Usability of Predefined Trackpad and Mouse Gesture Sets

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Fig. 1. An individual using trackpad gestures.

Amidst the exploration of futuristic air gestures and touch-based controls, the humble trackpad and mouse remain ubiquitous input devices. Yet, their predefined gesture sets often remain in obscurity, underutilized, and misunderstood. This research delves into the usability of these pre-defined gestures, exploring user awareness, adoption, and factors influencing their effectiveness. Through a combination of in-depth interviews (n=8) and survey questionnaires (n=9), we investigated user knowledge and habits regarding trackpad and mouse gestures. We found that while users possess a basic awareness, primarily through accidental discovery, proactive exploration remains minimal. This highlights a crucial gap in discoverability and trust. Our findings reveal three critical areas for improving gesture usability - enhanced discoverability, building trust, and adapting to users. This research paves the way for future advancements in gesture-based interaction, ensuring that these overlooked functionalities no longer remain hidden in plain sight.

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1 INTRODUCTION

Gesture controls have become synonymous with futuristic technologies, often conjuring images of air gestures and touch-based interactions. However, amidst this technological landscape, the everyday trackpad and mouse offer a realm of predefined gestures that remain underexplored. This research delves into the usability of trackpads and mouse gestures, shedding light on user intuition and the practicality of current systems.

While gesture controls aim to streamline user actions, users can struggle when they switch the system they interact with as the design of gestures can be inconsistent between devices or when they switch from non-gesture interactions to gesture-based interactions. The absence of clear instructional systems compounds the issue, hindering users from fully utilizing available gestures. Our study evaluates the practicality of existing systems by comparison, aiming to uncover common themes across prevalent gestures for intuitive and discoverable design.

To understand how individuals engage with gesture controls, we conducted interviews with 8 participants, ensuring diverse representation for a comprehensive perspective. Our findings highlight common themes regarding user familiarity with these systems and the efficiency of gestures. Users often discover gestures accidentally, indicating a gap in proactive exploration. We extended the insights by publishing a survey on Prolific.

Our research not only contributes to the understanding of user experiences with trackpad and mouse gestures but also underscores the need for improved discoverability and practicality in gesture design. As we delve into our findings, we reveal key insights that can enhance the usability of these ubiquitous input devices, paving the way for more intuitive and efficient interactions.

2 RELATED WORK

Alternative input methods are often underused by users. One paper discusses a few reasons why keyboard hotkeys are underused, suggesting an anticipated "performance dip" when learning, a lack of awareness, and the challenge of mastering non-intuitive key mappings [2]. One study examined how differences in user effort affect user preference for gesture controls. They show that users prefer methods that require less physical effort, even when those differences are slight [6]. Another suggests that user-defined gesture sets are easier to learn and recall and that errors are mostly due to association and not form [9].

Prior studies with gesture control explored the creation of gestures for specific actions. Studies on text editing for mobile devices noted that gesture controls were perceived as faster and easier to use, requiring less effort [11] [5]. Other researchers have explored extensions to existing gesture technology; one such paper considered the detection of varying levels of pressure in gestures, and another looked at the possibility of foot-based gestures for when hands are occupied or unavailable [12] [1]. Exploration of other novel gestures includes back-of-device gestures, auditory or audiovisual cues for gestures, and tilt and point gesture controls [3] [7] [13]. Moyle et al. focuses on the implementation of forward and back gestures for browser control that were significantly faster than using the forward and back buttons [8]. Users were enthusiastic about the gesture controls suggesting that there is demand for gesture controls.

With regard to gesture elicitation studies, users tend to favor familiarity. When encouraged to create novel gestures, participants used variations on a single gesture or focused on familiar gestures [10]. Users can be moved beyond these legacy biases by being asked to produce more gestures, however this comes at the cost of gesture variety. Refinement of elicited gestures can also be a means of understanding what gestural features matter to users [4].

3 METHODS

The present study investigates the usability of predefined trackpad and mouse gesture sets, aiming to provide a nuanced understanding of user experiences, preferences, and challenges associated with these input methods. The need to get both qualitative and quantitative insights in order to conduct a thorough investigation of user viewpoints informed the choice of research methodologies. Informed consent was obtained from all the participants, and measures were implemented to maintain confidentiality and anonymity throughout the data collection and analysis phases.

Two distinct but complementary methods were employed in order to get these insights and understand holistically the research objectives: in-depth interviews and a crowdsourced survey.

