Learning on paper or on screen?

A meta-analysis of media effects on reading comprehension

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Learning from Computerized Texts

- Schools – Reading comprehension and domain specific tasks
- Higher education – E-Textbooks and scientific papers
- Distance learning for working people
- Training programs at work
- Admission tests (e.g., GMAT, SAT, TOEFL)

Computerized learning is unavoidable anymore

Computers in Learning Sciences

Background:

1. Most reading comprehension models ignore the media as a factor potentially affecting reading outcomes (e.g., van der Broek & Helder, 2017)
2. Many learning designers and researchers assume transferability of learning skills across the media

However,

- People are still reluctant to study lengthy texts on screen (e.g., Mizrachi, 2015; The Guardian, 2017)
- Research comparing learning outcomes has yielded mixed results (see Singer & Alexander, 2017, for a review)

Research Question

Equivalent groups of people

Same study task – Plain text learning

On screen

On paper

Is there a difference in learning outcomes?

What factors moderate it?

An example

(Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012; Lauterman & Ackerman, 2014)

Method:

Materials

6 texts, 2-4 pages long

10 Multiple-choice questions for each text

Between-participant Procedure

Study and test on screen **or** on paper

Prediction of Performance (POP) at the end of learning

Conditions:

1. Free learning (*M* = 9.6 min.)
2. Fixed and too short study time (7 min.)

An example

(Ackerman & Goldsmith, 2011; Ackerman & Lauterman, 2012; Lauterman & Ackerman, 2014)

Summary of findings:

1st study: Social sciences students:

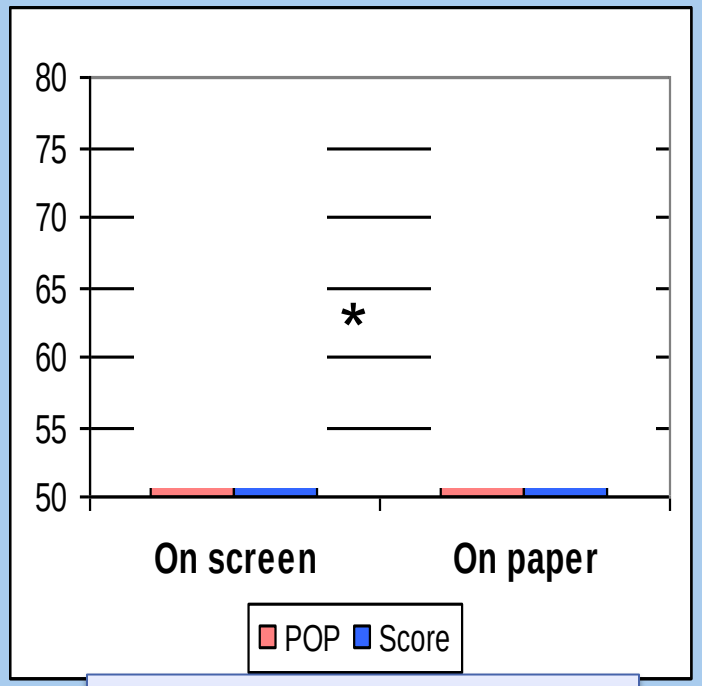
- Screen inferiority under free time

2nd study: Engineering students:

- Screen inferiority under time pressure

3rd study: Guiding to improve

- Overcoming screen inferiority by task design



Screen Inferiority

Population, allotted time, and task design are moderating factors

Meta-Analysis

Initial pool by keyword search and unpublished – 1800 records

Criteria for including studies:

- Comparing reading comprehension between the media
- Participants are normative population who read individually, in their daily used language
- Reading materials are comparable across the media
- Published or presented in 2000-2017
- Enough details for calculating **effect sizes**

