

# Using Paper, E-ink device or Desktop-PC for office work and subjective strain - a comparative study



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## Background

- ≡ A new generation of large mobile devices enable digital uses similar to paper. Unlike studies concerning the use of tablet-pcs, so far, it is unclear to what extent e-ink devices are more like paper or computers in respect of resulting strain.
- ≡ It was reported that people use paper, as it is easier to navigate through multiple pages [1]. Handwritten commentaries are usually inserted easier and faster than their digital counterparts [2]. So people often get frustrated and distracted when using digital formats for these tasks [1].
- ≡ Reading from computer monitors was found [3] to be significantly slower compared to paper. Other performance parameters like reading comprehension, or textual productivity differed between studies.
- ≡ On the other hand, people often prefer digital over analogue documentation [1]. And reducing information loss due to media breaks is an appreciated goal in most workplaces.
- ≡ The aim of this study was a comparison between an e-ink device, a conventional desktop-pc and common paper for a reading and a correction task.

## Method



### Tasks

- “proofreading” 40 lines of pseudo words
- reading double-sided texts with multiple choice questions

### Material

- large-size e-ink device (DPTS1 Sony, US-letter format)
- Desktop-PC (22"-LCD-Monitor)
- paper hardcopy

### Data

- subjective strain (NASA-TLX [5], scale 1= low, 21= high)
- Performance parameters (lines edited, errors, reading time)
- Media preference: for 5 different tasks

### Participants

- 36 Participants (15 man, 21 women), within- design
- Age: Ø 37 years (min: 20, max: 62 years)
- Technical affinity Ø 3.5 (SD= 0,59) (TA-EG [4], scale 1= low to 5= high)

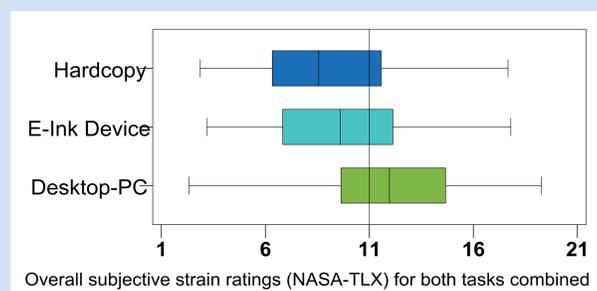
## Literature

- [1] Sellen AJ, Harper RHR (2002). The myth of the paperless office. MIT press.
- [2] Schneider SC (2014). Paperless Grading of Handwritten Homework: Electronic Process and Assessment. Proceedings of the ASEE North Midwest Section Conference, October 16-17, 2014, Iowa City, IA, 3B2.
- [3] Noyes JM, Garland KJ (2008). Computer- vs. paper-based tasks: Are they equivalent? Ergonomics 51.9, 1352-1375.
- [4] Karrer K, Glaser C, Clemens C, Bruder C (2009). Technikaffinität erfassen – der Fragebogen TA-EG.
- [5] Hart SG, Staveland LE (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. In: PA Hancock & N Meshkati (Eds.), Human mental workload. Amsterdam: North-Holland, 139–183.

## Results and Discussion

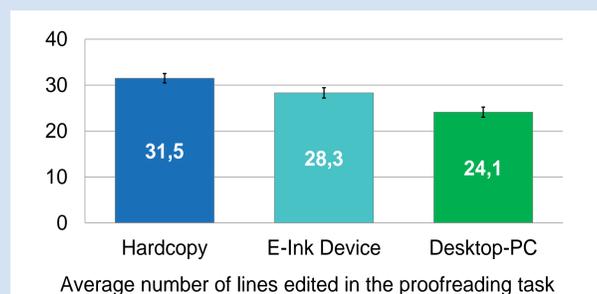
### Subjective strain:

- ≡ Overall the strain for the tasks were of medium intensity with a significant difference between conditions ( $F(2, 70) = 14.92, p < .001, \eta^2 = .30$ ). Compared to the desktop condition (Ø: 11.43 SD: 4.14) subjective strain for paper handling (Ø: 8.74 SD: 3.60) and the e-ink device (Ø: 9.55 SD: 3.67) was significantly lower.
- So a digital paper variant may help to optimize strain for similar tasks especially if executed over a longer period of time.



### Performance parameters:

- ≡ Divergent from data reported in [3] no difference for reading velocity was found between the media ( $F(2, 70) = 1.68, p = .194, \eta^2 = .05$ ).
- Reasons may be a greater display size and quality compared to [3] or a higher familiarity for reading from a computer display, probably both.
- ≡ Proofreading showed an effect of media used for lines edited ( $F(2, 70) = 42.73, p < .001, \eta^2 = .55$ ). Lines progressed from desktop-pc (Ø: 24.11 SD: 6.62) via e-ink device (Ø: 28.31 SD: 6.76) to hardcopy (Ø: 31.50 SD: 6.09). No differences for errors were found ( $F(2, 70) = 0.15, p = .859, \eta^2 < .01$ ).
- Tagging the pseudo words on the desktop-pc using a mouse caused a divide between hand and text. For both paper variants participants were able view text and hand/pen together, which could have caused the higher speed.



- ≡ The participants had indicated a high preference for paper prior to the experiment, especially for reading (first choice paper 90%) and correcting (71%). After using all three media 17% of the participants would have swapped the paper for the e-ink device for the reading task, and 14% for correcting.
- Even though this was not a high change in paper preference, it seems a noticeable amount for the short device use time.

## Conclusion

- ≡ Paper like digital devices combine the memory capacity and potential for organizing material with the paper like handling and subjective strain.
- ≡ User acceptance for the tested e-ink device was good and independent of age, gender or technical affinity.
- ≡ The results indicate that paper like digital devices like an e-ink device can be an alternative or a useful addition to using paper in the (mobile) workplace.

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