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Learners' confusion and cognitive load while learning from interactive videos

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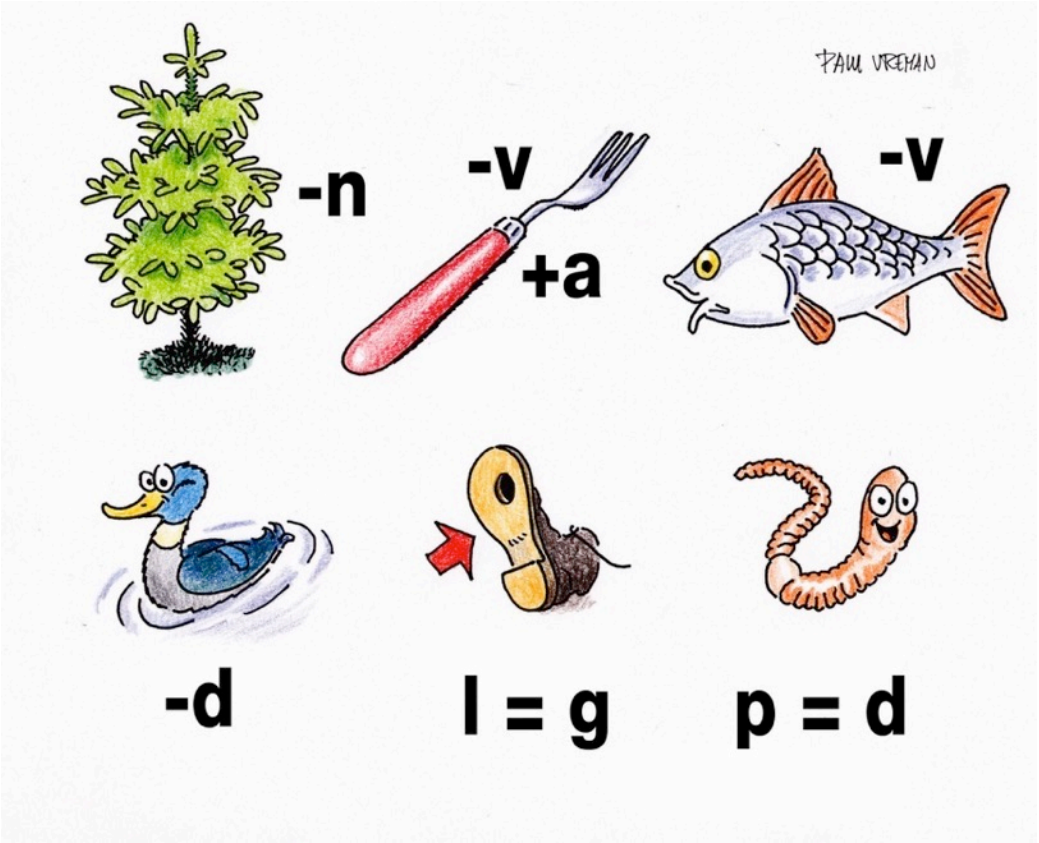
SCIENCE OF LEARNING RESEARCH CENTRE

Australian Government
Australian Research Council

Understanding confusion in digital learning environments

Making Sense from Information

Can you solve it?



Confusion

What is it?

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- **Epistemic** emotion
  (Pekrun & Stephens, 2012)
- Caused by a **cognitive disequilibrium** (impasses, discrepancies, contradictions, …)
  (Graesser, Lu, Olde, Cooper-Pye, & Whitten, 2005)
- **Unpleasant** emotion
  (Russell, 2003)
- Have different **effects on learning:**
  - Negative
  - Positive

  (D'Mello, Lehman, Pekrun, & Graesser, 2014)

Zone of Optimal Confusion

(Arguel & Lane, 2015; adapted from D'Mello, Lehman, Pekrun, and Graesser, 2014)

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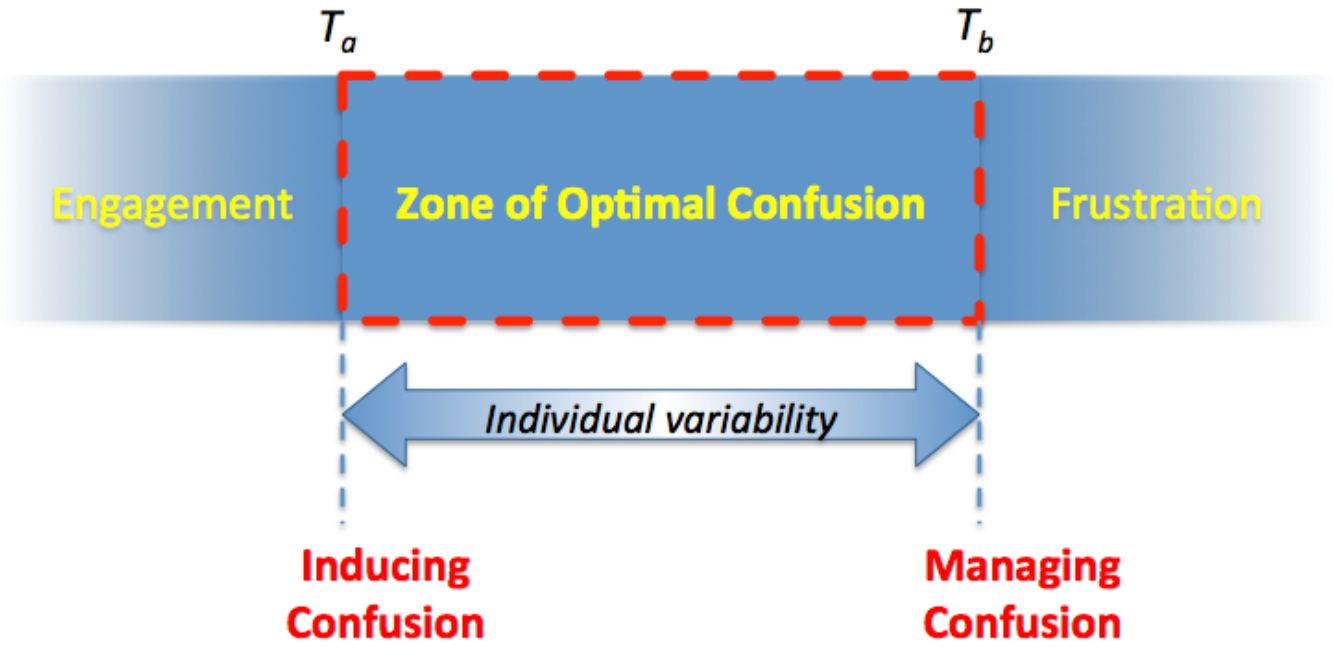

