Ben Kronberger and Meryem Maameri
Dr. Holschuh
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# DES 5185 Product Analysis Case Study: Apple MacBook Pro 13" 2020 Trackpad

## Problem

Laptops have become an integral part of any college student's life in order to complete assignments, projects, and for many design students, to create materials using various computer softwares. A study conducted by Harris Poll (2015) found that 86% of college students own a laptop, and a study from 2019 conducted by Jamf (2019) found that 71% of college students use or at least prefer Apple Macbooks as their laptop of choice. 59% of those students who preferred Apple Macbooks chose Macs due to their ease of use (Jamf, 2019). The question still remains of what is it about Apple Macbooks that sets them above other computer companies present today? To answer this, this report will identify and analyze human factors elements relevant to the leading laptop company for college students and will focus specifically on the design of the integrated laptop trackpad due to its rapid evolution over the past decade.

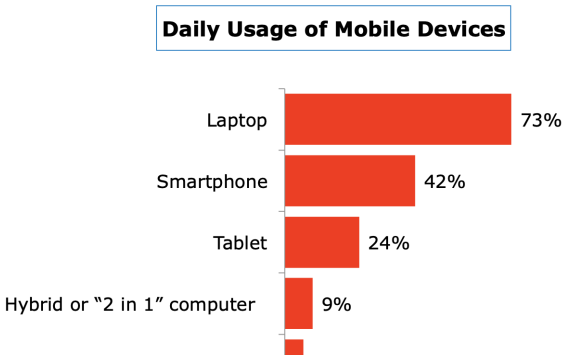


**Figure 1.** Daily Usage of Devices by College Students (Harris Poll, 2015)

## User

Given that students of today rely most on their laptops to complete coursework and other related activities (Harris Poll, 2015), this case study will investigate college students aged 18-22 who use a laptop and interact with the trackpad regularly. The age group has been selected to reflect the average college student population as well as the groups performing the study and subsequent analysis. The user group is also bound in this case to those who use the trackpad as a primary method of interaction with their computer, and by extension those who are physically able to do so. Those who cannot use a trackpad for a variety of reasons are not included in this report due to the requirement of differing accommodations, preferences, and method of use.

**Figure 2.** Apple Macbook Pro 13" 2020 (Apple, 2020)

## Product

Given its overwhelming presence on college campuses, this report will focus solely on the built-in trackpad of the 13" Apple Macbook Pro released in 2020. This selection has been made in order to investigate the ergonomics of using this input method, the methods that users utilize in order to interact with the laptop software through gestures and actions, and the user impact of the combination thereof. For these reasons, external and nontraditional trackpads have been excluded in order to focus on the most common use case, and to rule out differences in ergonomics between devices.

## Detailed Task Analysis

| Task | Perception/Cognition | Action |
|---|---|---|
| [1] Open Browser | [P] Look at laptop screen<br>[P] Track cursor as it navigates to browser icon<br>[C] Know where the browser is on the lower navigation bar<br>[C] Know how to move finger along trackpad and which action is needed to click or select | [1.1] Place hands on laptop<br>[1.2] Using dominant hand, slide finger across the laptop trackpad to move cursor to the browser icon<br>[1.3] Induce pressure on the trackpad to result in a click to open browser |