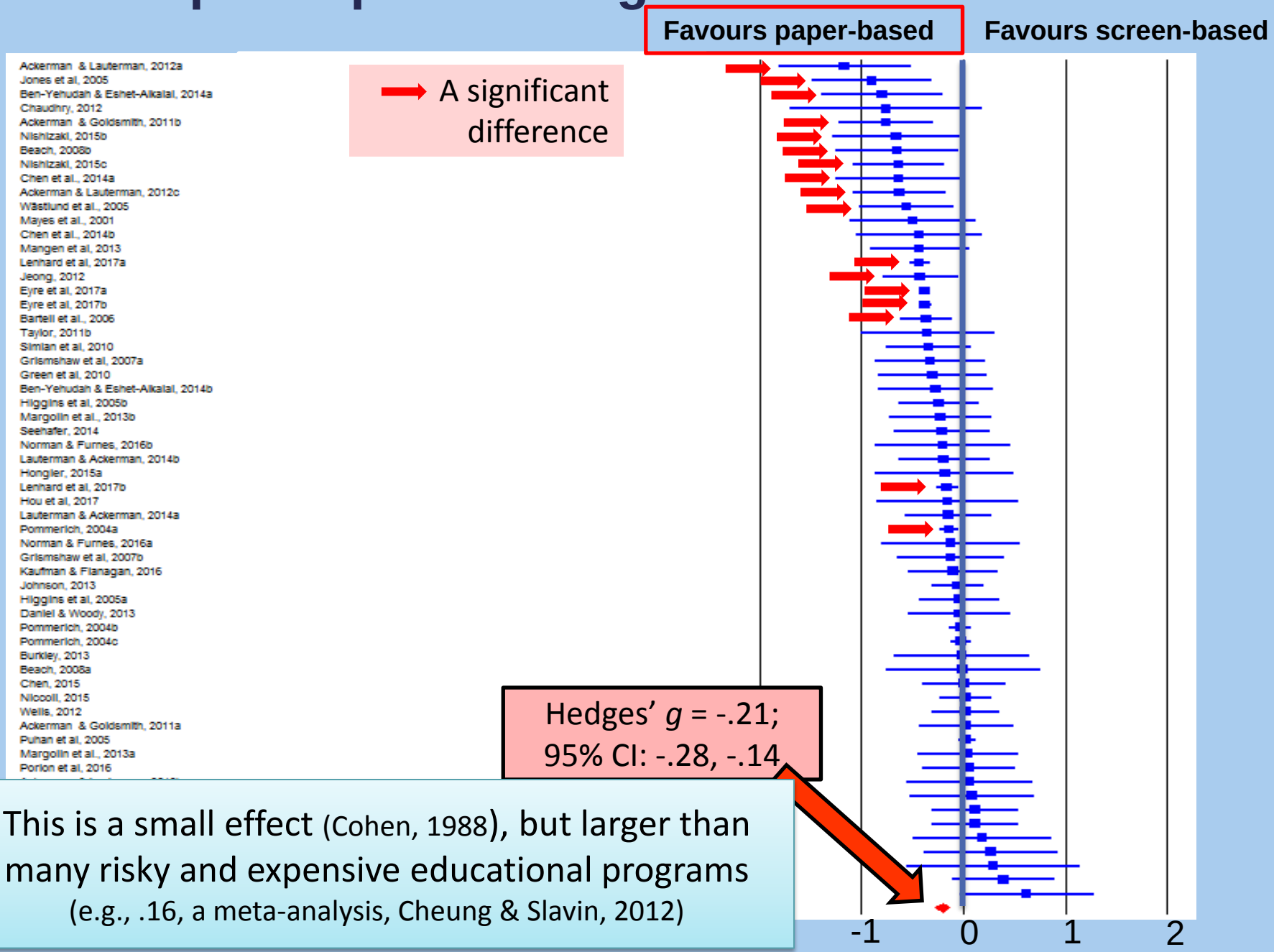
54 studies with 171,055 participants

Meta-Analysis

Study design – Two meta-analyses:

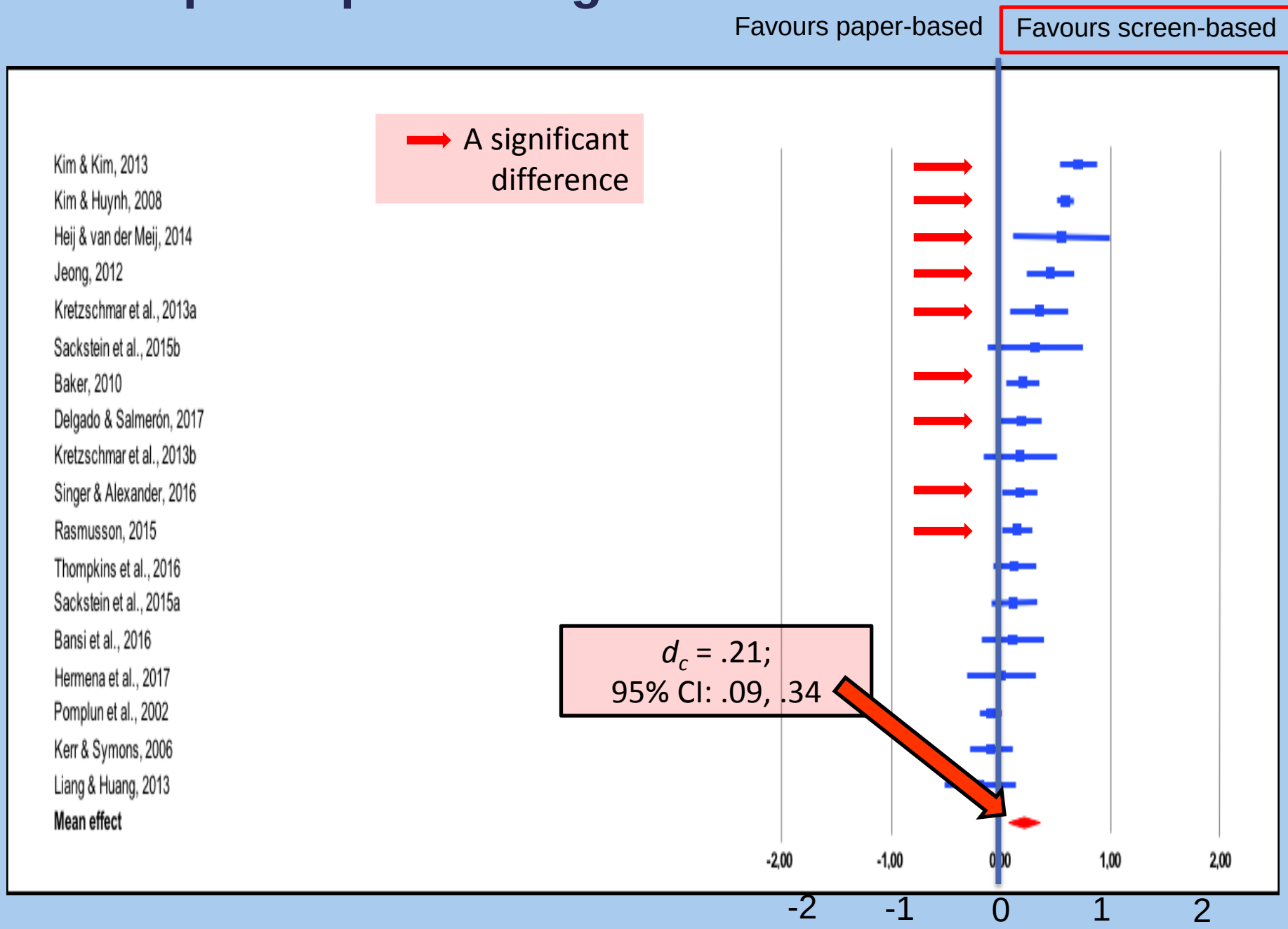
- 38 studies between participants
- 16 studies within-participant

Between-participants designs



This is a small effect (Cohen, 1988), but larger than many risky and expensive educational programs (e.g., .16, a meta-analysis, Cheung & Slavin, 2012)