Confusion in the Classroom

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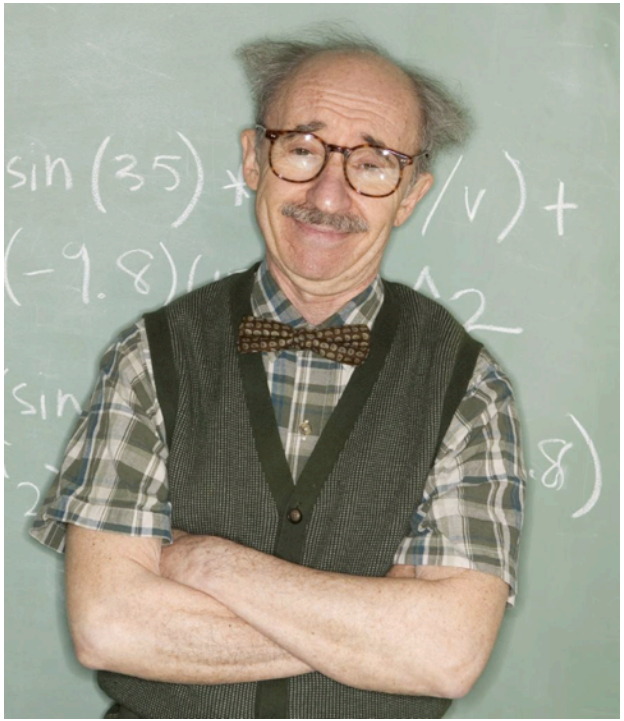
TEACHERS CAN PERCEIVE STUDENTS' EMOTIONS



In Digital Learning Environments

THE OCCURRENCE OF CONFUSION

When learning from computers, learners are actually quite **isolated,**

Their emotions **cannot be easily detected** by a teacher,

How to **detect learner's confusion** in digital learning environments?

It’s Not Only Confusion

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LEARNERS CAN EXPERIENCE A WIDE RANGE OF EPISTEMIC EMOTIONS

Measuring Confusion

And other epistemic emotions

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Different experimental methods to measure learners' confusion:

(Arguel, Lockyer, Lipp, Lodge, & Kennedy, 2017)

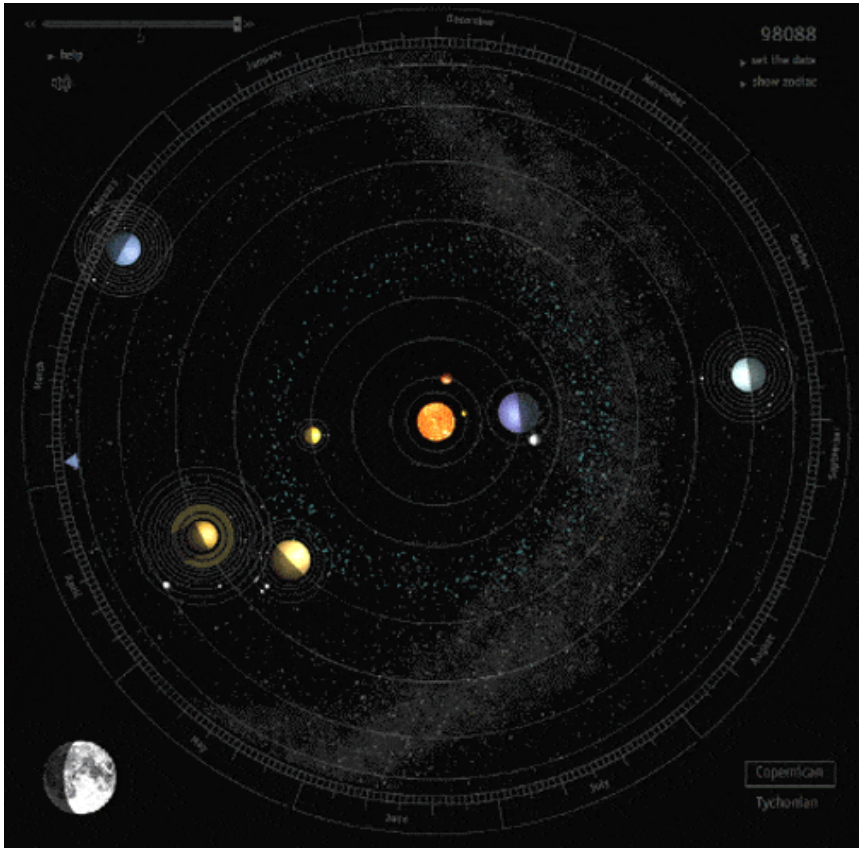
- Facial expressions
- Self-report
- Physiological changes
- Behavioural indicators
- In digital learning environments: **activity analytics**