| | | |
|---|---|---|
| [2] Open JSTOR website | [P] Recognize visual cue of flashing text cursor in the search bar in order to begin typing<br>[C] Know which url to type into the search bar, or find the website through a google search<br>[P] View the results given and locate the desired choice, the JSTOR website | [2.1] Moving hands up and down between the keyboard and trackpad, extend arms forward and backwards approx. 5”<br>[2.2] Move cursor with dominant finger to move it up to the search bar<br>[2.3] Move both hands away from trackpad and onto keyboard to type<br>[2.4] Click enter<br>[2.5] Raise hands approx. 2” away from the trackpad while waiting |
| [3] Search for topic of choice | [P] View the JSTOR homepage and visually locate the search bar<br>[C] Know that the website has loaded and is ready to be used | [3.1] Slide finger along trackpad to move cursor onto the landing page search bar<br>[3.2] Tap trackpad to select the search bar<br>[3.3] Move hands onto keyboard to type in desired search phrases<br>[3.4] Click enter<br>[3.5] Rest hands away from trackpad or computer while waiting for results to generate |
| [4] Choose article from list | [P] View the article titles that are presented and follow the page with eyes as it scrolls<br>[C] Know which article to choose based on which fits the search most accurately<br>[C] Know how the scrolling for the specific trackpad model works, move up to go down and move down to go up | [4.1] Once the results page has loaded, place dominant hand back on the computer<br>[4.2] Using dominant hand, place two fingers on the trackpad<br>[4.3] Glide two fingers along the trackpad in an upward motion to scroll the page downward or in a downward motion to scroll the page up<br>[4.4] Lift the two fingers and place them in the starting position and repeat the motion continuously until desired page location is reached<br>[4.5] Once desired article is located, remove one of the two fingers from the trackpad and glide the finger across the trackpad to move cursor onto the article title<br>[4.6] Without removing finger, induce pressure onto the trackpad to select the article |
| [5] Open article preview | [P] View the feedback from clicking on the article of the loading indication on the top of the page<br>[P] Recognize that the page has loaded and opened | [5.1] While waiting for the article to open, lift fingers from the trackpad<br>[5.2] Once page has opened, glide finger across the page and placed second finger on trackpad, scrolling upwards to view the entire article preview |
| [6] Download pdf version | [P] Locate the ‘read and download’ button on the page<br>[P] Recognize that it is a clickable button when the button changes when the cursor hovers over it<br>[C] Know which institution to search into the search bar when signing in<br>[C] Know the login information for the signing in process<br>[C] Know how to navigate the JSTOR signing in process as it transfers from the UMN Library system and back to JSTOR<br>[P] Look across the computer screen to find indicators in color or bold to help the process of signing in<br>[C] Know where the download icon is on | [6.1] Glide finger along trackpad to move cursor onto the ‘read and download button’<br>[6.2] Tap finger on trackpad to select the ‘read and download button’<br>[6.3] Lift finger while waiting for the page to respond<br>[6.4] Select the institution search bar and move hands away from trackpad and onto the keyboard to type in institution name<br>[6.5] Scroll using two fingers to find the University of Minnesota - Twin Cities<br>[6.6] Leave one finger on the trackpad and glide the cursor onto the institution name and induce pressure on the trackpad to select<br>[6.7] Once transferred to the UMN library system, glide finger across the trackpad to select the search bar<br>[6.8] Move hands away from trackpad and onto the keyboard to type in JSTOR |

| | | |
|---|---|---|
| | the browser pdf viewer and what it means<br>[P] Locate color cues for buttons, avoid those that are grayed and favoring those that are bright | [6.9] Move hands away from keyboard and place two fingers on the trackpad, scrolling down to find the JSTOR selection<br>[6.10] Glide finger to the JSTOR selection and induce pressure to select<br>[6.11] Sign in<br>[6.12] Repeat steps 3, 4 & 5 in order<br>[6.13] Glide finger along trackpad to move cursor onto the 'read and download button'<br>[6.14] Tap finger on trackpad to select the 'read and download button'<br>[6.15] Remove finger and slightly lift hand after selecting the download button<br>[6.16] Glide finger to move cursor on the pop-up button labeled "accept and download", then induce pressure on trackpad to select<br>[6.17] Lift hand and fingers away from trackpad while aiting for response<br>[6.18] As soon as page opens, place finger on trackpad and glide it to hover over the download icon and induce pressure on trackpad to select<br>[6.19] Glide cursor onto the finder popup and glide finger to move cursor onto the 'save' button, then induce pressure to select |
| [7] Locate file in downloads | [C] Know how to move across windows on the computer model either by clicking out of the current window or using the trackpad to slide to the adjacent window<br>[C] Know where downloaded files go based on where the automatic downloads are or where they were manually placed<br>[P] Look for the title of the article in the downloads folder | [7.1] Place three fingers on the trackpad and glide them to the right in order to move the current window away and open the desktop, or glide cursor up on the browser and click the red circle to exit<br>[7.2] Glide cursor down towards the navigation bar of the desktop and move it along the bar to find the 'finder' icon, or locate the downloaded file on the desktop and move the cursor above it<br>[7.3] Open finder and glide cursor around the pop-up window to navigate the folders until the file is found, some clicking may be necessary |
| [8] Open file on system viewer | [P] Locate the article by reading the title of the file<br>[C] Know how to navigate the desktop and finder<br>[C] Know which system viewer to use | [8.1] If file is on desktop, right click by placing two fingers on the trackpad and using them to induce pressure on the trackpad, then move cursor and click on the selected pdf viewer, or double clicking the file image by inducing pressure in two simultaneous motions<br>[8.2] If file is in 'finder' double click the file by inducing pressure in two simultaneous motions<br>[8.3] Lift finger while waiting for the file to open |

**Human Factors Concerns**

Physical Design & Anthropometrics

- The design of the trackpad itself should be geared towards the user group of college students aged 18-22, allowing for different hand sizes to complete successful interactions.
- Distance between trackpad and other elements of the laptop must not require no more than minimal extension of hands, arms and fingers.

Safety & Injury Prevention

- ❖ Students sitting for long hours should not be in danger of straining their fingers, wrists or overall hands and arms due to their extended use of the trackpad.
- ❖ There should be smooth interaction between the trackpad and finger to prevent finger injuries from metal, electricity or rough textures.
- ❖ Trackpad gestures must not require more than minimal force in order to prevent injury.

Cognitive Satisfaction

- ❖ Using the trackpad should not require a load of mental effort, but is easy to learn and users can quickly adapt to the interactions where mental effort is no longer needed.

**Human Factors Requirements**

| Variable | Requirement | Value | Justification | Meets |
|---|---|---|---|---|
| **Physical Ergonomics** | | | | |
| Anthropometrics: *Position on hardware* | Trackpad is sized and positioned to minimize stress on wrists during use | Trackpad centering allows for ease of wrist motion | (Avera et al., 2016) (Kelaher et al., 2001) | Yes |
| Biomechanics: *Use of fingers* | Trackpad is sized and designed with gestures that accommodate a 1-5 fingers | 1-10 finger multi-touch gestures | (Clavero et al., 2003) (Sundar et al., 2013) | Yes |
| Biomechanics: *Required force* | Trackpad actions require zero to minimal force to prevent prolonged stress on fingers and wrist | Available trackpad gestures require zero to minimal force by the user | (Clavero et al., 2003) (Kar et al., 2015) | Yes |
| Biomechanics: *Forward reaching* | Trackpad should prevent extended reach of hands from the body | Trackpad positioned under keyboard for minimal arm and hand extension | (Camilleri et al., 2012) (Moffet et al., 2002) | Yes |
| Biomechanics: *Handedness* | Trackpad allows for gestures to be completed with either left or right hand at any given moment | Gestures are not limited by handedness | (Berthellemy et al. 2015) (Gilbert & Wysocki, 1992) | Yes |
| **Cognitive Ergonomics** | | | | |
| Discoverability: *Minimal experience needed for full use of product* | Trackpad includes various features which are easily discoverable by users | Users discover new gestures through simple user guide or personal inquiry | (Norman, 2013) (Arthur et al., 2008) | Yes |
| Feedback: *Immediate Haptic, Auditory and/or Visual Response* | Trackpad produces haptic, auditory and/or visual feedback to communicate a successful action by the user | Auditory click, pressure haptic, visual feedback on screen | (Norman, 2013) | Yes |

| | | | | |
|---|---|---|---|---|
| Mapping: *Finger and Cursor Consistency* | Trackpad should allow for consistency between the user's finger movement on the trackpad and the movement of the cursor on the screen | No lag between finger interaction and corresponding cursor movement | (Norman, 2013) | Yes |
| Constraints: *Product capability is consistent to perceived constraints* | Trackpad design should have adequate constraints that are consistent with the users perception of the product's full range of use | User can interact with any part of the outlined trackpad | (Norman, 2013) | Yes |
| **Emotional Ergonomics** | | | | |
| Aesthetic: *Minimalism and Simplicity* | Trackpad is consistent with overall laptop design and maintains minimalist principles | Color and leveling of trackpad is consistent with laptop base | (Obendorf, 2009) | Yes |

**Product Evaluation**

The built-in trackpad found in the Apple Macbook Pro is remarkably designed as an input method for interacting with the device and its available software. Its positioning under the keyboard allows the user to minimize the extension of their arms in order to use it, minimizing the stress that can be placed on them and subsequently possible injury. The size of the trackpad also affords gestures from multiple positions and angles, reducing repetitive motion from the user and allowing for dynamic tendencies in use. The supported gestures also serve to accommodate many use cases and physical constraints on users, allowing interaction with a single, or up to 10, fingers. These gestures, referred to as multi-touch gestures, can be performed with varying levels of force from simply tapping the finger onto the trackpad applying no pressure, to applying enough force to perform a "force touch". One fault arises here however, as the primary feedback method for this device is of the haptic variety and is only triggered by a click registered with sufficient force, limiting feedback in the case of clicks performed with a simple touch, as the only feedback the user may receive is visually on the screen and not a multi-sensored response.

For matters of cognitive ergonomics the trackpad's design excels in aesthetics, but this can also obscure some of the functionality and complicate the user's mental model. The trackpad is a single, unlabeled rectangle of brushed aluminum, the same color and material as the rest of the computer. This is visually appealing for users of course, but the lack of labeling makes it unclear as to where certain gestures should be performed. In older trackpads on different computers, mouse buttons appeared on the bottom of the trackpad to be a direct mechanical method of performing specific mapped actions (Edwards, 2013). The lack of a present label or other ornamentation on the Apple trackpad suggests to the user that gestures can be performed anywhere, which gives the user a sense of autonomous intuition rather than designed suggestion.

Overall, this simple, solid aluminum rectangle is used everyday by college students all across the country and the world. It is a marvel of functionality in concert with its software, blending seamlessly into its surrounding environment of simple, yet highly innovative, technology. This report has shown that through Apple's high standards of design and attention to human factors concerns, it is no wonder they are the leading laptop company that college students use and prefer.

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