3.1 Interviews

The use of interviews was deemed essential since it provided us with the nuanced viewpoints of users who may or may not be familiar with gestures but would have opinions on them. It also provided us with qualitative insights and a diverse viewpoint based on the responses received. Eight participants were selected with purpose, and it was ensured that the diversity of thought was maintained. All the participants had ages ranging from 18-30 and had different technological and professional backgrounds.

The interviews were semi-structured, and the questions were open-ended in order to maximize the information exploration. The major focus was participants' experiences, preferences, and challenges related to predefined trackpad and mouse gesture sets. In all these interviews, participants were invited to craft a gesture in response to a given action as a small exercise. The purpose of this activity was to identify impromptu motions made by users, offering a fresh viewpoint on how participants naturally interacted with the devices.

Each interview, conducted in a controlled environment, lasted approximately 30 minutes, allowing us for a focused and detailed discussion. The audio recordings were transcribed verbatim, and the thematic analysis was employed to identify recurring patterns and emergent themes. This approach made it easier to comprehend the cognitive and affective aspects of user interactions at a deeper level.

3.2 Survey

To capture a broader spectrum of user experiences and preferences and a broader audience, a crowdsourced survey was administered. The survey was available online on Prolific, an online research platform that enables the recruitment of participants for data collection. The survey aimed to reach a wide demographic range. The questionnaire encompassed a mix of Likert scale questions, multiple-choice items, and open-ended prompts, which enabled both quantitative and qualitative data collection.

The survey was designed in a way in which it prioritized anonymity to encourage candid responses, thus leading to a more inclusive representation of user sentiments. The open-ended questions brought in a richer set of data, which was beneficial in procuring diverse thoughts.

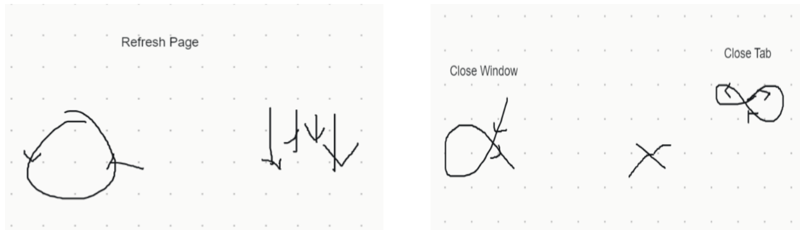

Fig. 2. An example of one of the participants' idea of a gesture in case of Refreshing a browser page*(left)* and Closing current window and tab*(right)*

The survey questions studied the following primary factors for gesture usability:

- **User Experience** - Delved into the users' emotional and cognitive dimensions of the participants' experience with the gestures.
- **Preference** - Investigated nuanced aspects of user preference, considering specific gesture sets, as well as providing the freedom to craft their own gesture to get a viewpoint and establish a pattern of the gesture friendliness, intuitiveness, and ease of use.
- **Challenges** - Carried out a thorough analysis of the difficulties that participants encountered, including both technological complexities and user-centered barriers while using predetermined movements.

4 RESULTS

4.1 Interviews

4.1.1 Learning and Awareness. Participants demonstrated varying levels of awareness regarding predefined gestures. Some drew inspiration from predefined gestures that have been popular and widely adopted in the mainstream, while others cited familiarity with gestures through applications used on a daily basis, be it on their mobile phones, laptops, or tablet devices.

One of the participants had a very positive outlook on the ease of usage of gestures, stating,

> *Even a tech-newbie, a modern caveman, would work with gestures with ease. They are so relatable and intuitive and 'real-worldly'*

4.1.2 User Defined Gestures Exercise. During the exercise, where participants crafted gestures for specific actions, a range of responses emerged. Some participants suggested intuitive, simple gestures that performed multiple functions, emphasizing efficiency. Others expressed challenges in devising gestures, highlighting the need for gestures to be both natural and capable of handling diverse tasks. Figure 2 shows one participant's responses to this exercise while figure 3 demonstrates that variability that arises between participants' concepts of what an intuitive gesture would look like for the task of closing a browser window. The results of this exercise demonstrate how a high variability in user preferences leads to a need for users to be able to define their own gestures for tasks.

Some of the usability insights shared by the participants were as follows: It is quick and easy to navigate on laptop touchpads; Gestures for central screen access and desktop navigation are perceived to be faster; familiarity with gestures on multiple devices makes it easy to adapt them across multiple devices and the consistency across adds to the usability and ease of pickup.