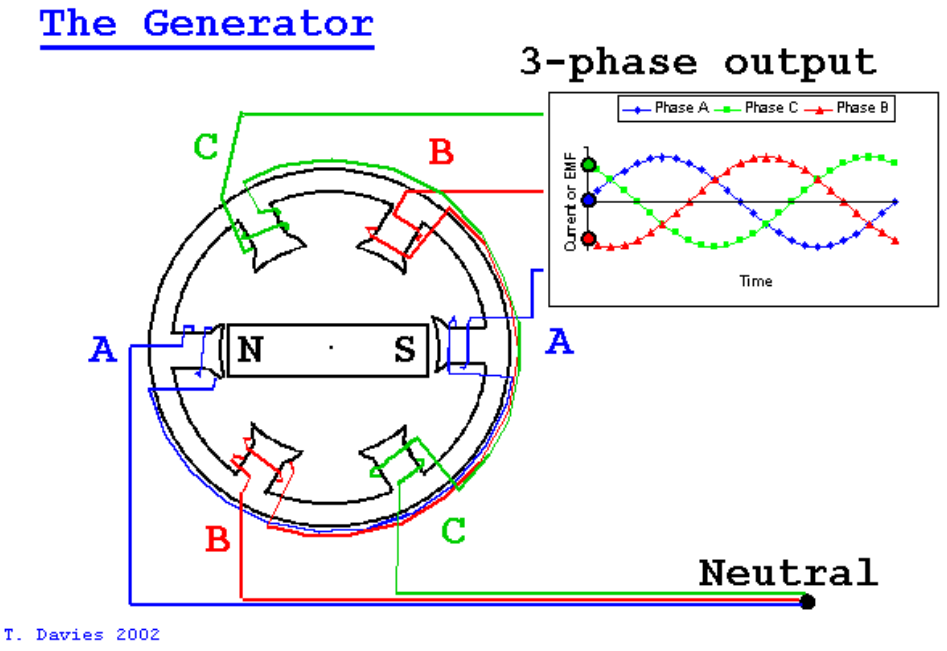
Learning from videos

Interactive digital learning environment

Advantages of videos

Congruence principle (Tversky, Morrison, & Bétrancourt, 2002)





Problem with videos

The Transience of Information

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Animations can generate **higher cognitive load** due to the transience of information
(Ayres & Paas, 2007)

Possible solution:
To embed **control features** in videos:

- To improve **learning**,
(Berney & Bétrancourt, 2016)
- To reduce **cognitive load**,
(Hasler, Kersten, & Sweller, 2007; Tabbers & de Koeijers, 2010)
- Also, to manage **confusion**?

Internet Explorer 9

Opera

Safari

Chrome

Firefox

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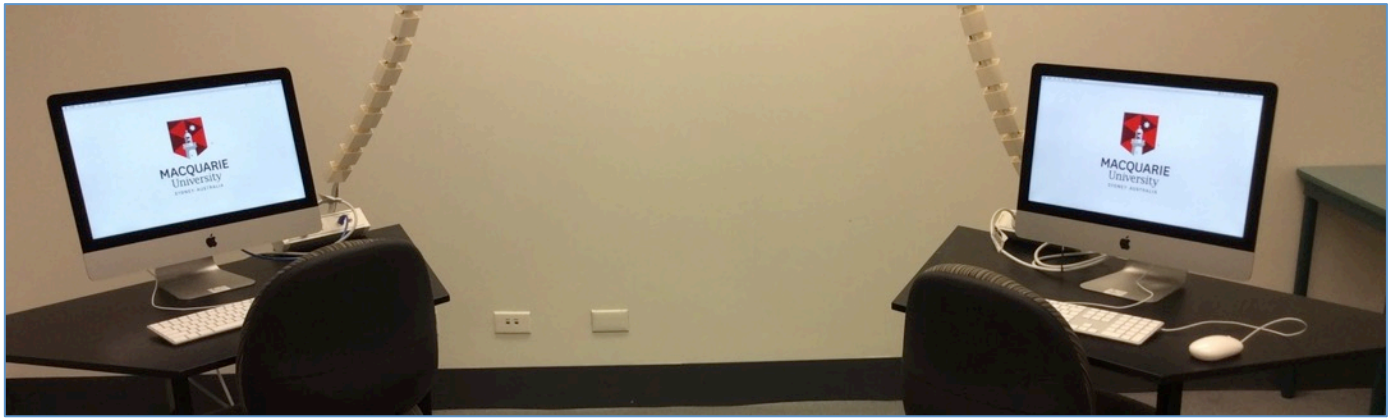
Experimental Study

Learning from instructional videos

Testing environment

Learning Research Lab



Participants

- **51 participants** recruited from Macquarie University
- Age range 18-53 (*M* = 22.2, *SD* = 5.79)
- No background in engineering, chemistry, mechanics, or electronics

Learning Material

Instructional Videos on “How Stuff Works”

