CS4249 Assignment 1 Part 1

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# **Experiment Design**

1. **Define the research question**

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| 1.1: Start with a general question | *How does marking menu compare with radial menu in terms of performance?* |
| 1.2:Define the target population | *Computer users* |
| 1.3:Define task(s) | *Select items from menu with different menu depths.* |
| 1.4: Define measure(s) | *Speed, accuracy, number of attempts* |
| 1.5: Define other factor(s) | *Different menu depth, different computers, different familiarity of using computers, different input devices used (mouse vs touchpad)* |

1. **Determine variables**

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| 2.1: Techniques, Task Types, & Other Factors → Independent variables | *Independent variables:*   * *Technique (2 levels: Marking Menu, Radial Menu)* * *Menu depths (3 levels: 1,2,3)* * *Menu breadths (2 levels: 4, 8)* * *Input devices (2 levels: Mouse, Touchpad)* |
| 2.2: Measures → Dependent variables | *Dependent variables:*   * *Completion time (seconds)* * *Error rate (%)* * *Attempts (count number)* |
| 2.3: Everything else → Control/Random Variables | *Control variables:*   * *Same computer, same instruction*   *(same experiment time, same instruction)*   * *E.g. Time of day, device, same instruction, etc.*   *Random variables:*   * *Age, gender, occupation, background of using computers* * *E.g. Participants’ age, gender, occupation, etc.* |

1. **Arrange conditions**

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| 3.1: List all independent variables and their levels | * *Technique (2 levels Marking Menu, Radial Menu) → Fully counter-balanced* * *Menu Depth (3 levels: 1,2,3) →*   *No counter-balance, sequential, because there should be a learning effect if users go to depth 3 menu prior to other depth menus*   * *Menu Breadth (2 levels: 4,8) → Fully counter-balanced* * *Input Device (2 levels: mouse, touchpad) → Fully counter-balanced* |
| 3.2: Decide counter-balancing strategy for each variable |
| 3.3: Determine the minimum No. of participants | *2!\*1\*2!\*2! = 8* |
| 3.4: Arrange the overall design | *Refer to the overall design below this table* |
| 3.5: Determine detailed arrangement for each participant | *Refer to the detailed arrangement for each participant below this table.* |

1. **Decide trials**

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| 4.1: Estimate time for each trial (typically >= 3 trials per condition) | *Estimate time for each trial: 10 seconds*  *Number of trials for each condition: 3*  *Total number of trials: 3 trials/condition x 24 conditions = 72*  *Total time: 72 x 10 sec = 12 minutes* |
| 4.2: Decide number of trials so that the main experiment is within 45 minutes |
| 4.3: Combine trials with the condition arrangement |

1. **Set instruction and procedures**

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| --- | --- |
| 5.1: Recruit participants (determine target users and randomize) | *Minimum number of participants to recruit is 8. They will all have at least three years of experience in using a computer.* |
| 5.2: Consent form and pre-experiment questionnaire | *Refer to the additional document ‘Lin\_Jingchuan\_E0336117\_A1\_P2\_*  *Pre-Experiment\_Questionnaire’* |
| 5.3: Instructions | *Refer to the additional document ‘Lin\_Jingchuan\_E0336117\_A1\_P2\_*  *Experiment\_Instructions’* |
| 5.4: Practice trials | *Make sure people start with each technique with roughly the same experience. You may decide to include or not include any practice trials for one or more of your testing conditions. We leave this for you to decide.* |
| 5.5: Main experiment with breaks | *Ask participants to take breaks* |
| 5.6: Post-experiment questionnaire and interview | *Refer to the additional document ‘Lin\_Jingchuan\_E0336117\_A1\_P2\_*  *Post-Experiment\_Questionnaire’* |
| 5.7: Debriefing | *Answer any questions, thank the participants, etc.* |

# **Arrangements**

## 3.4 Overall Design Arrangement

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ordering | IV1: Technique | | IV2: Menu Depth | | | IV3: Menu Breadth | | IV4: Input Device | |
| 1 | Marking | Radial | 1 | 2 | 3 | 4 | 8 | Mouse | Touchpad |
| 2 | Marking | Radial | 1 | 2 | 3 | 8 | 4 | Mouse | Touchpad |
| 3 | Marking | Radial | 1 | 2 | 3 | 4 | 8 | Touchpad | Mouse |
| 4 | Marking | Radial | 1 | 2 | 3 | 8 | 4 | Touchpad | Mouse |
| 5 | Radial | Marking | 1 | 2 | 3 | 4 | 8 | Mouse | Touchpad |
| 6 | Radial | Marking | 1 | 2 | 3 | 8 | 4 | Mouse | Touchpad |
| 7 | Radial | Marking | 1 | 2 | 3 | 4 | 8 | Touchpad | Mouse |
| 8 | Radial | Marking | 1 | 2 | 3 | 8 | 4 | Touchpad | Mouse |