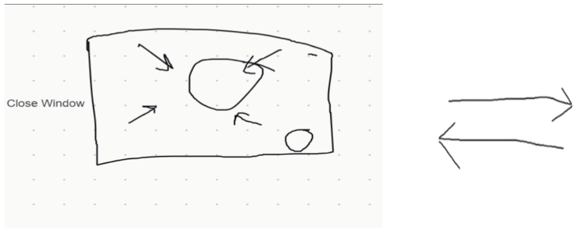

Fig. 3. An example of the idea of a gesture to close a browser window by two different participants

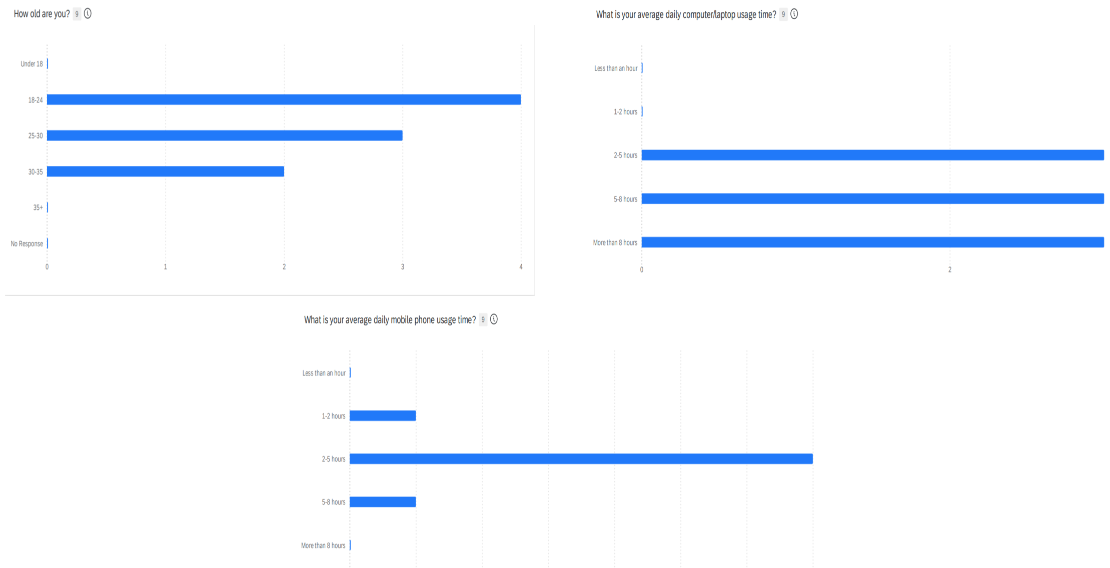

Fig. 4. The breakdown of the answers to the crowd-sourced survey questions - the age of the participant*(top-left)* and the daily usage of computers*(top-right)* and mobile phones*(bottom-middle)*

When asked about the challenges, the list of responses is as follows: The complexity of a task might influence gesture preference; for e.g., a programmer might use gestures at all, while a graphic designer might have a hard time performing without using gestures. This was supported by one of the participants stating - *"Depends on the task"*. People not used to the technology might be overwhelmed with gestures, and they might find using them complex.

4.2 Crowdsourced Survey

Nine people participated in the crowd-sourced survey, and the data was collected from this group. The demographic information for the participants can be seen in figure 4. Participants ranged in age from 18 to 35 years old. All participants interacted with their phones and laptops for a minimum of 2 hours per day. Information on the daily usage of these devices provides insights into how perceptions of gesture controls change with respect to the amount of device interaction time.