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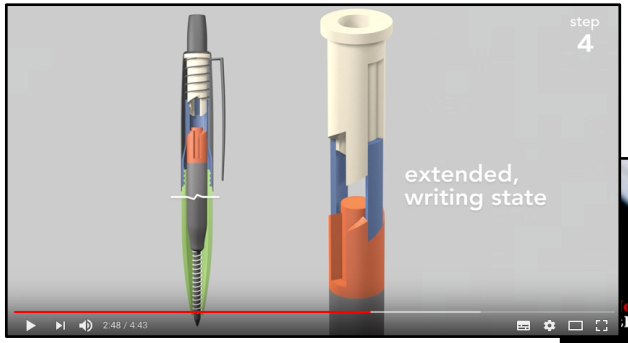
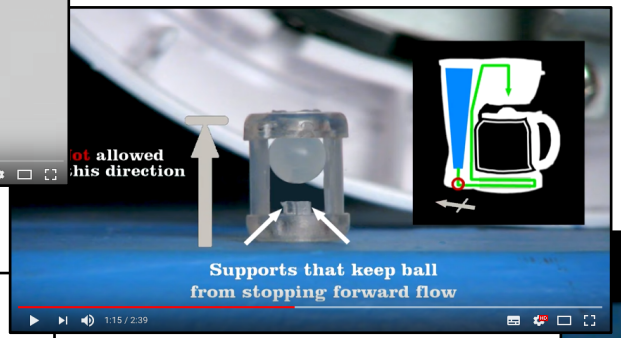
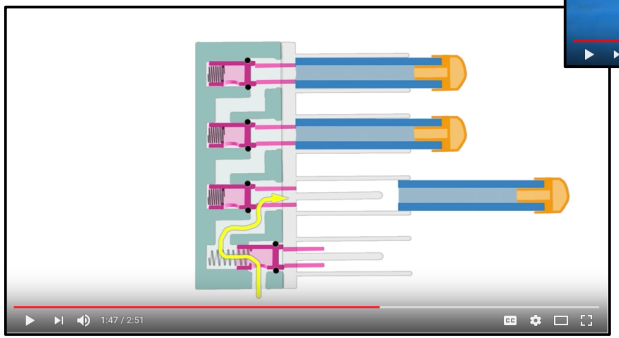


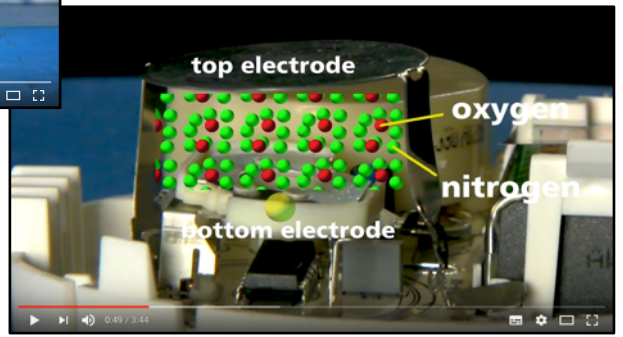
Video 1: Ballpoint pen



Video 2: Coffee machine



Video 3: Nerf blaster



Video 4: Smoke detector

Dependent Variables

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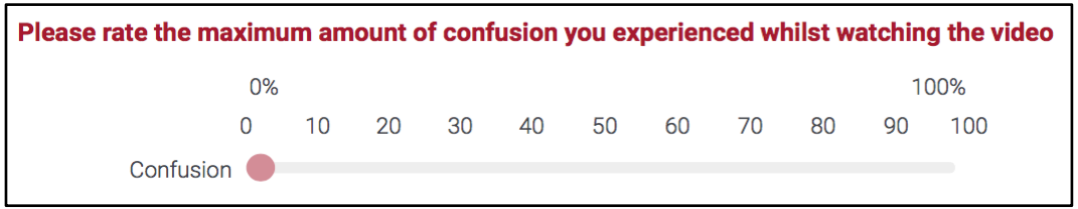
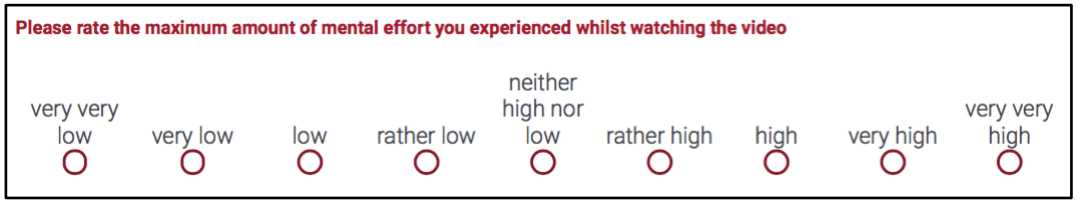
Self-reported confusion (expected lower with video controls)



Cognitive Load (Paas, 1992) (expected lower with controls)

