CS6750 Homework 3

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1 QUESTION1

Let's consider the game *Mario Kart*, a popular racing game.

Slip: A slip in *Mario Kart* could occur when a player intends to use a power-up (like a mushroom for speed boost) but accidentally presses the drift button instead, causing the player to slide around a corner unintentionally. This kind of slip happens when the player knows what they want to do (use a power-up), but due to misaligned hand-eye coordination or button placement, presses the wrong button.

Reason for Slip: The slip might happen because the power-up and drift buttons are located close to each other on the controller. In the heat of the game, a player might panic or feel rushed, leading to pressing the wrong button.

Prevention: To prevent this slip, the interface could be adjusted by mapping the power-up button to a more distinct or easily reachable part of the controller, separating it from the drift button. Providing haptic feedback before using a power-up (e.g., a brief vibration) could also give players a moment to verify their intention.

Mistake: A mistake might happen when a new player, unfamiliar with the game mechanics, tries to use a power-up but doesn't know how to activate it. For instance, they may mistakenly try to use the analog stick or a non-designated button to activate a mushroom.

Reason for Mistake: This mistake could occur because the player isn’t familiar with the controller layout or the mechanics of using items, leading to confusion about which button triggers the action.

Prevention: To prevent this mistake, the game could include a brief tutorial that explicitly shows which buttons correspond to each action. Adding visual cues on the screen when a player picks up a power-up (such as a flashing icon over the correct button) could improve discoverability.

Challenge: One challenge in *Mario Kart* that is neither a slip nor a mistake is mastering the timing of drifting around corners to gain speed boosts. This requires skill and practice, as players must learn the precise moment to start and release the drift. This challenge adds depth to gameplay without causing errors.

2 QUESTION2

For this assignment, I'll refer to the paper titled "Sleep Duration and Cognitive Performance: Findings From the UK Biobank" published in the journal Sleep (2021).

You can access it through this publicly available link:

https://academic.oup.com/sleep/article/44/2/zsaa210/5902064.

Hypotheses: Null Hypothesis (H_0): There is no significant association between sleep duration and cognitive performance. Alternative Hypothesis (H_1): There is a significant association between sleep duration and cognitive performance, implying that cognitive performance is affected by how much sleep individuals get.

Dependent and Independent Variables: Independent Variable: Sleep duration (measured in hours). This is a ratio variable since it has a true zero point (e.g., zero hours of sleep) and equal intervals. Dependent Variable: Cognitive performance (measured via cognitive tests, such as memory recall). Cognitive performance is treated as a ratio variable, as the performance scores are quantifiable with meaningful differences between values and a true zero score is possible.

Statistical Test Used: The paper uses an Analysis of Variance (ANOVA) to examine the relationship between sleep duration and cognitive performance. The researchers were looking for differences in cognitive performance scores across various sleep duration groups (e.g., individuals who sleep 4–6 hours, 6–8 hours, etc.).

Plain Language Explanation: ANOVA was used to test whether the average cognitive performance differs significantly across different sleep duration categories. The goal was to determine if sleep duration had a significant impact on cognitive performance scores. The researchers found that cognitive performance was indeed associated with sleep duration, with both short and long sleep durations linked to poorer performance compared to moderate sleep durations (7-8 hours).

Appropriateness of Statistical Test: ANOVA is appropriate for this study for several reasons:

Independent Groups: The study compares cognitive performance across different sleep duration groups, which are independent from each other.

Normally Distributed Data: ANOVA assumes that the dependent variable (cognitive performance) is normally distributed within each group.

Equal Variances: ANOVA also requires homogeneity of variance, meaning the spread of cognitive performance scores should be roughly the same across sleep groups.

The study appears to meet these conditions. Sleep duration groups are independent, and the authors report steps taken to ensure that the assumptions of normality and equal variances were met (e.g., through pre-analysis checks). Therefore, the use of ANOVA was appropriate in analyzing whether sleep duration impacts cognitive performance.

3 QUESTION3

Good Representation: Google Maps

Google Maps is an interface that uses a well-designed representation of its underlying content—geographical locations and navigation information. The map interface directly reflects real-world locations, with roads, landmarks, and buildings accurately placed and labeled. The connections between the representation and the underlying content are clear: a user can see exactly where they are on the map, search for a destination, and follow a route that corresponds to actual roads and paths.

