Group 20

Dark Mode vs. Light Mode:

Does Display Choice increase Code Reading Speed with Syntax Highlighting for Novice Programmers?

Motivation

- Previous research did not take syntax highlighting into account
- Research code readability and learning effectiveness
- Find best display mode to help beginners learn to code

Related Work

Sethi et al. (Ergonomics, 2023) and *Palmén et al. (CHI, 2023)* show that Light Mode is better:

➔ Typing on virtual keyboards is faster in Light Mode
➔ Reading Text Speed is faster in Light Mode

However, *Shrestha et al. (2024)* have shown that students tend to prefer Dark Mode

➔ Visual fatigue is lower according to self-reports

Research Aim

Does display mode (Light vs. Dark) affect code reading speed and programming comprehension for novice programmers?

Hypotheses:

H_0: The display mode has no effect on the speed for reading code for novice programmers.

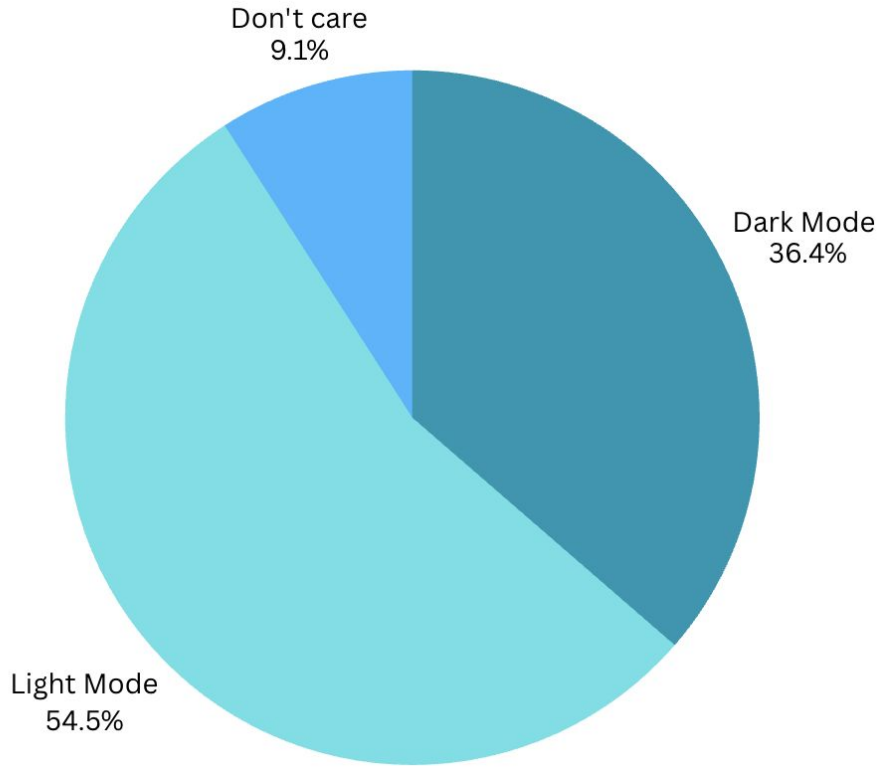
H_1: There is a difference between the speeds of Light and Dark Mode when reading code for novice programmers.

Methodology: Step 1 - Participants

- N = 12 (7 Female, 5 Male)
- Age 17-38

- Almost all participants were programming novices

Mode Preference before:



Methodology: Step 2 - Read, Understand & Practice

Need to teach novice participants so they understand basic code

- C code crash course
  - Integer and float variables
  - If-else statements
- Two pieces of sample code as warm up

Participants rated the crash course positively.

