“Is dark mode better than light mode?”: Comparing Effects of Light and Dark Modes on Reading and Memory Recall

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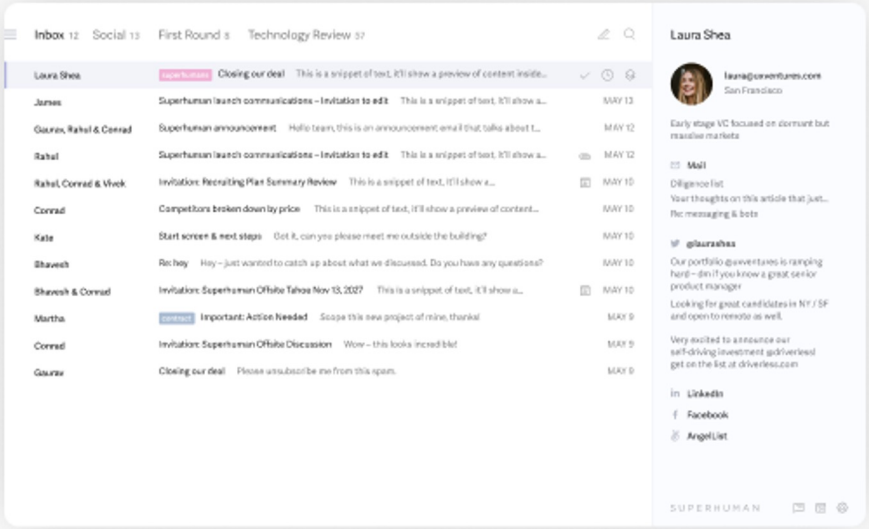
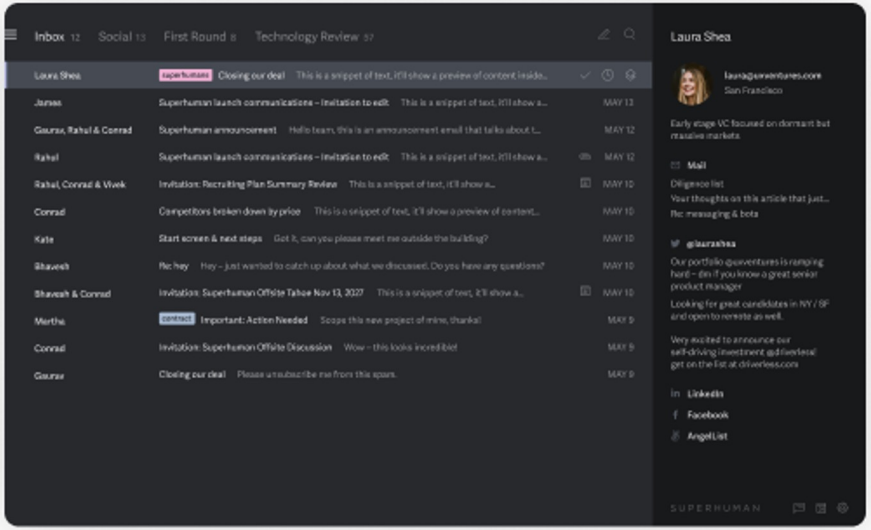
LIGHT VS. DARK MODE





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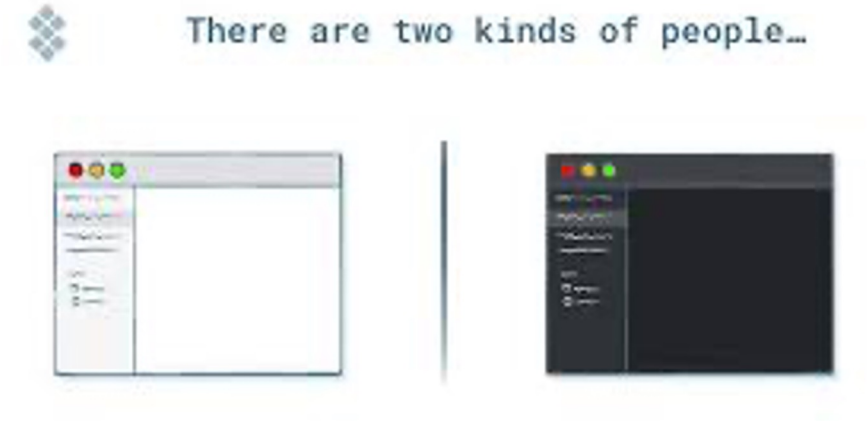
Light vs. Dark Mode: The Great Debate

- Has the potential to affect users' productivity, reading comprehension, speed, and memory retention in unique and complicated ways.
- Light mode has long been the default choice for desktop displays and applications. Although this is widely debated



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WYSIWYG Principle - Dominance of Light Mode

accessibility and universal design

Light mode resembles traditional printed text

High contrast and legibility for easy reading

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Emerging Preference for Dark Mode

- Dark mode has capacity to diminish eye strain, particularly in dimly lit situations or at night.