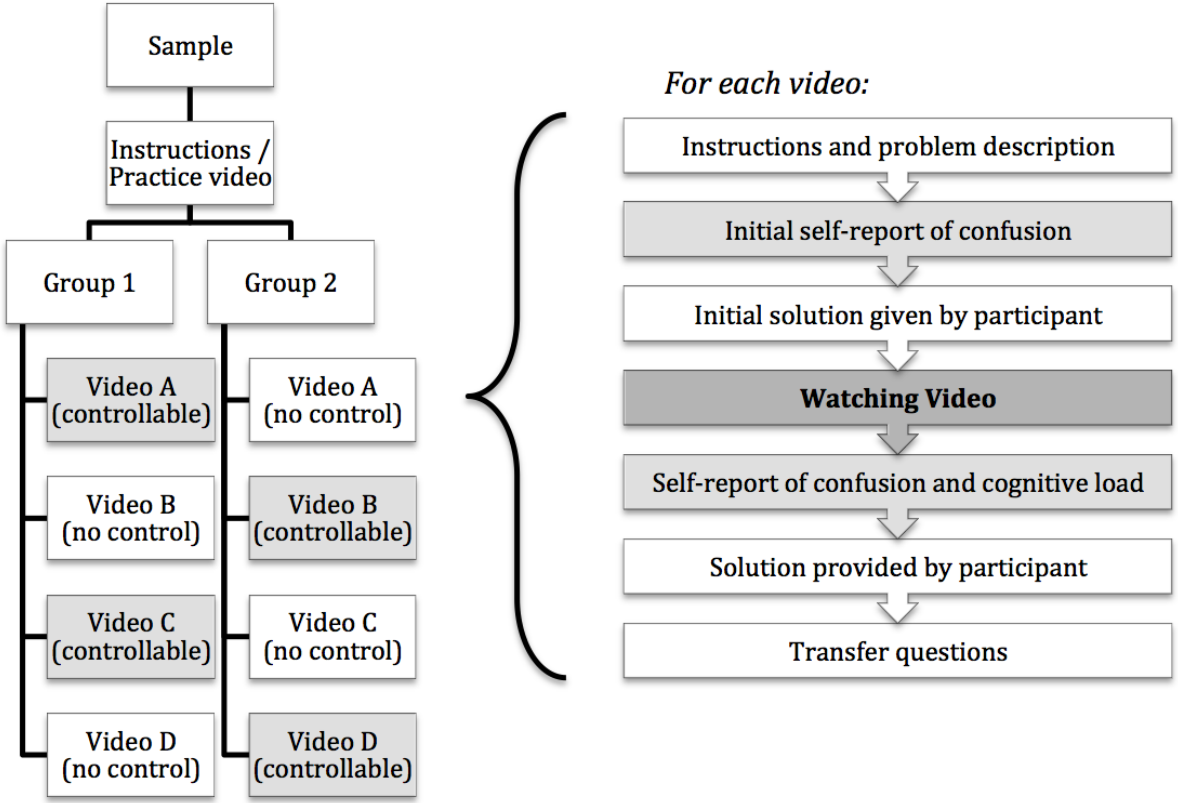


Learning performance: (expected better with controls)