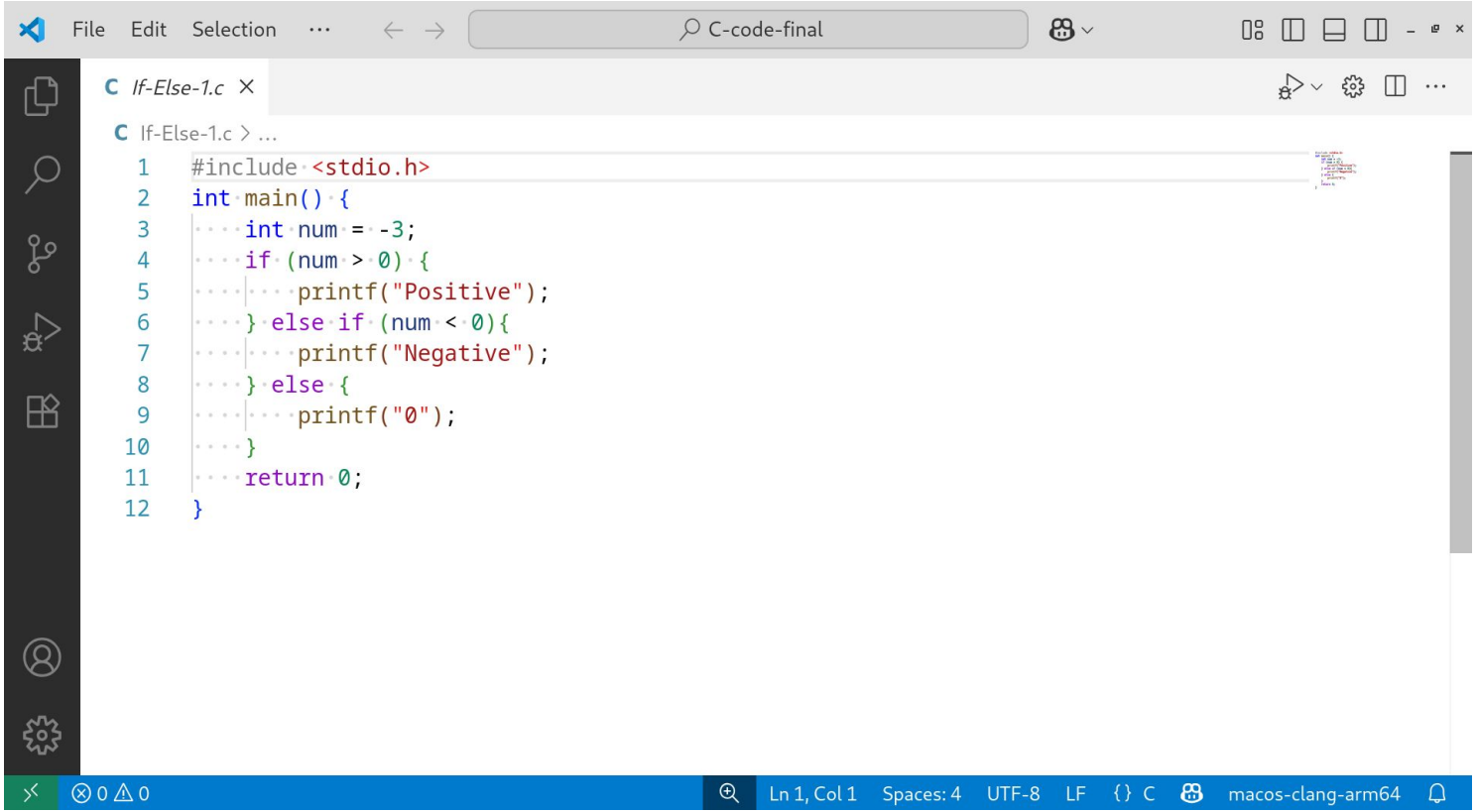
Methodology: Step 3 - Tasks

Within-group Design ➔ Participants read code in both modes