- Darkmode is said to improve focus and reduce distractions.
    - The display's subdued colours and reduced brightness can promote concentration.

- Dark Mode reduces the amount of blue light emitted from screens.
    - Can be a more sleep-friendly option.

Research Questions

1. How do light and dark modes influence reading comprehension and retention?

2. Can the selection of light or dark mode significantly affect memory recall and overall cognitive load during extended computer use?

By addressing these questions, we aim to provide a comprehensive understanding of the light vs. dark mode debate, enabling designers and developers to make more informed choices in crafting user-friendly interfaces.

Related Work

- *Hall and Hanna*
  - light mode better at keeping attention, dark mode had better ‘aesthetic’ ratings
- *Piepenbrock*
  - tested proofreading and legibility, favoring light mode - differences at small text sizes but less so at large text sizes
- *Sethi & Ziat*
  - self perceived ratings of effort are lower for reading dark mode text
- *Kim*
  - dark mode is better for sustained low attention tasks, light mode better for shorter, focused efforts
- Metrics include: Visual acuity/ readability, retention, fatigue and perceived effort, and aesthetic and personal preference rating

Methodology

- Criteria
  - 10 participants started with dark mode and another 10 with light mode
  - Consent form must be submitted before the experiment begins
- Apparatus
  - Computer set with either light mode or dark mode
  - Timing device - stopwatch
  - Questionnaire
- Survey
  - Start of experiment
    - Age, preference on modes and reason for their preference
  - End of experiment
    - Changes in preference, differences experienced, choices of modes on memorizing, reading, and understanding

Methodology

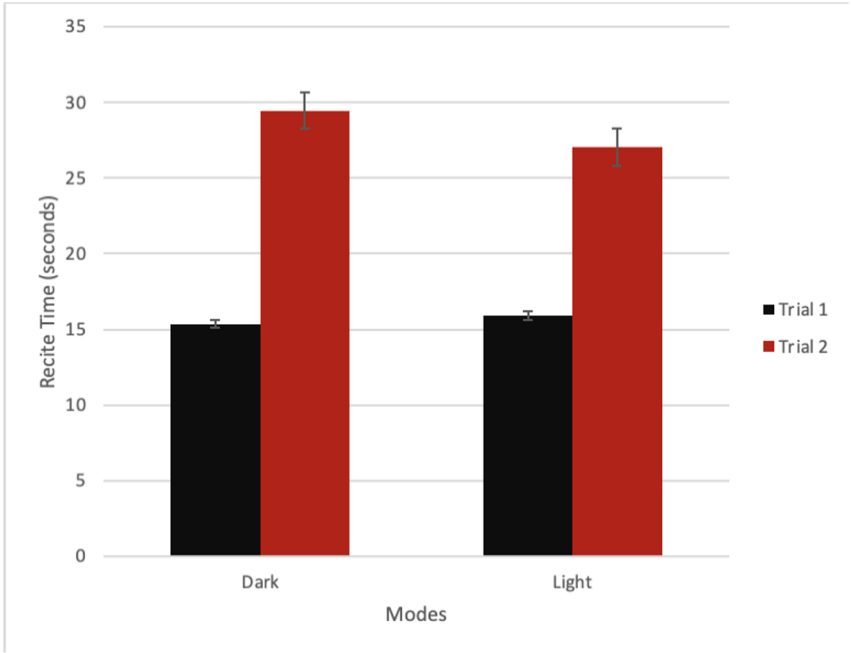
- Experimental testing
  - Memorization
    - Accuracy and speed of memorization on the given text are measured
    - 2 levels are tested for memorization
      - Easy level consists of names and numbers
      - Hard level consists of numbers and random characters
  - Speed reading
    - Accuracy and speed of their understanding based on their answers to the questions about the passage
    - 2 levels were tested for speed reading
      - Passage in easy level is comparatively easier than hard level