6 multiple choice questions for each video

Testing protocol

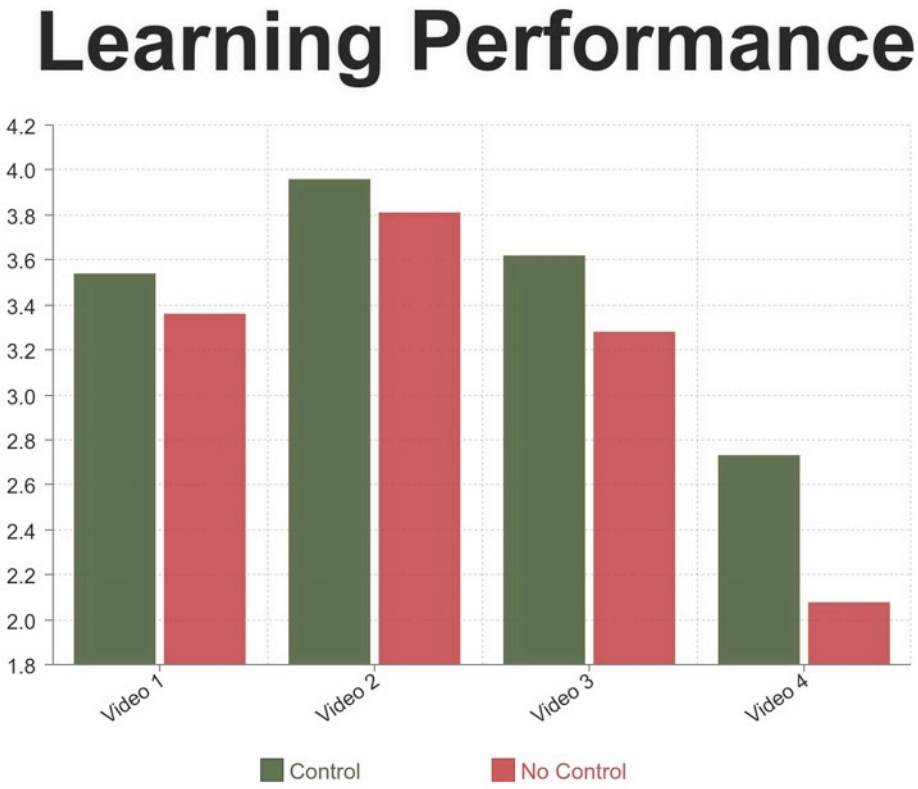
Experimental design



Results

Results

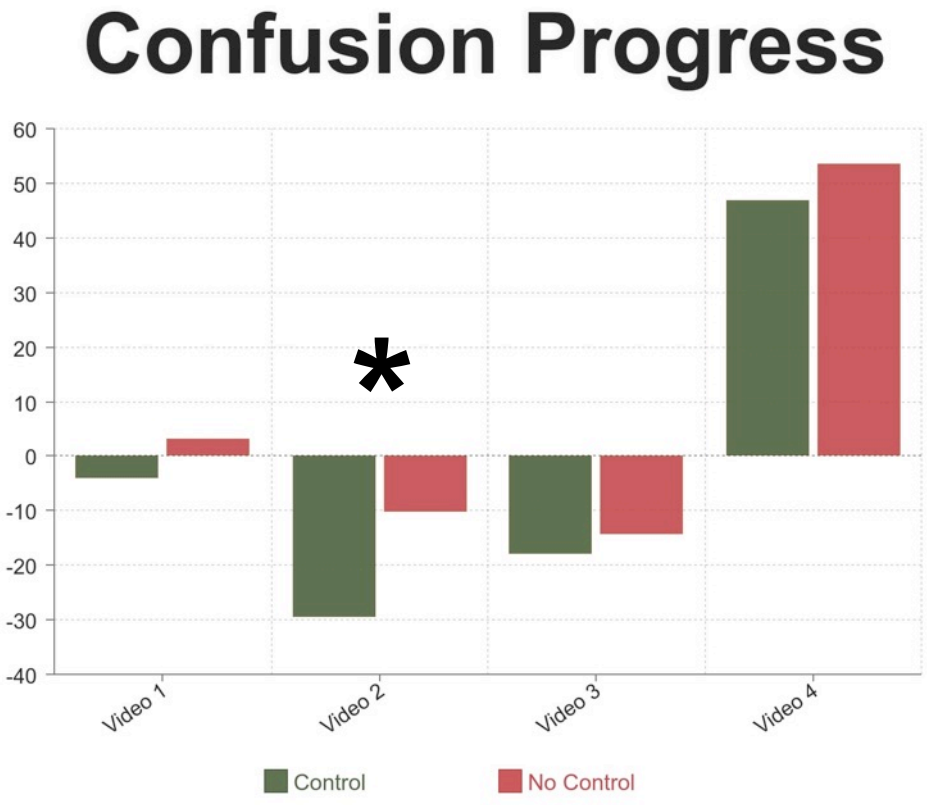
Effect of Controllability on Learning Performance



No statistically significant difference between the groups ($p > .05$)

Results

Effect on Change of Confusion (post – pre-test)

