commands. Subjects remarked positively about the ability to review the drawing while doing character entry or command entry. It helped them to concentrate on the drawing. A few subjects commented that speech seemed natural to use.

Subjects liked not having to search for an icon for editor actions. However, a couple of subjects felt that they needed to memorize the speech commands even though two sheets containing the complete list of commands were in front of them. A few subjects wanted to see the removed tool bar bitmaps to quickly see what commands were available.

There were some negative remarks about speech recognition also. One subject commented about getting very confused when using speech recognition. Several subjects wanted to talk while using speech recognition with the microphone on. One final negative comment about speech recognition was that speech made the subject thirsty.

Listed below are some general comments made by subjects about the experiment:

- Several subjects wanted to talk to the computer while using the pen-only editor just after finishing using the pen and voice editor.
- One subject said that his/her hand is not steady enough to use the pen accurately. The subject stated that a mouse, keyboard, and voice interface might have been preferable.
- One subject wanted an all speech recognition interface and several subjects wanted the pen and pen/voice editors to be combined.
- Two subjects wanted to put computer on a surface other than the desk.
- One subject commented that training real words didn’t seem tedious, but training characters and digits did.
- Many subjects did not like the fact that while using the pen, their hand covered part of the drawing window.
• Several subjects did not like the speech character recognition and several subject said they like liked Graffiti better. However, a few subjects did like the speech character recognition and commented that the speech text entry was faster.

B.8.2 Tools

Overall, performance of the two versions of Picasso was excellent. While many subjects did not master the interfaces presented to them, the subjects were able to draw all the diagrams in a reasonable amount of time. See Section 5.2 for some critical problems.

The pen caused problems for many subjects. About a third of the subjects had problems getting tapping gestures to recognize consistently. In addition, several subjects could not control the location of the pen accurately because they could not hold the pen steady. In order to compensate for this lack of control, one subject suggested that the ability to move objects through a discrete interface might be helpful.

The experiment subjects had a problem with the selection functionality of both versions of the editor was the selection functionality. Most of the subjects were used to editors that automatically deselect all objects every time a mouse button is pressed and don’t need to select an object explicitly before moving it. In addition, a few subjects wanted some method of selecting objects in a certain screen region. Many subjects could not become accustomed to the selection methodology in Picasso before the experiment trial was over. However, this problem should not have affected experiment results since both versions of the editor used the same method of selection.

An editor undo feature would have been beneficial to the experiment. One experiment task was destroyed from a delete command with all objects selected which couldn’t be reversed. Several subjects tried speaking the word “undo” in the pen/voice editor even though the command did not exist.

There are several features of the experimental Picasso editor that should be modified. The first problem feature is resizing. Right now the resize operation resizes all selected objects simultaneously. Not only does this functionality have minimal use, but since subjects tended to forget to deselect objects, this feature frustrated a number of subjects.
Grouping turned out to be difficult to use as implemented in the experimental editors. Groupings need to be copied over to the clipboard during copy and paste operations in future versions of the editor.

Grid snapping should not cause objects so snap in grid increments. Snapping should occur on the grid lines themselves. The current functionality of the grid snapping caused several subjects to turn off snap to grid for certain operations. The snap to grid toggle should not have been included in the editor. The diagrams drawn where subjects turned snap to grid off look far more inferior to those diagrams that used the feature continuously. There was also a bug in the editor where subjects could not turn off snap to grid in text mode as the toggle had no effect.

Subject 11 found a major flaw in the editor which caused the editor to crash. Shape changing after a cut and paste operation on the last drawn shape caused the problem. In addition, subject 11 found that shape changing also had a bug that caused labels to not be copied over to the new shape after a change. This was a major bug when automatic object labeling was turned on. In this situation, the editor would prompt for a label before recognizing a drawn shape. If the shape needed to be changed, the entered label would be lost. All subjects that went after subject 11 to only use shape changing immediately after drawing a shape.

There was also a bug in the editor where subjects were able to create small shapes that turned out to be impossible to select. These shapes appeared as lines, but the functionality of Picasso required the subjects to click inside the shapes. Some diagrams had some defects because of this. Defects caused by this problem only once when counting final diagram imperfections. Subjects were told to ignore these marks when they occurred.