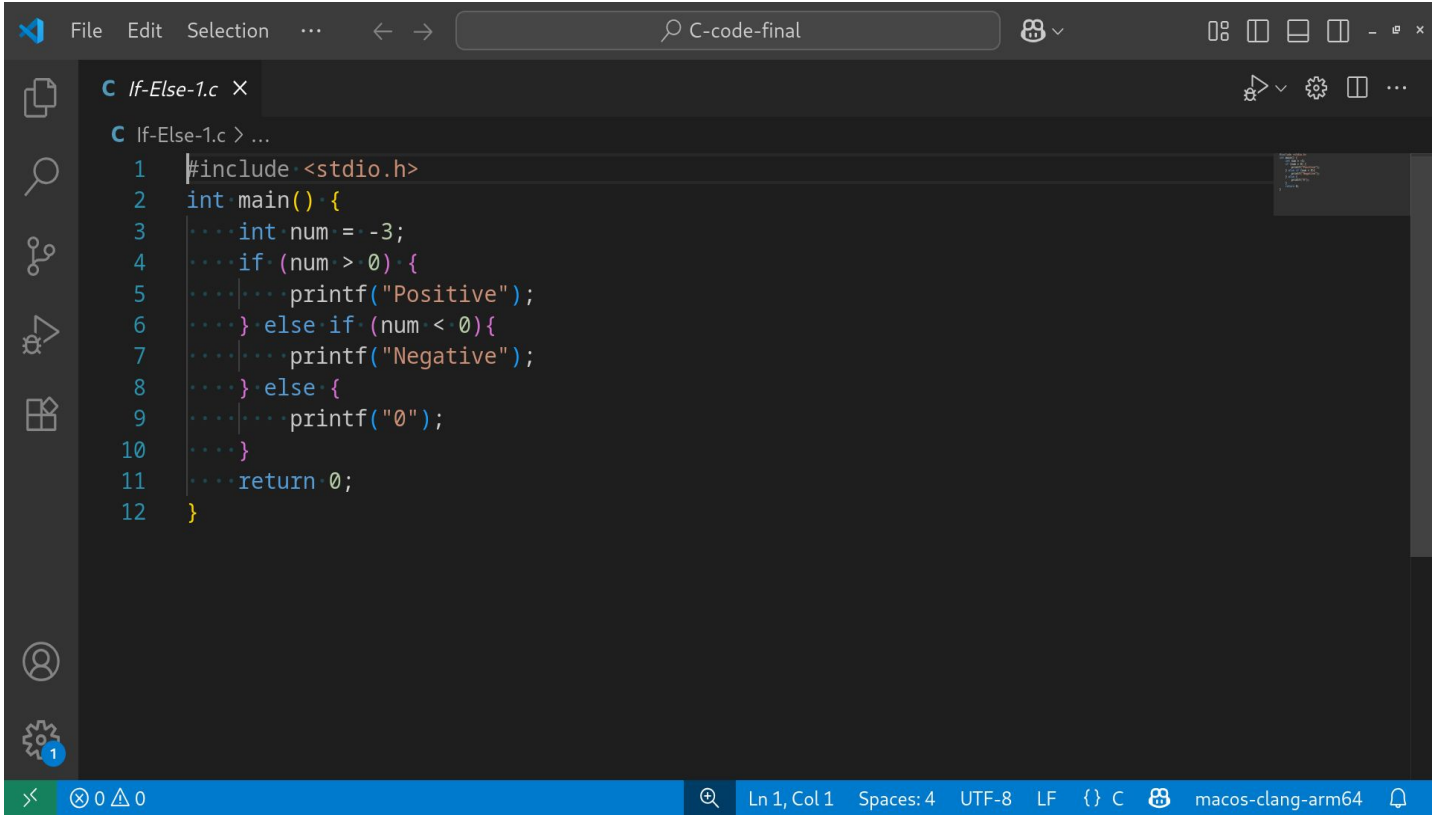
Independent Variable ➔ Code in both Light and Dark Mode (VSCode)