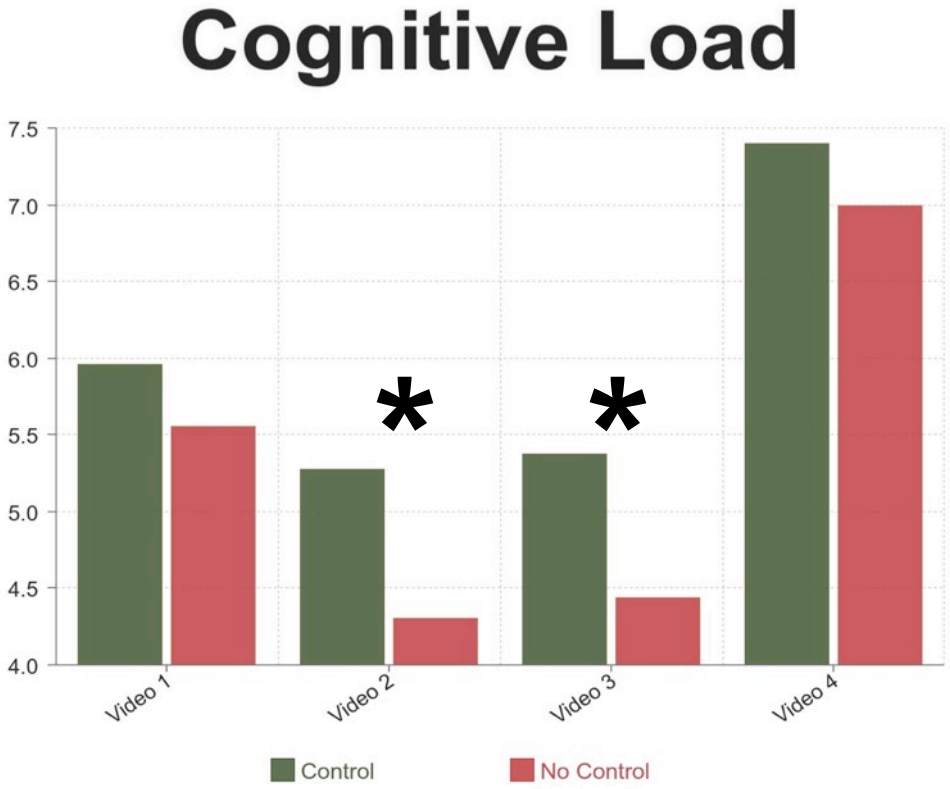


Confusion reduction tended to be stronger for the group with control features

Only one significant difference observed:
* Video 2: $F(49) = 2.01$, $p = .02$

Results

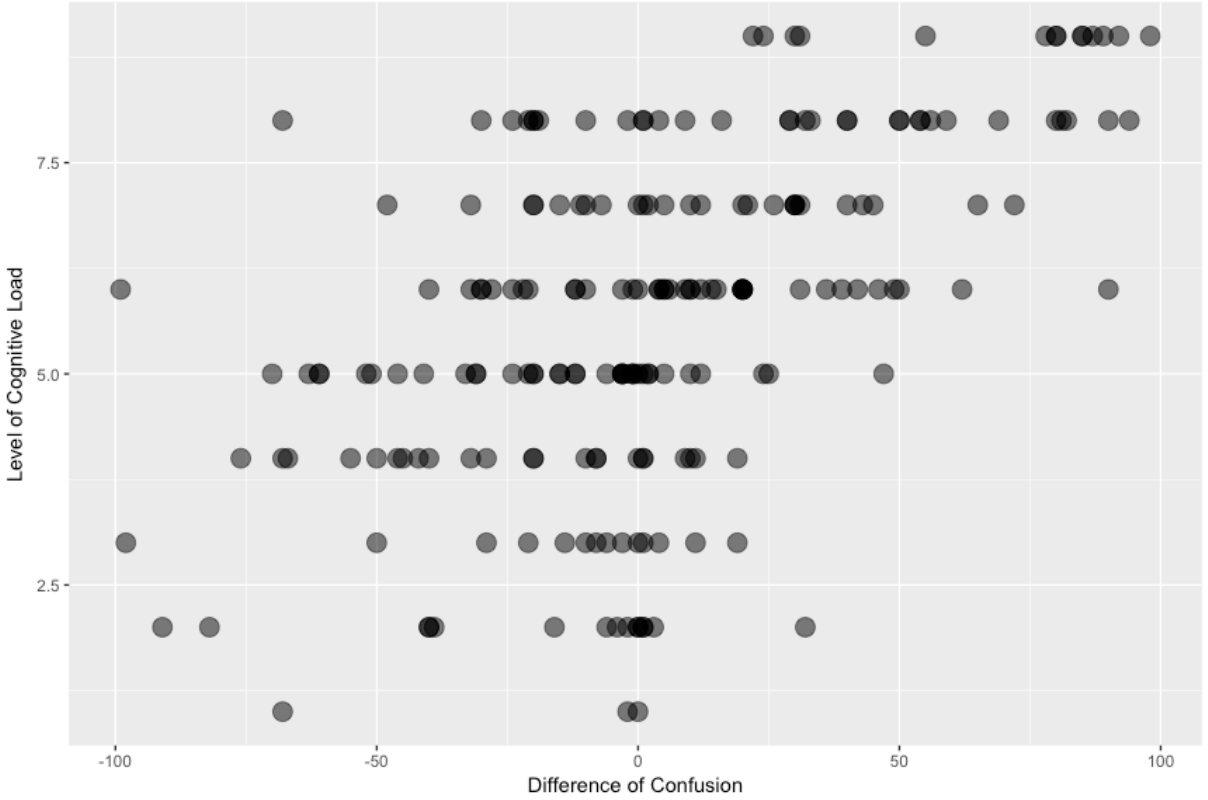
Effect on Level of Cognitive Load



The level of CL tended to be higher with control features

Significant differences observed:
* Video 2: $F(49) = 1.94$, $p = .05$
* Video 3: $F(49) = 2.08$, $p = .04$

Relationship between Confusion and Cognitive Load

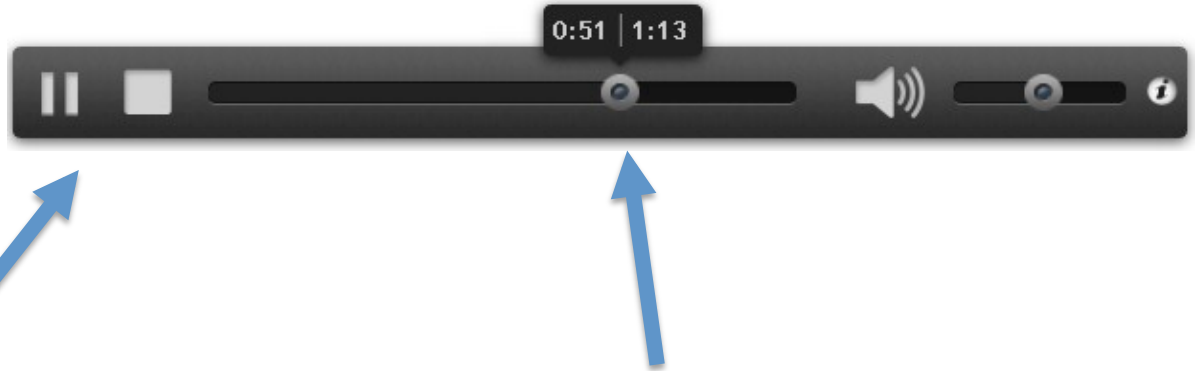


Positive correlation between self-report Confusion and CL

$r(202) = .542$, $p < .001$

Control features

And their actual usage



No one used the **play/pause** button

Manipulating the **cursor** was used by:

- 36% of participants for Video 1
- 50% for Video 2
- 48% for Video 3
- 46% for video 4