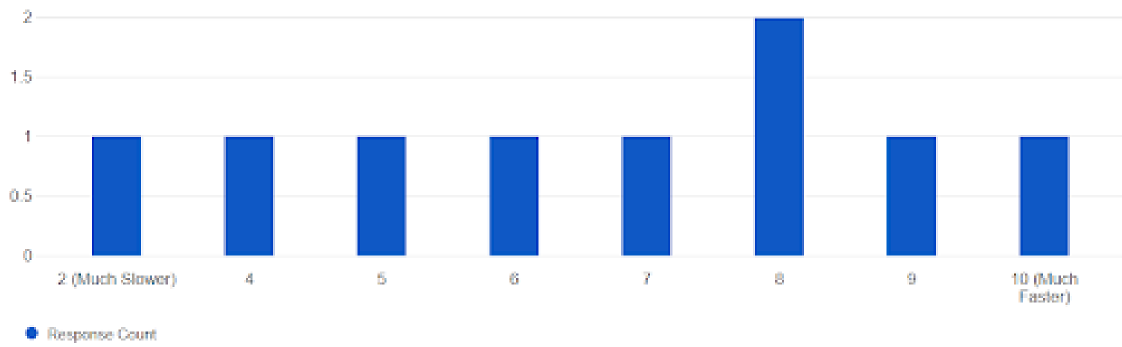

Fig. 5. Responses from the crowdsourced survey on the speed of gesture controls compared to traditional controls. We observe an almost uniform distribution with a small spike at 8 indicating that gesture controls may produce a slight increase in task completion speed.

Respondents to the survey shared information about how frequently they use gestures, where more than half of the participants used them frequently(5/9 or 55%) while almost a third of the participants(3/9 or 33%) never used them. Certain users discovered that gestures occasionally required more time than conventional controls. According to the survey, gestures were generally thought to be a little more user-friendly than conventional controls. One such response was

> *Using gestures on my laptop touchpad is more quick and easy than the mouse. Using two fingers to scroll while navigating, pinch to zoom instead of holding $ctrl$ and using the mouse wheel or in the case there isn't a mouse manually zooming on a page/picture. It's faster to go to the central screen through a gesture on a touchpad than to close manually each and all other windows. Easier and faster to comb between multiple Desktops with gestures on a laptop.*

Another participant said:

> *The use of them as shortcuts as a means of productability. More easy and quick to read articles about the use of them. Short video format from helpdesk promoting the use and benefit of them. Make me understand why sometimes is better/efficient to use them rather than clicking with the mouse*

While this wasn't the sentiment shared by the entire group. Some participants felt the use of gestures to be an overkill, and said that gestures take a lot of energy and skill to use, and also, the familiarity and comfort with the conventional means prevented them from picking up the use of gestures.

> *I don't need to, I have used my keyboard and mouse for so long I'm proficient in using them.*

> *Sometimes using gestures takes more time*

> *I find keyboard shortcuts much more intuitive and faster*

When asked to rate how fast gesture navigation is, compared to traditional methods (e.g., mouse or touchpad), on a scale of 1*(very slow)* to 10*(very fast)*, the responses received had a mean rating of 6.56 with a maximum of 10 and a minimum of 2.

Similarly, when asked about the ease of using gesture navigation compared to traditional methods (with 1 being *very difficult* and 10 being *very easy*), the response ratings had a mean of 6.11, with a maximum of 9 and minimum of 2.

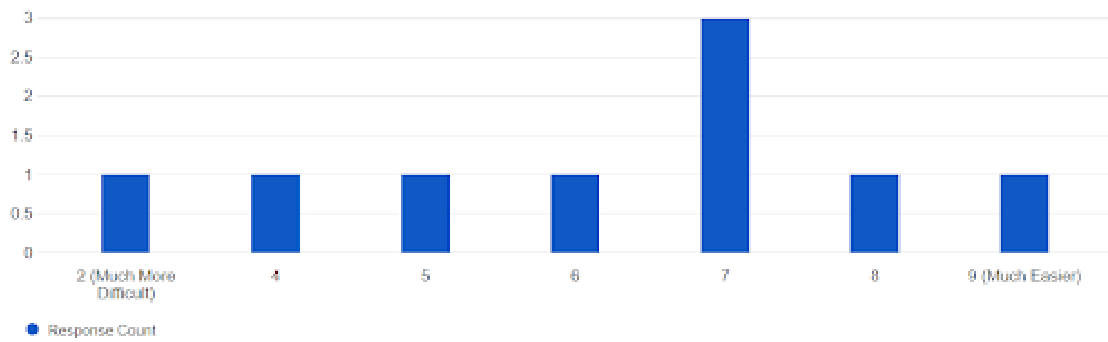

Fig. 6. Responses from the crowdsourced survey on the relative difficulty of gesture controls compared to traditional controls. We observe an even spread of responses with a spike at a rating of 7. This indicates that users tend to feel that gesture controls are mildly easier to use than traditional control methodologies.

When it comes to the discoverability of gestures, participants were asked how they were able to find a particular gesture, i.e., by the necessity of use or just by coming across it by accident and adopting it later. Two-thirds of the participants said that they actively search for gestures. The fact that users are turning to outside sources raises the possibility that the built-in systems on their devices are not highly visible, simple to use, or readily available for learning movements. The numbers were the same when the users were asked if they discovered gestures by accident, i.e., two-thirds of the participants said they found the gesture they use now by accident. This suggests that some movements are made to be in line with consumers' innate tendencies. Because it enables users to discover new functions with ease during everyday interactions, this implicit design might be advantageous.

4.3 Factors that Influence Usability

Improved discovery:

- Participants suggested providing subtle visual cues and customizable gesture guides.
- Requests for gesture tutorials and prompts from the device were common.

Increasing trust:

- Misinterpretation of gestures and familiarity with mouse and keyboard controls were key reasons for not using gestures.
- Participants expressed a desire for a better understanding of when and why to use gestures efficiently.

Adapting to users:

- Customization emerged as a recurring theme, with participants expressing a desire to tailor existing gesture controls and create personalized gestures.

5 DISCUSSION

The results of the study have consequences for the creation and application of preset gestures. Improving gesture recognition with customizable manuals, tutorials, and visual signals helps close the awareness gap between users and efficient use. Enhancing device recognition capabilities and educating users about the effectiveness of gestures could promote broader usage in order to overcome trust-related issues.

The robust demand for customizable features points to a user-centric design, implying that preset motions ought to be flexible enough to accommodate personal preferences. Making custom gestures available to users can help them engage with devices in a more customized and natural way.

The difference in user preferences between the use of a mouse and a touchpad emphasizes how the device interface affects the adoption of gestures. Task dependency was found to be an important element, indicating that the type of job being performed and its context determine how effective a gesture is.

Positive comments about how quick and easy touchpad motions are to use point to a potentially useful way to improve user experiences. Nonetheless, because these preferences vary depending on the activity at hand, designing gesture systems requires a sophisticated strategy that can accommodate a wide range of user procedures.

Although our study offers insightful information, its limitations should be noted. The limited sample size and the participants' varying levels of technological proficiency could impact the generalizability of the findings.

The gesture design exercise employed during interviews provided valuable insights into participants' thought processes when conceptualizing new gestures. Notably, their proposed gestures often mirrored real-world actions performed with physical objects. Alternatively, they drew inspiration from pre-existing gestures used for similar tasks on other platforms. A/B testing could be employed to explore these preferences further and validate user intuition. This approach would involve presenting participants with two sets of gestures for the same task, allowing them to compare and evaluate their intuitiveness. Additionally, a follow-up study conducted after a period of time could measure implicit gesture recall. By asking participants to perform a target task using gestures spontaneously, researchers could determine which design option from the A/B test first comes to mind, indicating potential long-term memorability and ease of integration into habitual use.

6 CONCLUSION

The research findings underscore the importance of discoverability, trust-building, consistency, and ease of use when adopting gesture-based navigation.

Discoverability is a key factor in adoption when it comes to gesture controls, and many responses indicated that the existence of a list of available gestures would increase discoverability. While systems typically include information on available gesture controls, they are often neither highlighted nor brought to the user's attention. As such, a simple way to increase the adoption of gesture controls would be for designers of gesture control systems to promote their available gestures.

User confidence increases when gestures function in a consistent way and when the systems are made apparent. Trust in these systems is largely hindered by user perceptions of the reliability of gesture recognition. The dependability of gesture controls can be strengthened by using visual or responsive animations to indicate successful execution. In order for users to accept gestures as a natural element of their device interaction, this trust must first be established. Encouraging users to try out gesture controls for themselves would provide a method for building this trust in a natural manner.

A significant aspect that emerges is gesture systems' capacity to adapt to the needs of users. Prioritizing intuitiveness in design means utilizing users' natural movements to match their mental models. Our interviews provide a look at the diversity of gestures that individuals consider to be "easy to use." This diversity suggests that there is no "one size fits all" gesture system and that designers should begin with "intuitive" systems and allow users to make adjustments. This flexibility supports the various ways users may choose to interact with their devices in addition to improving usability.

The results highlight the significance of user-centric design and highlight the need for better usability-enhancing customization options, enhanced trust through user education, and improved discovery mechanisms. User input and preferences will be crucial in building intuitive and effective gesture-based interactions as the technology develops.

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