Dependent Variable

Methodology: Step 3 - Tasks



Methodology: Step 3 - Tasks



Methodology: Step 3 - Tasks

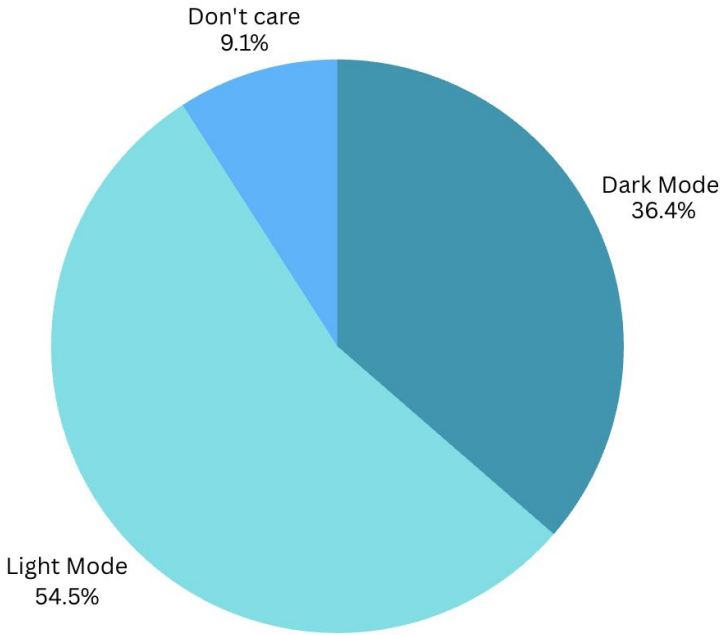
Within-group Design ➔ Participants read code in both modes

Independent Variable ➔ Code in both Light and Dark Mode (VSCode)

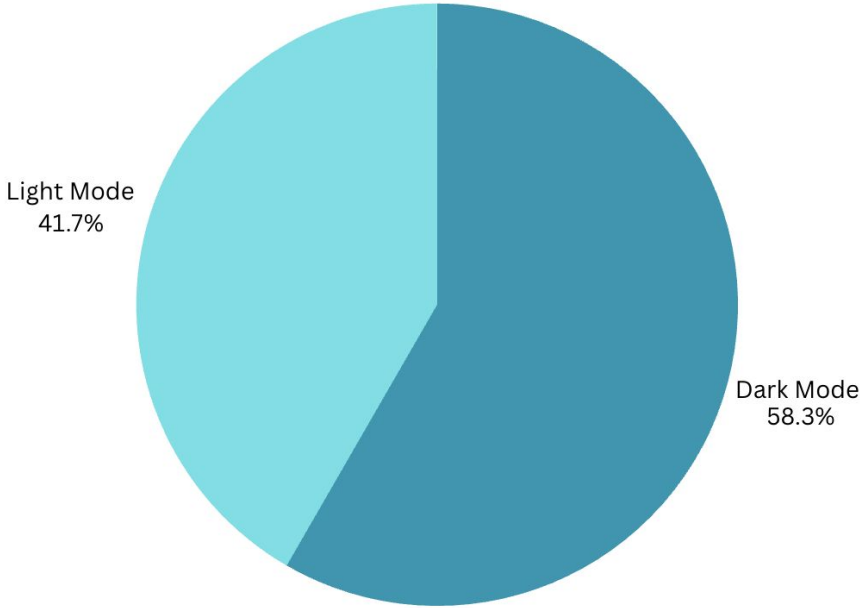
Dependent Variable ➔ Time to find certain integers, floats or if-branches

Results: Data

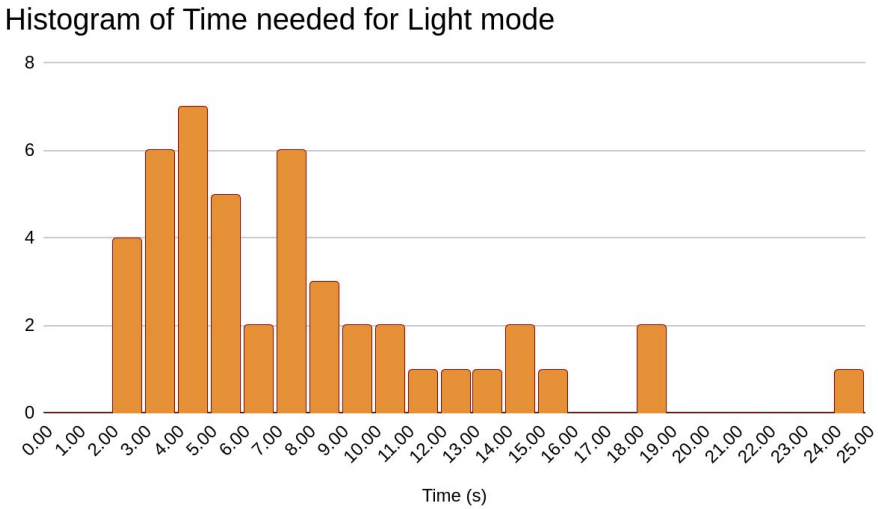
Mode Preference before:

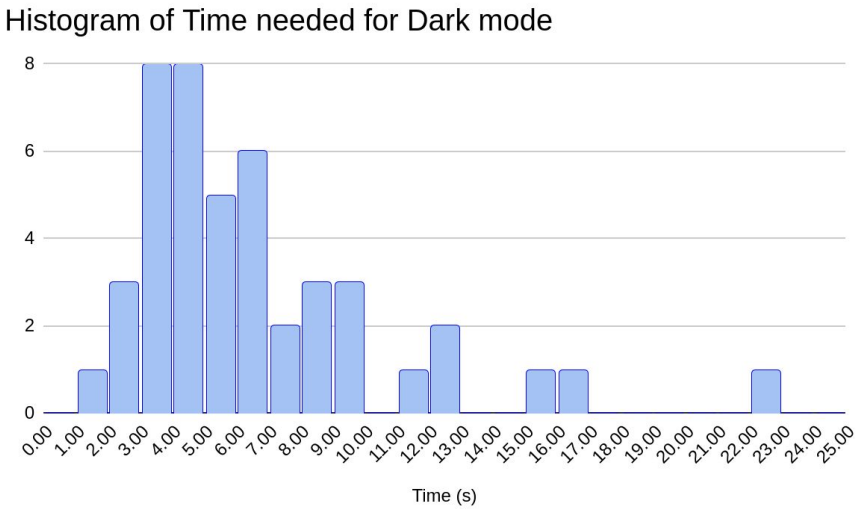


Mode Preference after:



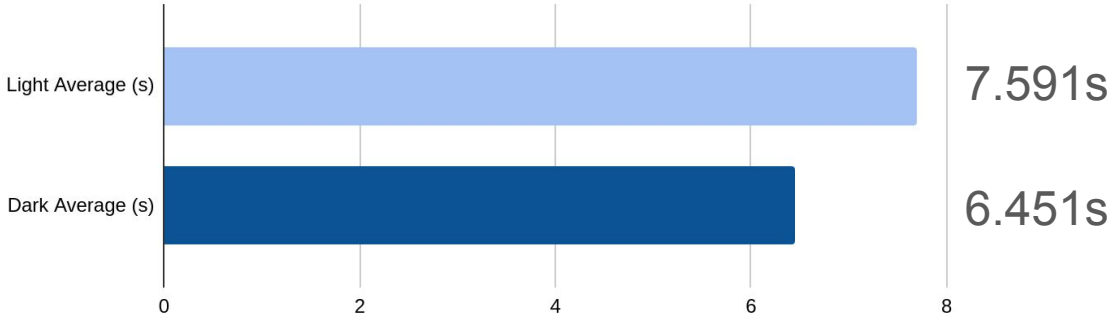
Results: Data





Results: Data

Average time needed:



p-value = 0.238 → Can't reject H_0!

There is no significant difference between the task completion time in both display modes.

Discussion

No statistically significant differences were found

- **However**, on average the speed of Dark Mode was still faster
- Participants rated Dark Mode as more comfortable

As such it is unlikely that Light Mode poses an advantage when reading code.

- This is **in contrast to previous research** focusing on monochrome text
- Dark mode's bright syntax enhances visibility and focus.

Perhaps, Dark Mode can help novices learn programming better.