Navigation behaviours

With the controllable videos

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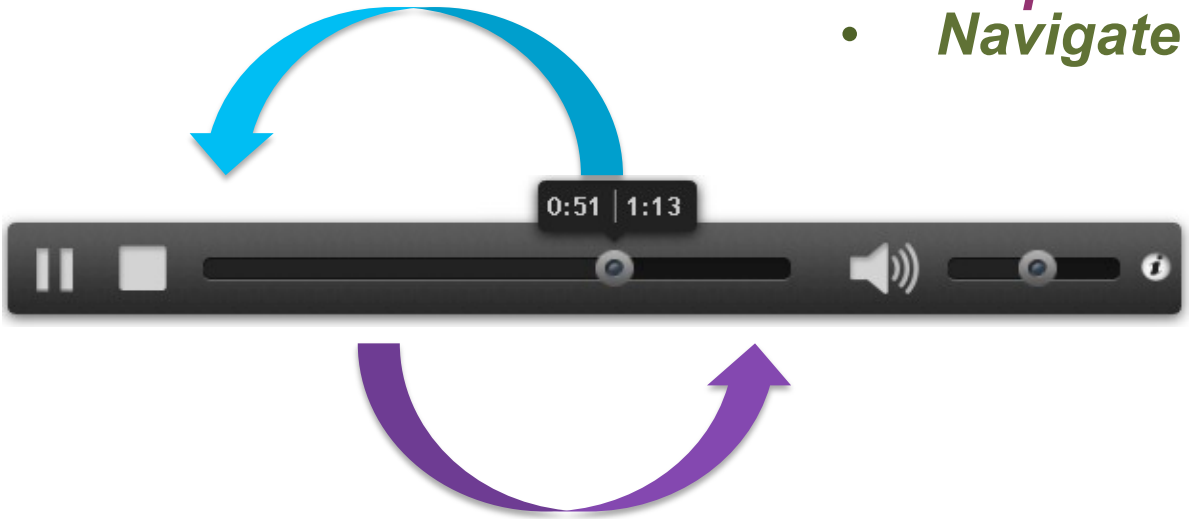

3 types of behaviours:

- ***Replay***
- ***Skip***
- ***Navigate*** (replay and skip)

Navigation behaviours

With the controllable videos

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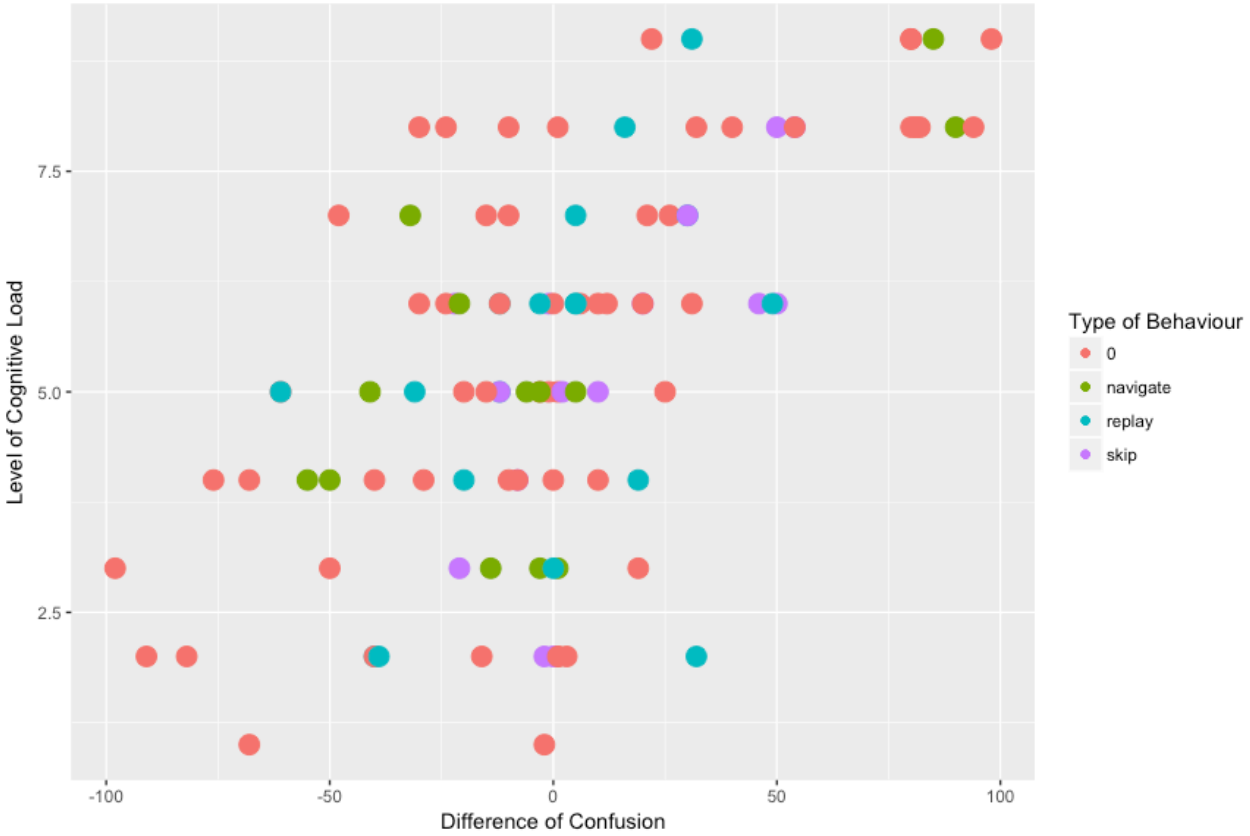

Not enough observations to allow the identification of typical patterns of interactions

Discussion

Questions and further directions

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- Offering the possibility of interacting with videos can produce **beneficial effects**
  How to interpret the increase of CL?
- **Confusion** seemed to be linked with the level of self-reported **CL**
  Could confusion promote Germane CL?
  Inducing "positive confusion" for engaging learners?
- **Interaction activity analytics** is a promising way to identify confusion in digital learning environments
  Defining the parameters of predictive models?
  Indicator of CL?

Thank you

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