Total number of orderings: 2! x 1 x 2! x 2 = 8

## 3.5 Detailed Arrangement for each Participant

For ordering 1:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cond | Ordering | IV1: Technique | | IV2: Menu Depth | | | IV3: Menu Breadth | | IV4: Input Device | |
| 1 | 1 | Marking |  | 1 |  |  | 4 |  | Mouse |  |
| 2 | 1 | Marking |  |  | 2 |  | 4 |  | Mouse |  |
| 3 | 1 | Marking |  |  |  | 3 | 4 |  | Mouse |  |
| 4 | 1 | Marking |  | 1 |  |  |  | 8 | Mouse |  |
| 5 | 1 | Marking |  |  | 2 |  |  | 8 | Mouse |  |
| 6 | 1 | Marking |  |  |  | 3 |  | 8 | Mouse |  |
| 7 | 1 | Marking |  | 1 |  |  | 4 |  |  | Touchpad |
| 8 | 1 | Marking |  |  | 2 |  | 4 |  |  | Touchpad |
| 9 | 1 | Marking |  |  |  | 3 | 4 |  |  | Touchpad |
| 10 | 1 | Marking |  | 1 |  |  |  | 8 |  | Touchpad |
| 11 | 1 | Marking |  |  | 2 |  |  | 8 |  | Touchpad |
| 12 | 1 | Marking |  |  |  | 3 |  | 8 |  | Touchpad |
| 13 | 1 |  | Radial | 1 |  |  | 4 |  | Mouse |  |
| 14 | 1 |  | Radial |  | 2 |  | 4 |  | Mouse |  |
| 15 | 1 |  | Radial |  |  | 3 | 4 |  | Mouse |  |
| 16 | 1 |  | Radial | 1 |  |  |  | 8 | Mouse |  |
| 17 | 1 |  | Radial |  | 2 |  |  | 8 | Mouse |  |
| 18 | 1 |  | Radial |  |  | 3 |  | 8 | Mouse |  |
| 19 | 1 |  | Radial | 1 |  |  | 4 |  |  | Touchpad |
| 20 | 1 |  | Radial |  | 2 |  | 4 |  |  | Touchpad |
| 21 | 1 |  | Radial |  |  | 3 | 4 |  |  | Touchpad |
| 22 | 1 |  | Radial | 1 |  |  |  | 8 |  | Touchpad |
| 23 | 1 |  | Radial |  | 2 |  |  | 8 |  | Touchpad |
| 24 | 1 |  | Radial |  |  | 3 |  | 8 |  | Touchpad |

Total number of conditions for each ordering: 2 x 3 x 2 x 2 = 24

For ordering 2:

(M,1,8,M), (M,2,8,M), (M,3,8,M), (M,1,4,M), (M,2,4,M), (M,3,4,M),

(M,1,8,T), (M,2,8,T), (M,3,8,T), (M,1,4,T), (M,2,4,T), (M,3,4,T),

(R,1,8,M), (R,2,8,M), (R,3,8,M), (R,1,4,M), (R,2,4,M), (R,3,4,M),

(R,1,8,T), (R,2,8,T), (R,3,8,T), (R,1,4,T), (R,2,4,T), (R,3,4,T).

For ordering 3:

(M,1,4,T), (M,2,4,T), (M,3,4,T), (M,1,8,T), (M,2,8,T), (M,3,8,T),

(M,1,4,M), (M,2,4,M), (M,3,4,M), (M,1,8,M), (M,2,8,M), (M,3,8,M),

(R,1,4,T), (R,2,4,T), (R,3,4,T), (R,1,8,T), (R,2,8,T), (R,3,8,T),

(R,1,4,M), (R,2,4,M), (R,3,4,M), (R,1,8,M), (R,2,8,M), (R,3,8,M).

For ordering 4:

(M,1,8,T), (M,2,8,T), (M,3,8,T), (M,1,4,T), (M,2,4,T), (M,3,4,T),

(M,1,8,M), (M,2,8,M), (M,3,8,M), (M,1,4,M), (M,2,4,M), (M,3,4,M),

(R,1,8,T), (R,2,8,T), (R,3,8,T), (R,1,4,T), (R,2,4,T), (R,3,4,T),

(R,1,8,M), (R,2,8,M), (R,3,8,M), (R,1,4,M), (R,2,4,M), (R,3,4,M).