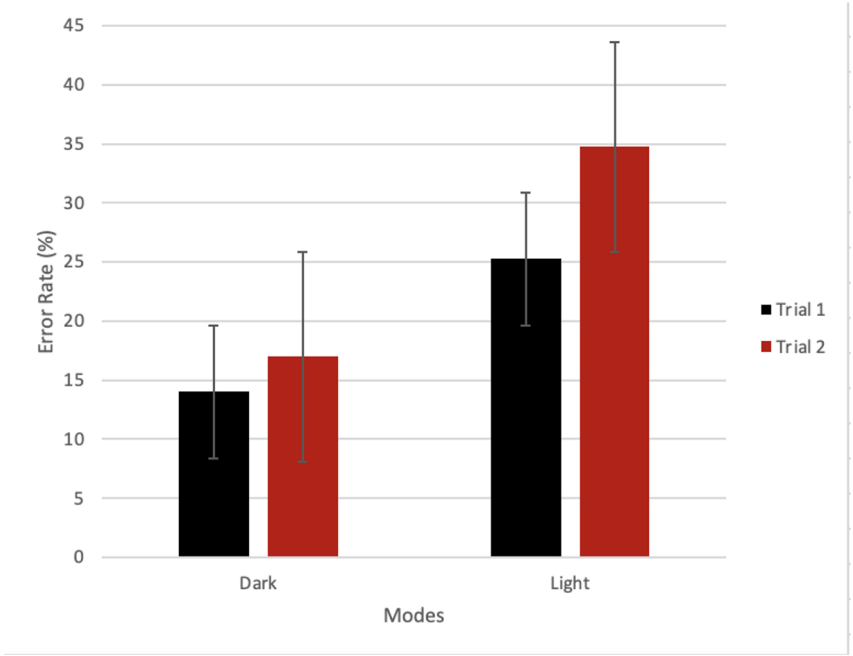
Results & Discussion

Memorization				
	Dark Mode		Light Mode	
	Task One	Task Two	Task One	Task Two
Error (Mean)	14.0 %	25.25 %	17.0 %	34.75 %
Error (Standard Deviation)	14.65 %	14.55 %	14.55 %	15.34 %
Recite Time (Mean)	15.35	29.45	15.90	27.05
Recite Time (Standard Deviation)	5.24	7.51	8.25	8.84

Results & Discussion

Memorization





Results & Discussion

Memorization

ANOVA_table_for_time (seconds)

Effect	df	SS	MS	F	p
Participant	19	1671.938	87.997		
mode	1	17.113	17.113	0.326	0.5745
mode_x_Par	19	996.138	52.428		

ANOVA_table_for_error (%)

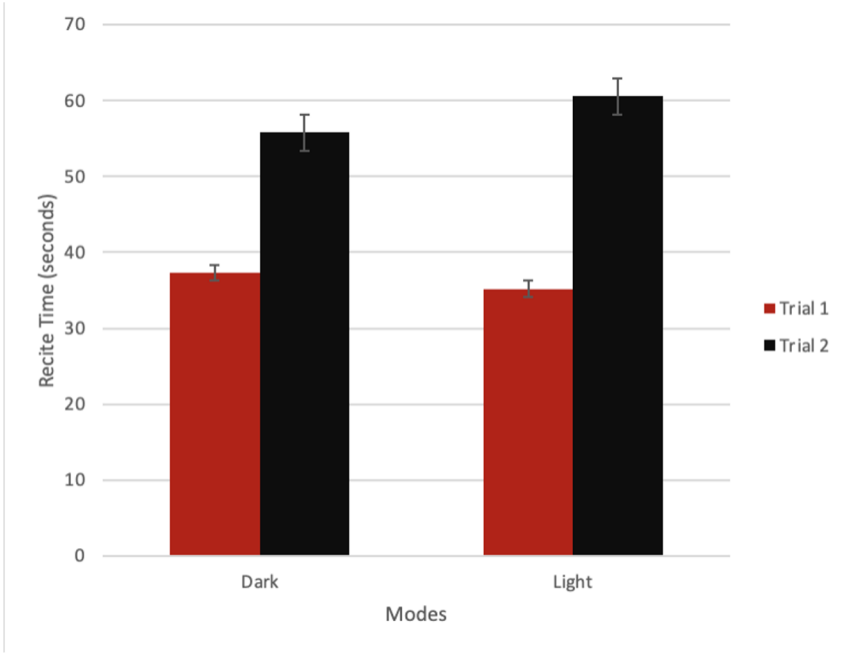
Effect	df	SS	MS	F	p
Participant	19	9495.000	499.737		
mode	1	781.250	781.250	5.668	0.0279
mode_x_Par	19	2618.750	137.829		