This representation meets two key criteria for good design:

Clarity: The interface visually simplifies complex geographic information without losing key details. Roads, landmarks, traffic, and transit options are all presented in a way that makes them easy to interpret.

Affordance: The interactive nature of the map allows users to zoom in/out, drag, and click on elements to reveal additional information. The design makes it intuitive to explore areas and find destinations without overwhelming the user.

Poor Representation: Home Thermostat (Old Dial-Type)

Old-style dial thermostats, which require manual setting of the temperature by rotating a dial, often suffer from a poor representation of the underlying concept—temperature regulation. The physical dial represents the desired temperature, but it provides little feedback or clarity on how that temperature correlates to the actual system's functioning (e.g., heating or cooling delays).

This violates two criteria:

Visibility of system status: There is no clear feedback on whether the system is actively heating or cooling, or how close the current temperature is to the set temperature.

Discoverability: The user is left uncertain about how rotating the dial will impact the system immediately or over time. A lack of visual cues means users might set the temperature incorrectly, thinking the system will respond more quickly than it actually can.

These issues make it difficult for users to control the system efficiently.

4 QUESTION4

Cognitive Task Analysis of Duo Two-Factor Authentication (TFA) Process

Step 1: Navigate to login page

Knowledge required: The user needs to know the correct URL (e.g., mail.gatech.edu) and how to navigate to the login page using a browser.

Source of knowledge: General knowledge of how to use the web and find specific URLs, usually acquired from prior experience.

Step 2: Enter Georgia Tech credentials (username and password)

Knowledge required: The user must know their Georgia Tech username and password.

Source of knowledge: This information is either memorized or stored in a password manager. The interface provides text boxes and labels indicating where to input credentials.

Step 3: Initiate Duo Two-Factor Authentication

Knowledge required: The user must understand that Duo TFA is required to complete the login. This comes from experience with the system.

Source of knowledge: The interface displays a prompt that explains the next step involves two-factor authentication.

Step 4: Open Duo Mobile App on the phone

Knowledge required: The user must know that they need to use the Duo Mobile app on their phone to retrieve the code.

Source of knowledge: This expectation is often learned from initial setup instructions for Duo or prior usage. The interface might show an alert that indicates the need for the Duo app.

Step 5: Retrieve authentication code from the Duo app

Knowledge required: The user must know how to open the Duo app and retrieve the specific 6-digit code generated for login.

Source of knowledge: The Duo Mobile app interface guides the user by showing the code associated with the Georgia Tech account.

Step 6: Enter the code into the web interface

Knowledge required: The user must copy the correct 6-digit code into the field provided on the login page.

Source of knowledge: The Duo app displays the code and the login interface provides a field for the user to enter it.

Step 7: Successfully log into the account

Knowledge required: The user should understand that after entering the code, they should gain access to their account.

Source of knowledge: The interface confirms successful login with a notification or redirect to the user's email inbox.

Lightweight Heuristic Evaluation of Duo TFA Process

Heuristic 1: Match between system and real world (Nielsen's heuristic)

Evaluation: The Duo TFA process follows this heuristic well. The system uses clear, real-world language such as "Enter the code" and provides familiar security concepts like using an app for two-factor authentication. The app's interface matches expectations for a simple code-based login system, which users are likely already familiar with from other apps.

Conclusion: The system adheres to this heuristic by using consistent, understandable language and recognizable actions, minimizing cognitive load.

Heuristic 2: Visibility of system status

Evaluation: The interface does a good job of showing system status throughout the process. For example, when entering the username and password, the system clearly prompts the user for the next step (the Duo authentication), and after entering the code, the system provides confirmation that login was successful by redirecting to the inbox or displaying a success message.

Conclusion: The system maintains good visibility of status, keeping users informed of progress and next steps throughout the login process.

Heuristic 3: Error prevention

Evaluation: The interface could improve in this area. When entering the 6-digit Duo code, there is no indication of whether the code is incorrect until after submission. A more user-friendly approach might be to provide immediate feedback if an invalid or incomplete code is entered (e.g., highlighting incomplete entries in red).

Conclusion: While the system prevents major errors by keeping the process sequential and structured, real-time feedback when entering the code could help prevent simple mistakes, such as entering an incorrect digit.