For ordering 5:

(R,1,4,M), (R,2,4,M), (R,3,4,M), (R,1,8,M), (R,2,8,M), (R,3,8,M),

(R,1,4,T), (R,2,4,T), (R,3,4,T), (R,1,8,T), (R,2,8,T), (R,3,8,T),

(M,1,4,M), (M,2,4,M), (M,3,4,M), (M,1,8,M), (M,2,8,M), (M,3,8,M),

(M,1,4,T), (M,2,4,T), (M,3,4,T), (M,1,8,T), (M,2,8,T), (M,3,8,T).

For ordering 6:

(R,1,8,M), (R,2,8,M), (R,3,8,M), (R,1,4,M), (R,2,4,M), (R,3,4,M),

(R,1,8,T), (R,2,8,T), (R,3,8,T), (R,1,4,T), (R,2,4,T), (R,3,4,T),

(M,1,8,M), (M,2,8,M), (M,3,8,M), (M,1,4,M), (M,2,4,M), (M,3,4,M),

(M,1,8,T), (M,2,8,T), (M,3,8,T), (M,1,4,T), (M,2,4,T), (M,3,4,T).

For ordering 7:

(R,1,4,T), (R,2,4,T), (R,3,4,T), (R,1,8,T), (R,2,8,T), (R,3,8,T),

(R,1,4,M), (R,2,4,M), (R,3,4,M), (R,1,8,M), (R,2,8,M), (R,3,8,M),

(M,1,4,T), (M,2,4,T), (M,3,4,T), (M,1,8,T), (M,2,8,T), (M,3,8,T),

(M,1,4,M), (M,2,4,M), (M,3,4,M), (M,1,8,M), (M,2,8,M), (M,3,8,M).

For ordering 8:

(R,1,8,T), (R,2,8,T), (R,3,8,T), (R,1,4,T), (R,2,4,T), (R,3,4,T),

(R,1,8,M), (R,2,8,M), (R,3,8,M), (R,1,4,M), (R,2,4,M), (R,3,4,M),

(M,1,8,T), (M,2,8,T), (M,3,8,T), (M,1,4,T), (M,2,4,T), (M,3,4,T),

(M,1,8,M), (M,2,8,M), (M,3,8,M), (M,1,4,M), (M,2,4,M), (M,3,4,M).

The notation rule is described below:

* 1st element: M = Marking Menu, R = Radial Menu;
* 2nd element: 1 = Menu Depth 1, 2 = Menu Depth 2, 3 = Menu Depth 3;
* 3rd element: 4 = Menu Breadth 4, 8 = Menu Breadth 8;
* 4th element: M = Mouse, T = Touchpad.

## 4.3 Combine Trials with the Condition Arrangement

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Cond | Ordering | IV1: Technique | | IV2: Menu Depth | | | IV3: Menu Breadth | | IV4: Input Device | | Trial |
| 1 | 1 | Marking |  | 1 |  |  | 4 |  | Mouse |  | 1 |
| 1 | 1 | Marking |  | 1 |  |  | 4 |  | Mouse |  | 2 |
| 1 | 1 | Marking |  | 1 |  |  | 4 |  | Mouse |  | 3 |
| 2 | 1 | Marking |  |  | 2 |  | 4 |  | Mouse |  | 1 |
| 2 | 1 | Marking |  |  | 2 |  | 4 |  | Mouse |  | 3 |
| 2 | 1 | Marking |  |  | 2 |  | 4 |  | Mouse |  | 2 |
| 3 | 1 | Marking |  |  |  | 3 | 4 |  | Mouse |  | 2 |
| 3 | 1 | Marking |  |  |  | 3 | 4 |  | Mouse |  | 1 |
| 3 | 1 | Marking |  |  |  | 3 | 4 |  | Mouse |  | 3 |
| 4 | 1 | Marking |  | 1 |  |  |  | 8 | Mouse |  | 2 |
| 4 | 1 | Marking |  | 1 |  |  |  | 8 | Mouse |  | 3 |
| 4 | 1 | Marking |  | 1 |  |  |  | 8 | Mouse |  | 1 |
| 5 | 1 | Marking |  |  | 2 |  |  | 8 | Mouse |  | 3 |
| 5 | 1 | Marking |  |  | 2 |  |  | 8 | Mouse |  | 1 |
| 5 | 1 | Marking |  |  | 2 |  |  | 8 | Mouse |  | 2 |
| 6 | 1 | Marking |  |  |  | 3 |  | 8 | Mouse |  | 3 |
| 6 | 1 | Marking |  |  |  | 3 |  | 8 | Mouse |  | 2 |
| 6 | 1 | Marking |  |  |  | 3 |  | 8 | Mouse |  | 1 |
| … |  |  |  |  |  |  |  |  |  |  |  |

Total number of trials for each participant: 3 trials/condition x 24 conditions = 72