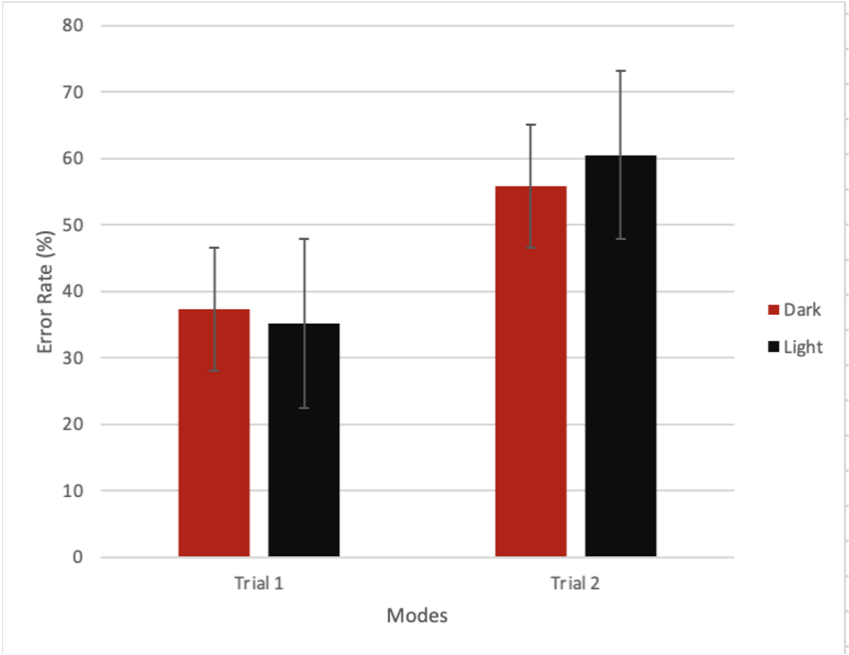
Results & Discussion

Reading				
	Dark Mode		Light Mode	
	Task One	Task Two	Task One	Task Two
Error (Mean)	25 %	27 %	22 %	33 %
Error (Standard Deviation)	18.21 %	19.76 %	18.24 %	22.73 %
Reading Time (Mean)	37.30	55.80	35.15	0.35
Reading Time (Standard Deviation)	8.29	15.70	9.95	17.79

Results & Discussion

Speed Reading





Results & Discussion

Speed Reading

ANOVA_table_for_time(seconds)

Effect	df	SS	MS	F	p
Participant	19	9273.300	488.068		
mode	1	33.800	33.800	0.569	0.4599
mode_x_Par	19	1128.700	59.405		

ANOVA_table_for_error (%)

Effect	df	SS	MS	F	p
Participant	19	10455.000	550.263		
mode	1	45.000	45.000	0.125	0.7279
mode_x_Par	19	6855.000	360.789		

Results & Discussion

- Younger participants generally show a preference for dark mode over light mode.

- Participants in the older generation age group tend to prefer light mode.
  - One common reason cited by some older participants is light mode is the default setting on their devices
  - Dark mode is perceived as harder to see for them

- The younger generation leans towards dark mode, often stating that it looks better aesthetically and is easier on the eyes.

- The majority of participants maintain their preferences even after the study concludes.

Conclusion

- Age-Related Preference Pattern
  - Younger (age < 30) prefer dark mode, older (age > 30) prefer light mode
  - Visibility and eye comfort in older study group are an issue, esp. for memorization
  - Aesthetics are important in younger aged study group, esp. for speed reading

- Power of Default Settings
  - Light mode as the default option made it statistically significantly preferred

- Future areas of work
  - Non functional testing of light vs dark such as aesthetic, not just functional
  - Blue light filter effects, for late night content consumption

- Improvements
  - Increased diversity of usability testing, over longer time and increased sample size

Contributions

- Age-specific Interfaces
  - Get light mode or dark mode depending on users age for given website/app
- Accessibility Insights
  - Increased accessibility to software by lowering cognitive strain & increasing attention
- User Behaviour
  - Increase engagement by changing mode depending on user's activity, as default
- Temporal Theories of UI - 'Technological Inertia'
  - Method of technology usage stayed same over time - high persistence & low adaptation/habituation

Limitations and Future Work

- Methods used to collect the data
  - a simple app (Google Docs) was used for the research
    - design an app that will help improve our study

- Selection Bias
  - limited ability to gain access to appropriate scope of participants
  - set range of age between 18 to 40 years old
    - expand our study with larger scope of participants that is not limited

- Time constraints
  - Participants are only available to conduct the study for a limited time
  - Accuracy of data might be impacted
    - Future study is needed to test the accuracy of our research

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THANK YOU

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