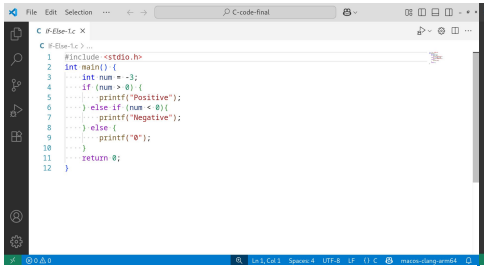
➢ Further research is needed

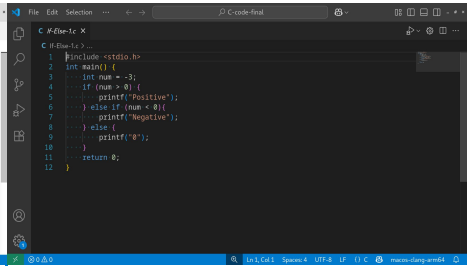
Summary

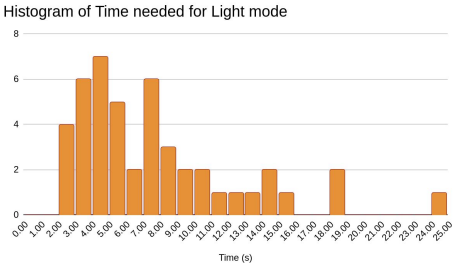
- Previous research suggests Light Mode is better for productivity

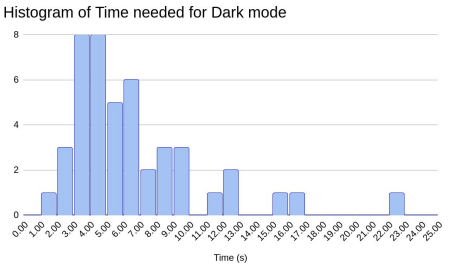
- Participants who were novices in programming were recruited
- A C crash course was given to teach basic programming concepts
- On average, Dark Mode was faster
    - But no statistically significant effects were found
- Participants rated Dark Mode as being more comfortable

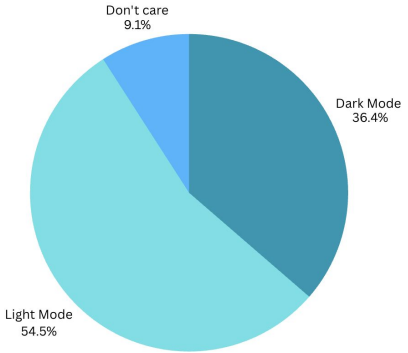
- These results are in contrast to previous research

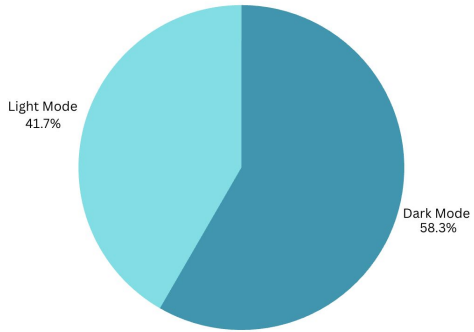












References

1. Shrestha, Awan, et al. "An Exploration of Effects of Dark Mode on University Students: A Human Computer Interface Analysis." *arXiv preprint arXiv:2409.10895* (.2024).
2. Sethi, T., & Ziat, M. (2023). Dark mode vogue: Do light-on-dark displays have measurable benefits to users?. *Ergonomics*, *66*(12), 1814-1828.
3. Palmén, H., Gilbert, M., & Crossland, D. (2023, April). How bold can we be? the impact of adjusting font grade on readability in light and dark polarities. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (pp. 1-11).
4. Pedersen, L. A., Einarsson, S. S., Rikheim, F. A., & Sandnes, F. E. (2020, July). User interfaces in dark mode during daytime–improved productivity or just cool-looking?. In *International Conference on Human-Computer Interaction* (pp. 178-187). Cham: Springer International Publishing.
5. Hannebauer, C., Hesenius, M. & Gruhn, V. Does syntax highlighting help programming novices?. Empir Software Eng 23, 2795–2828 (2018). https://doi.org/10.1007/s10664-017-9579-0