A few subjects complained that they needed to write in the Graffiti window rather than at the location where the text was to appear. The subjects commented that it was time consuming to have to write a character and then look around to see if the character was recognized correctly. This functionality of Graffiti caused some increase in time for drawing pen-only diagrams.
Appendix C

Subject Diagrams

Appendix C contains the task diagrams drawn by each subject.
Subject 1

FIGURE C-1. Diagram Task 1 for Subject 1

FIGURE C-2. Diagram Task 2 for Subject 1
Subject 2

FIGURE C-5. Diagram Task 1 for Subject 2

FIGURE C-6. Diagram Task 2 for Subject 2
Subject 2

FIGURE C-7. Diagram Task 3 for Subject 2

FIGURE C-8. Diagram Task 4 for Subject 2
Subject 3

FIGURE C-9. Diagram Task 1 for Subject 3

FIGURE C-10. Diagram Task 2 for Subject 3
Subject 3

FIGURE C-11. Diagram Task 3 for Subject 3

FIGURE C-12. Diagram Task 4 for Subject 3
Subject 4

FIGURE C-13. Diagram Task 1 for Subject 4

FIGURE C-14. Diagram Task 2 for Subject 4
Subject 4

FIGURE C-15. Diagram Task 3 for Subject 4

FIGURE C-16. Diagram Task 4 for Subject 4
Subject 5

FIGURE C-17. Diagram Task 1 for Subject 5

FIGURE C-18. Diagram Task 2 for Subject 5
Subject 5

FIGURE C-19. Diagram Task 3 for Subject 5

FIGURE C-20. Diagram Task 4 for Subject 5
Subject 6

FIGURE C-21. Diagram Task 1 for Subject 6

FIGURE C-22. Diagram Task 2 for Subject 6
Subject 6

FIGURE C-23. Diagram Task 3 for Subject 6

FIGURE C-24. Diagram Task 4 for Subject 6
Subject 7

FIGURE C-25. Diagram Task 1 for Subject 7

FIGURE C-26. Diagram Task 2 for Subject 7
Subject 7

FIGURE C-27. Diagram Task 3 for Subject 7

FIGURE C-28. Diagram Task 4 for Subject 7
Subject 8

FIGURE C-29. Diagram Task 1 for Subject 8

FIGURE C-30. Diagram Task 2 for Subject 8
Subject 8

Diagram
Unavailable

FIGURE C-31. Diagram Task 3 for Subject 8

FIGURE C-32. Diagram Task 4 for Subject 8
Subject 9

FIGURE C-33. Diagram Task 1 for Subject 9

Diagram
Unavailable

FIGURE C-34. Diagram Task 2 for Subject 9
Subject 9

FIGURE C-35. Diagram Task 3 for Subject 9

FIGURE C-36. Diagram Task 4 for Subject 9
Subject 10

FIGURE C-37. Diagram Task 1 for Subject 10

FIGURE C-38. Diagram Task 2 for Subject 10
Subject 10

FIGURE C-39. Diagram Task 3 for Subject 10

FIGURE C-40. Diagram Task 4 for Subject 10
Subject 11

FIGURE C-41. Diagram Task 1 for Subject 11

FIGURE C-42. Diagram Task 2 for Subject 11
Subject 11

FIGURE C-43. Diagram Task 3 for Subject 11

FIGURE C-44. Diagram Task 4 for Subject 11
Subject 12

FIGURE C-45. Diagram Task 1 for Subject 12

FIGURE C-46. Diagram Task 2 for Subject 12
Subject 12

FIGURE C-47. Diagram Task 3 for Subject 12

FIGURE C-48. Diagram Task 4 for Subject 12
Subject 13

Diagram
Unavailable

FIGURE C-49. Diagram Task 1 for Subject 13

FIGURE C-50. Diagram Task 2 for Subject 13
Subject 13

FIGURE C-51. Diagram Task 3 for Subject 13

FIGURE C-52. Diagram Task 4 for Subject 13
References


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