Within-participant designs



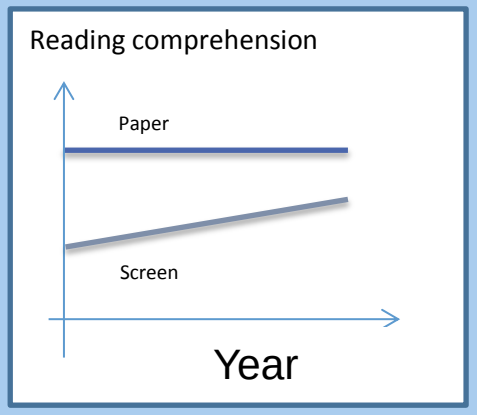
Moderators

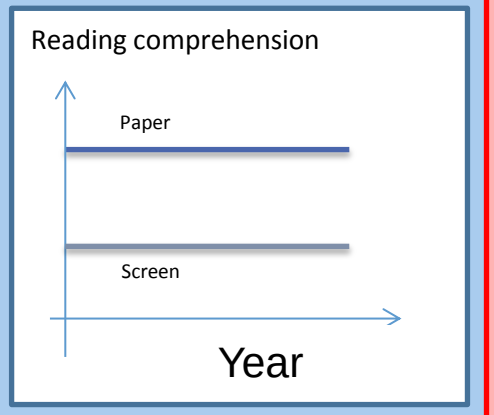
Significant interaction

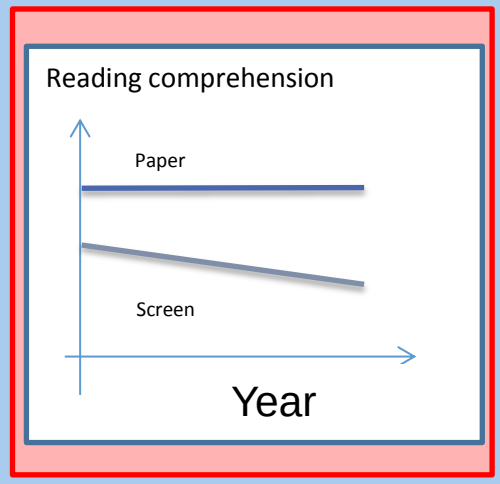
Not-significant interaction

No interaction

- Participants (age, sample size)
- Digital device (e.g., computer vs. hand-held, scrolling)
- Reading material (e.g., narrative vs. expository, length)
- Task design (e.g., time frame, guiding instructions)
- Test type (inferential vs. memory, open vs. closed books)
- Publishing (published?, year)







Conclusions

- Screen inferiority persists across study designs, age groups, and increases in recent years
- The moderating factors:
  - Promote understanding the mixed results
  - Provide predictable conditions for screen inferiority and media equivalence

Open issues:

- Will our children know to learn from texts?
- How to improve learning on screen?
- What is the role of individual differences?

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Thank You

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5th study

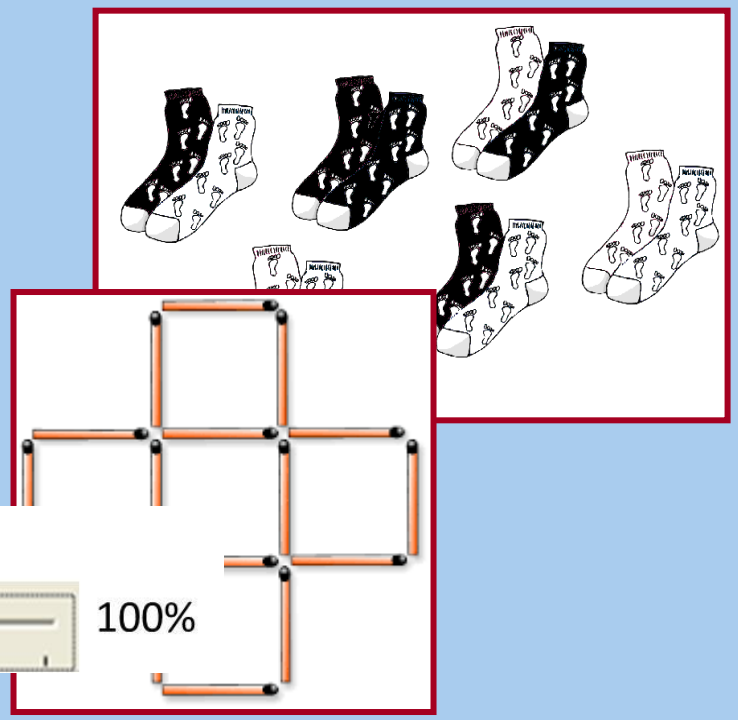
(Sidi, Shpigelman, Zalmanov, & Ackerman, 2017)

Question:
Does screen inferiority depend on text length?

Method:

Materials

6 highly challenging logic problems

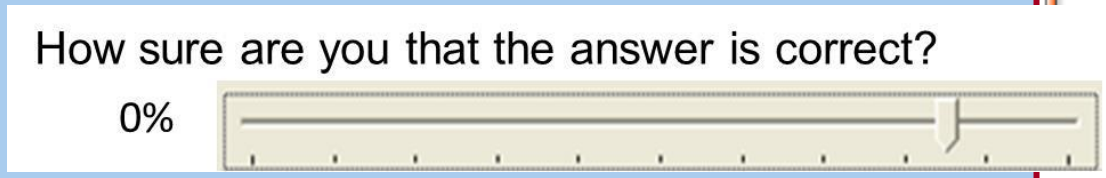


Between-participant Procedure

Solving on screen **or** on paper

With **or** without time pressure

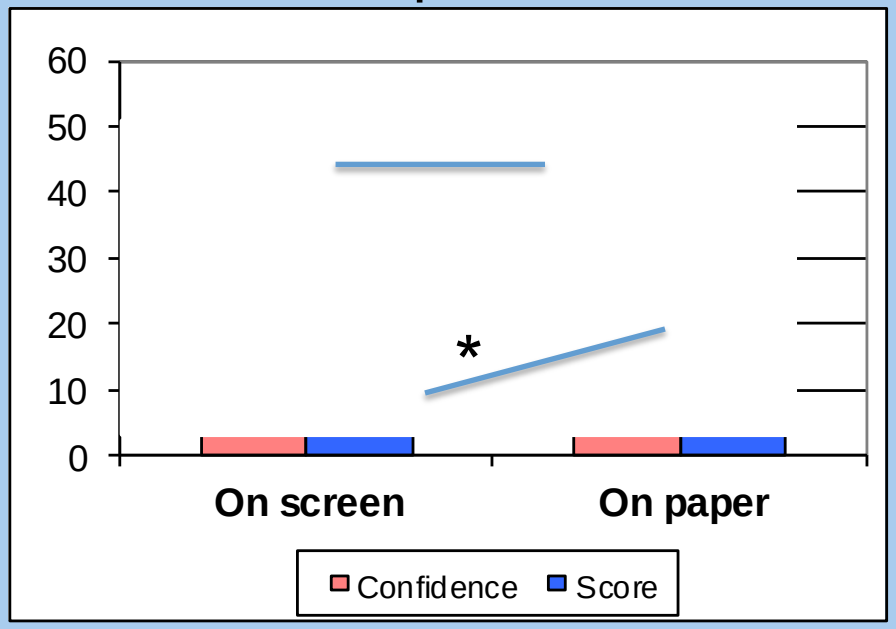
Confidence for each solution



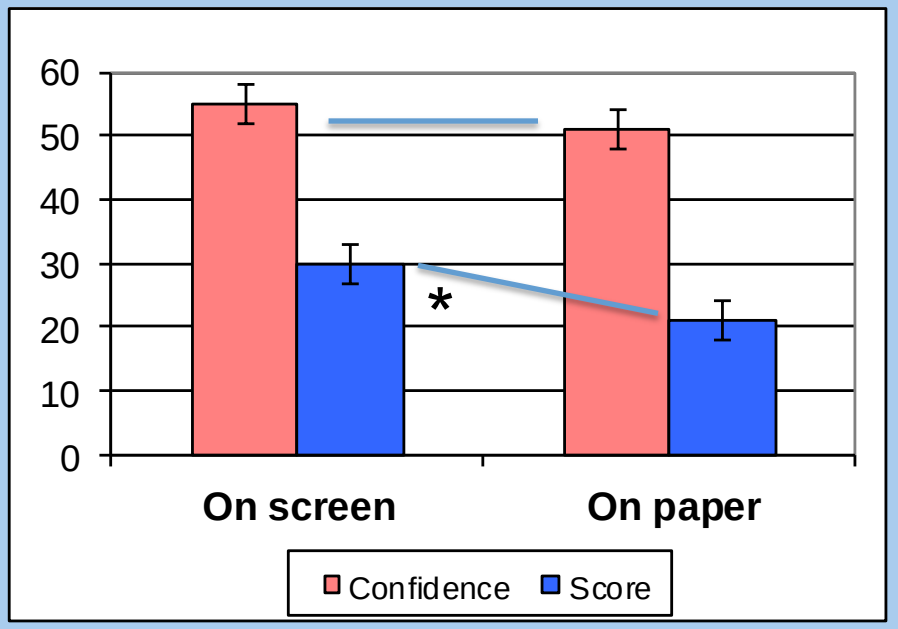
5th study

(Sidi, Shpigelman, Zalmanov, & Ackerman, 2017)

Time pressure



Loose time frame



Experiment 1:
Replicating the findings with lengthy texts with brief texts
Experiment 2: Cognitive load by time pressure?
Replicating within participants, with importance framing

5th study

(Sidi, Shpigelman, Zalmanov, & Ackerman, 2017)

Conclusions:

- Text length and other technological factors are not central factors in the found screen inferiority
- Inferior effort regulation on screen - Cues that legitimate shallow processing take stronger effect on screen than on paper
- There are simple ways to overcome screen inferiority, but they require task-designers' attention