Methodology: Step 1 - Participants

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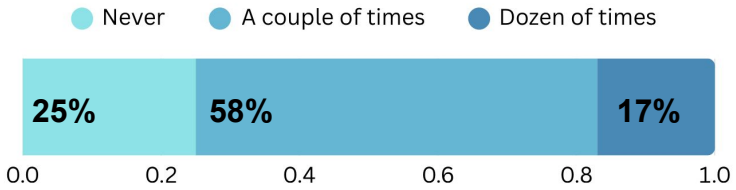
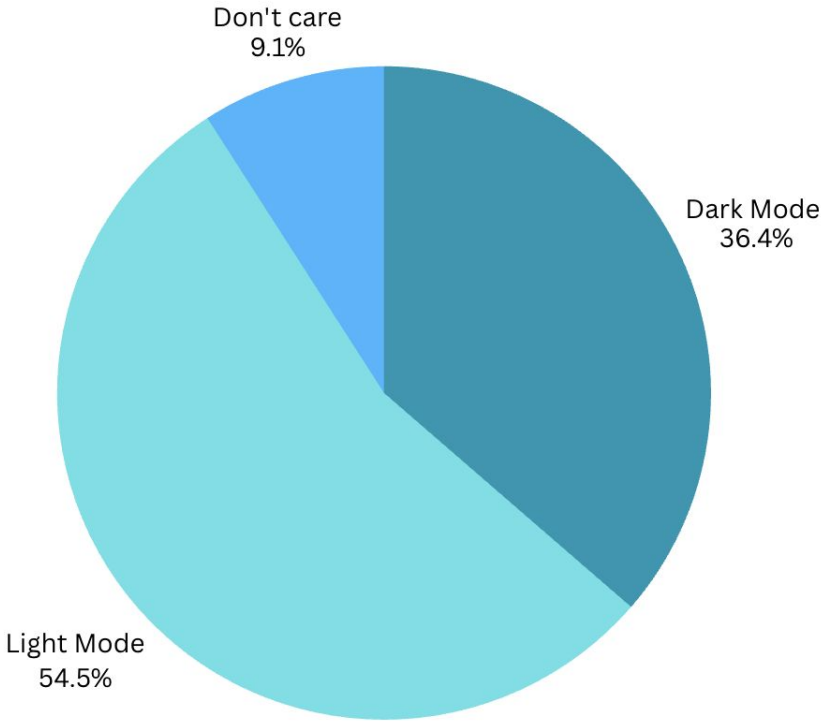
Read code before:



Programming Experience:

Mode Preference before:

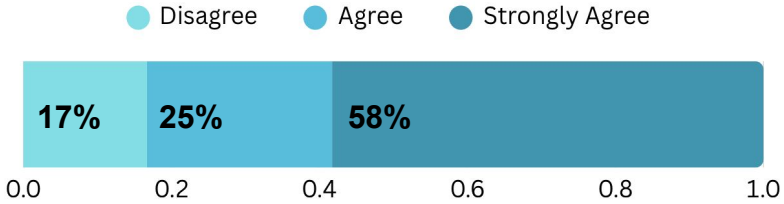


Data Results

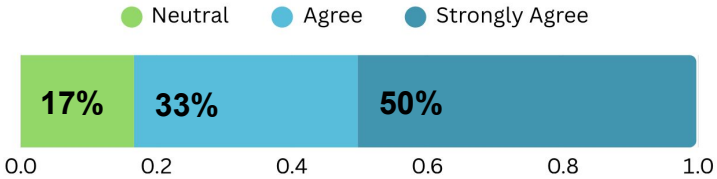
Average time needed:

Light Mode	Dark Mode
7.591 seconds	6.451 seconds

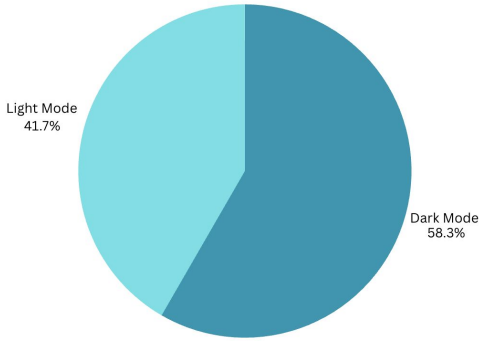
Crash course comprehension:



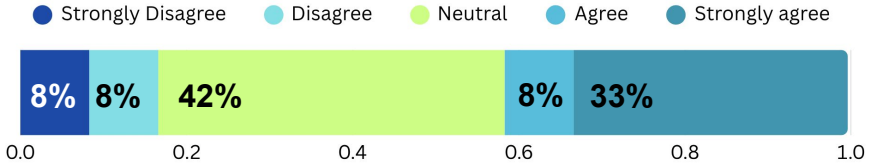
C code comprehension:



Mode Preference after:



Light Mode comfort:



Dark Mode comfort: