

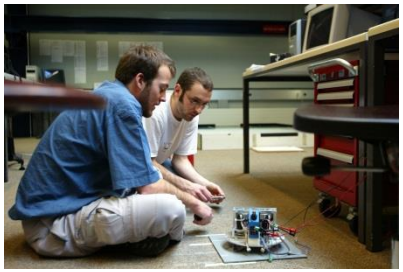

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How People Learn: An overview

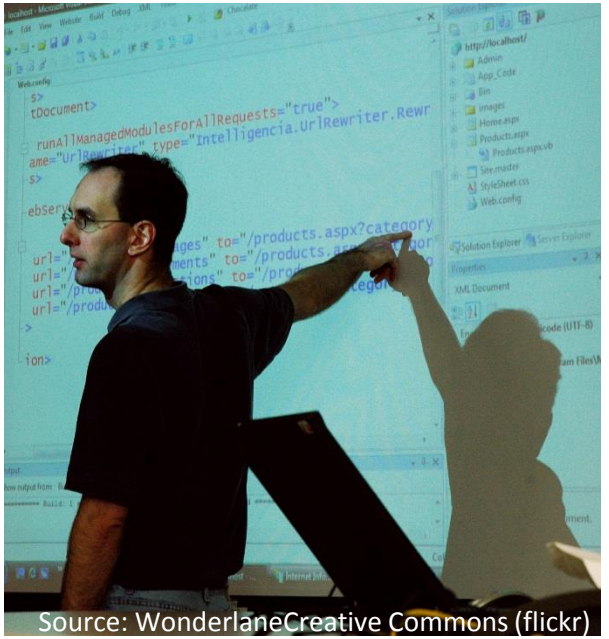
Roland Tormey

How People Learn I

Teaching Support Centre / Centre d'appui à l'enseignement
Email: roland.tormey@epfl.ch

Source: UCD School of Medicine Creative Commons (flickr)

Which of these professions should base their practice on research evidence?



Source: WonderlaneCreative Commons (flickr)

Is educational practice based on evidence?

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- Learning styles…
- Student Competitions (as opposed to cooperation)…
- “Don’t try to understand in the lecture..”

  - And many higher education practices…

Introduction

- Where does evidence about learning come from?
- Key findings:
  - Working
  - Prior Knowledge
  - Feedback systems
  - Appropriate Challenge
  - Spread over time
  - Independence
  - Beliefs about self and material

Sources of Evidence

- American Psychological Association Review of Evidence on school reform (1997)
- US National Research Council review of Evidence on learning and teaching (2000)
- Best evidence synthesis on learning for diverse settings (2003)
- Meta-analysis of 800 meta-analyses on learning (2009)

Sources of evidence

- Different focus
  - School reform
  - Diversity
  - Learning

- Similar findings

- Key findings:
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Learning is work

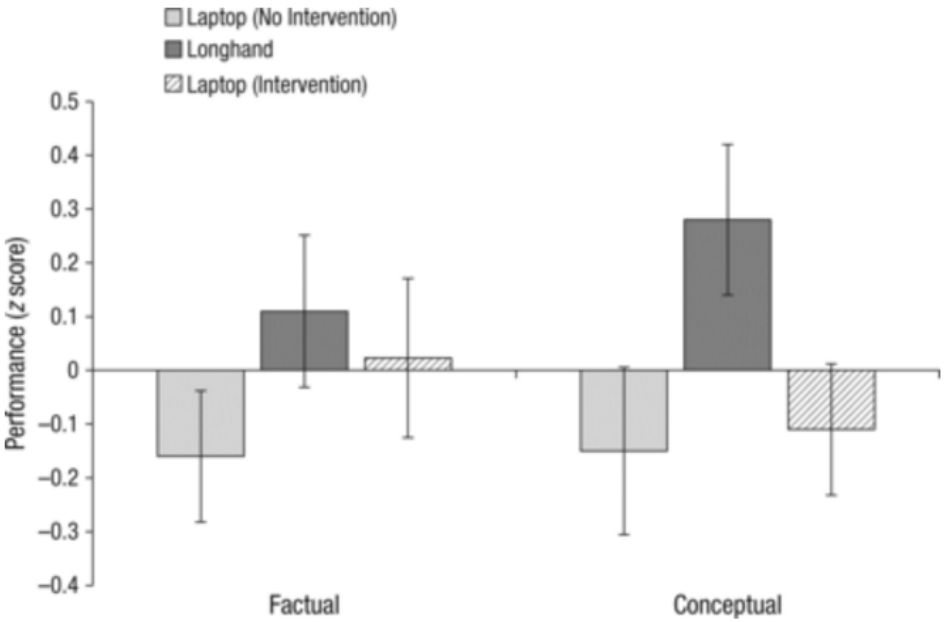

Fig. 4.

Mean *z*-scored performance on factual-recall and conceptual-application questions as a function of note-taking condition (Study 2). Error bars indicate standard errors of the mean.

- "…synthesizing and summarizing content rather than verbatim transcription can serve as a desirable difficulty…"

The Pen Is Mightier Than the Keyboard
Advantages of Longhand Over Laptop Note Taking
Mueller and Openheimer 2014 *Psychological Science*

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Our Knowledge is Connected (or not…)

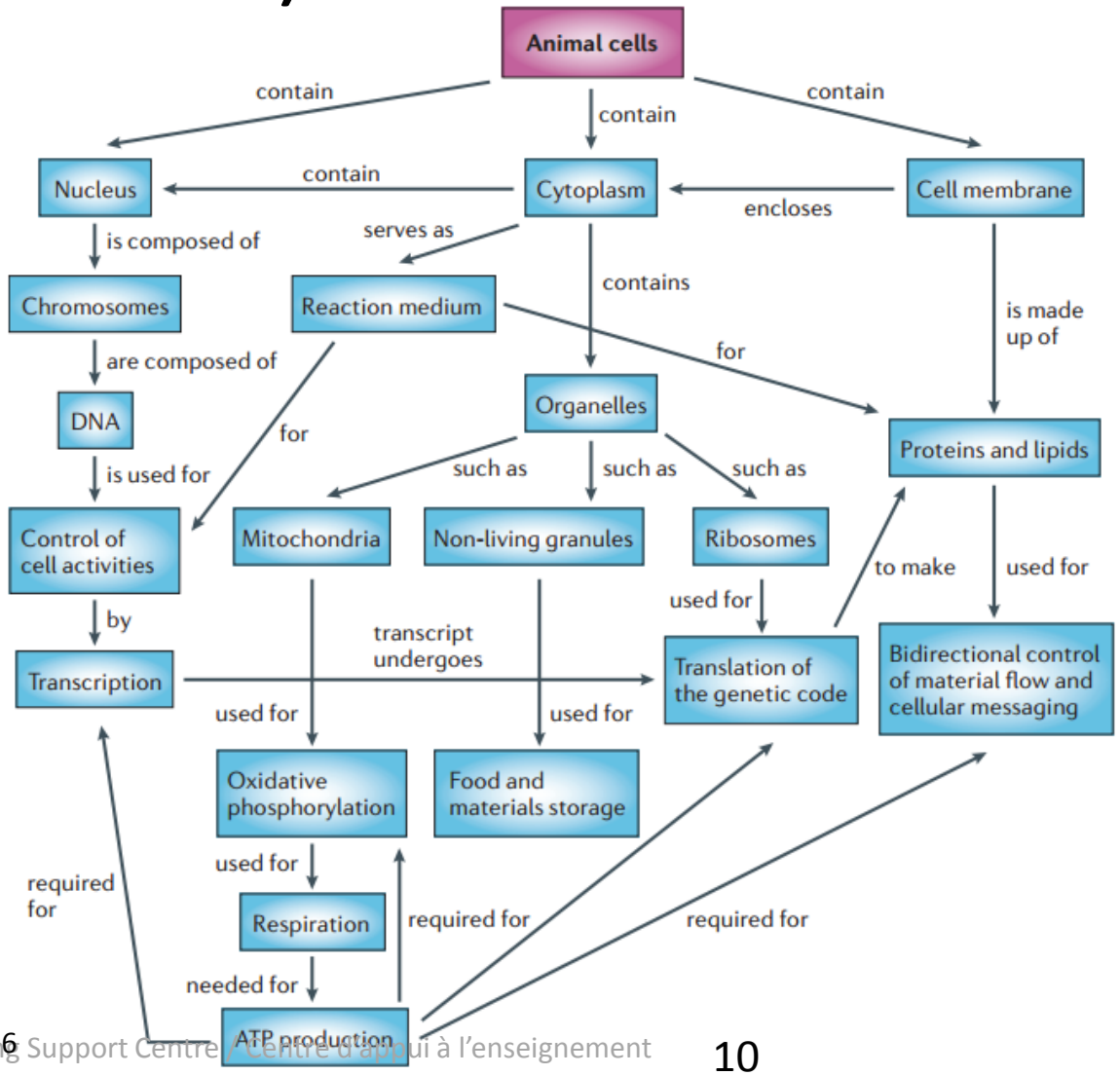
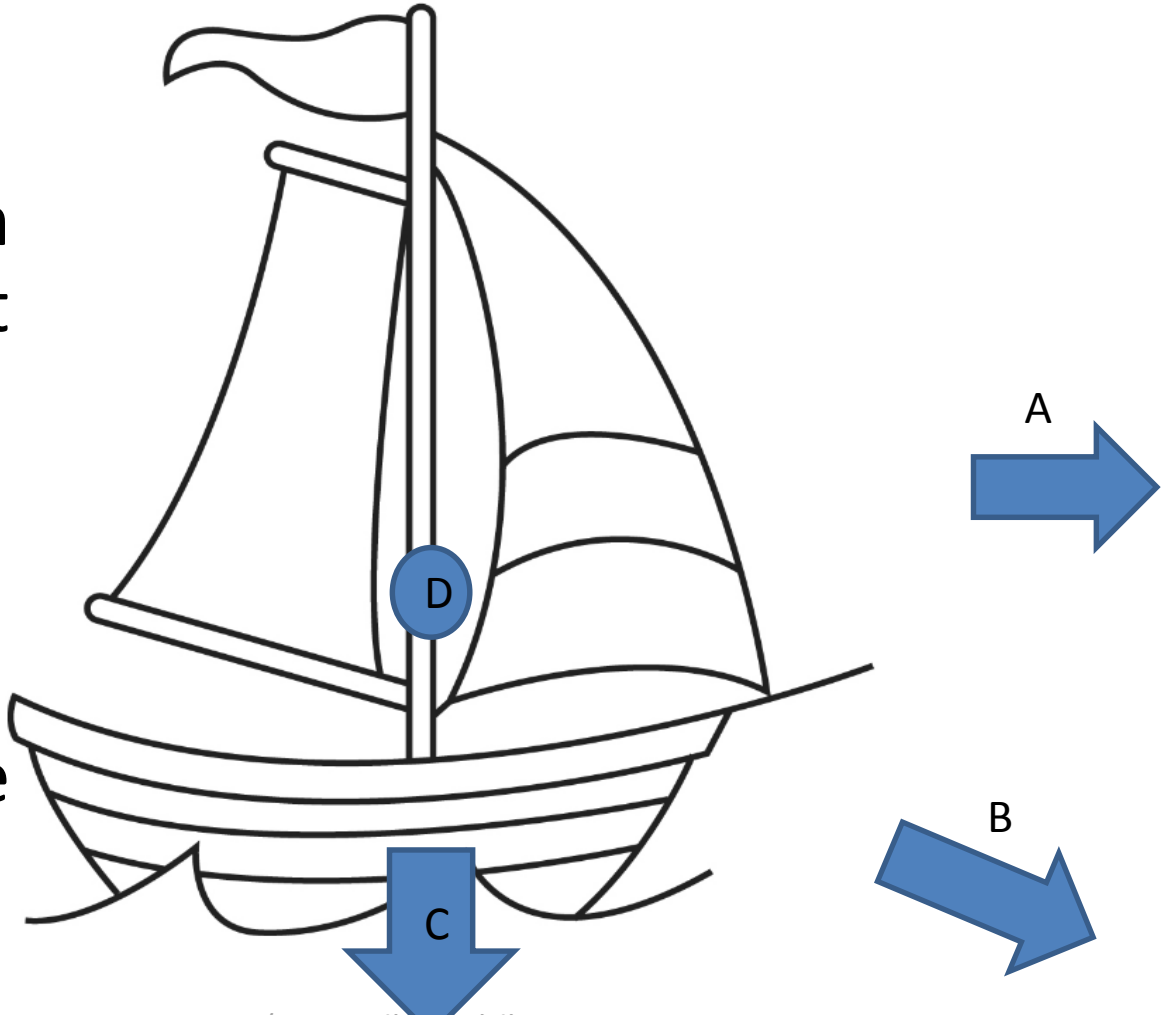


Image: Stephen Dicarlo (2006)

Nature Reviews Molecular Cell Biology **7**, 290-296

- Boat being driven by the wind straight in NE direction, at constant speed of 6 km/h.
- What is the direction of the net force?



Prior (Implicit) Misconceptions

About Forces:

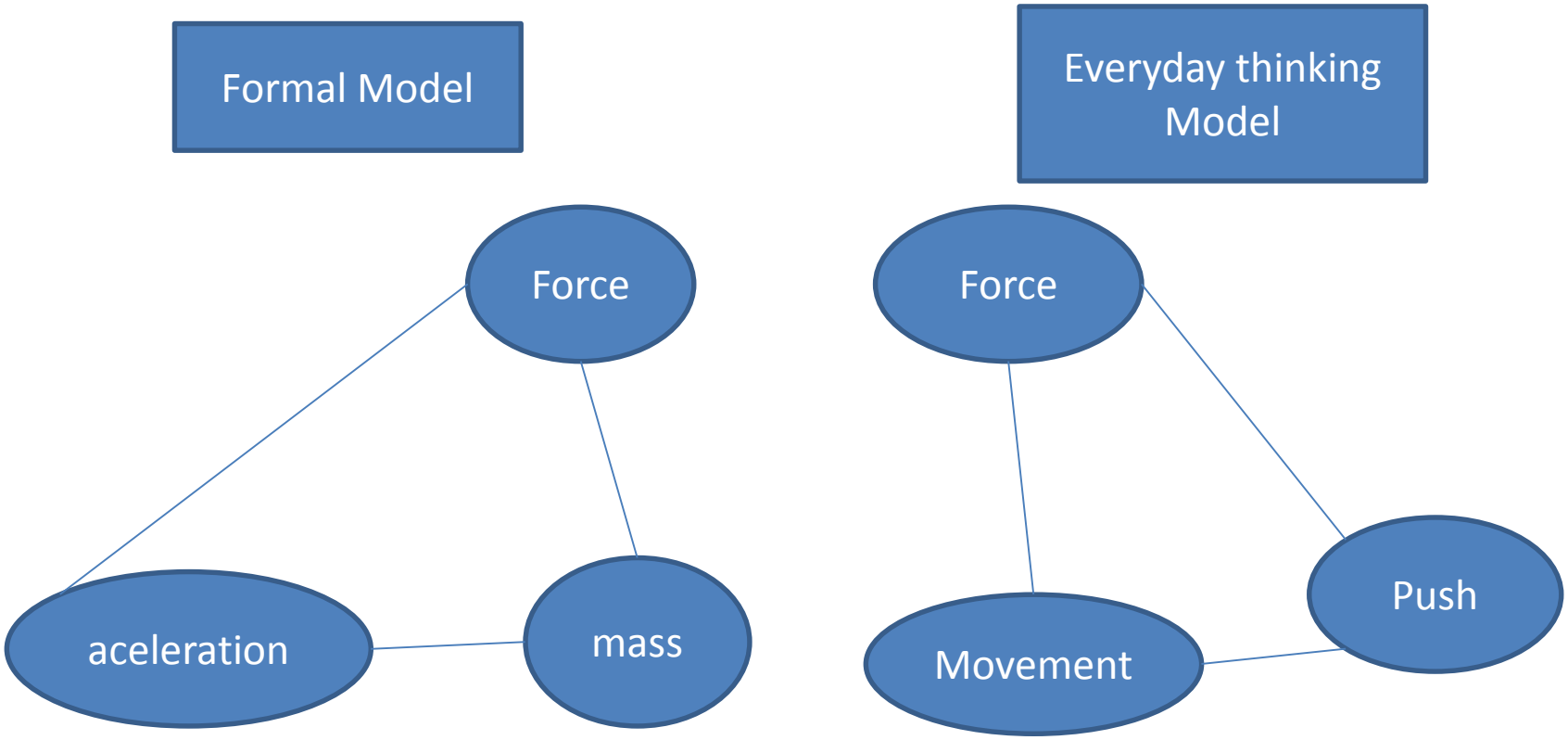
- "If something is not moving there are no forces acting on it"

About thermodynamics:

- "Heating always results in an increase in temperature"
- "Materials like wool have the ability to warm things up"

About oxidation:

"When metal rusts it gets lighter"


Formal Model
Force
aceleration
mass
Everyday thinking Model
Force
Push
Movement

- Key findings:
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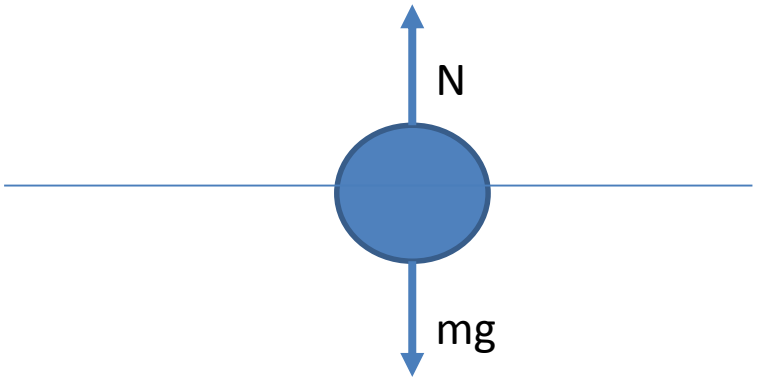
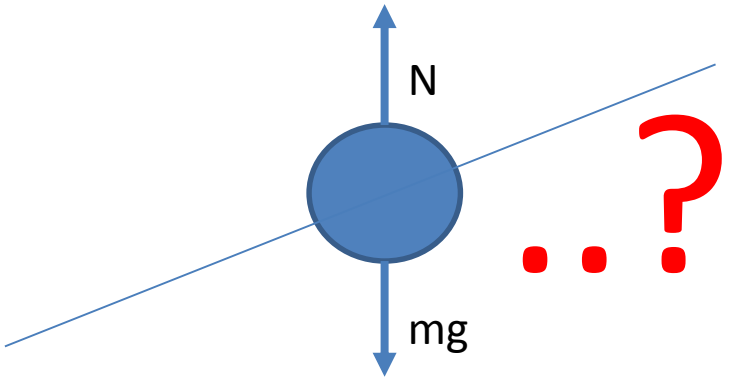
Feedback

- Learners make errors, then what?
  - feedback is “among the most powerful influences on achievement” (Hattie, 2009, p. 173)
  - Immediate feedback is preferable
  - Focus on goals, not the person
- What sources of feedback are typically available in college?





Erreurs dans les copies d'examen

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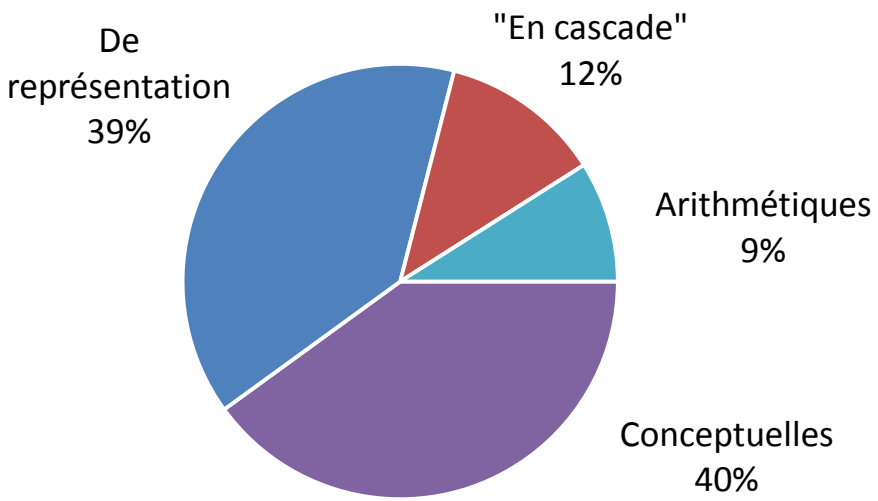
- Representation errors were common in student exams
  - Project forces onto a coordinate system
- This type of activity was practiced in almost every exercise session!!
- Many students appear to not learn from mistakes

Types d'erreurs à l'examen de Physique Générale I (136 copies, 2014)



P. Campiche, O. Chandran, D. Lombardo, and A. Trömel, « Identification of common errors in learning classical mechanics », How People Learn Student Presentations, EPFL, Lausanne, 2015.

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Limits to Processing Capacity

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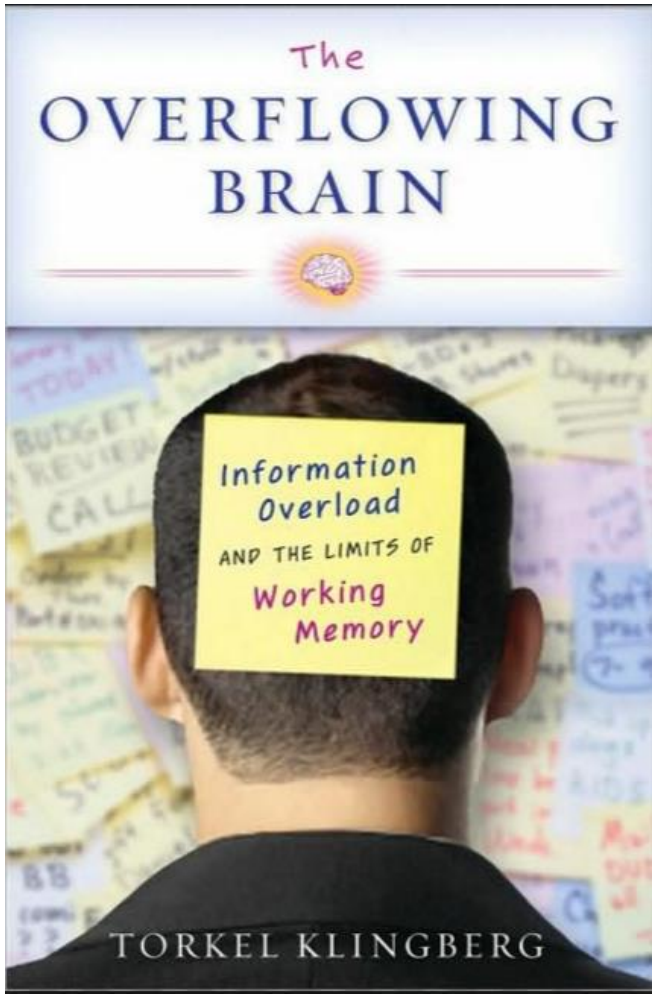
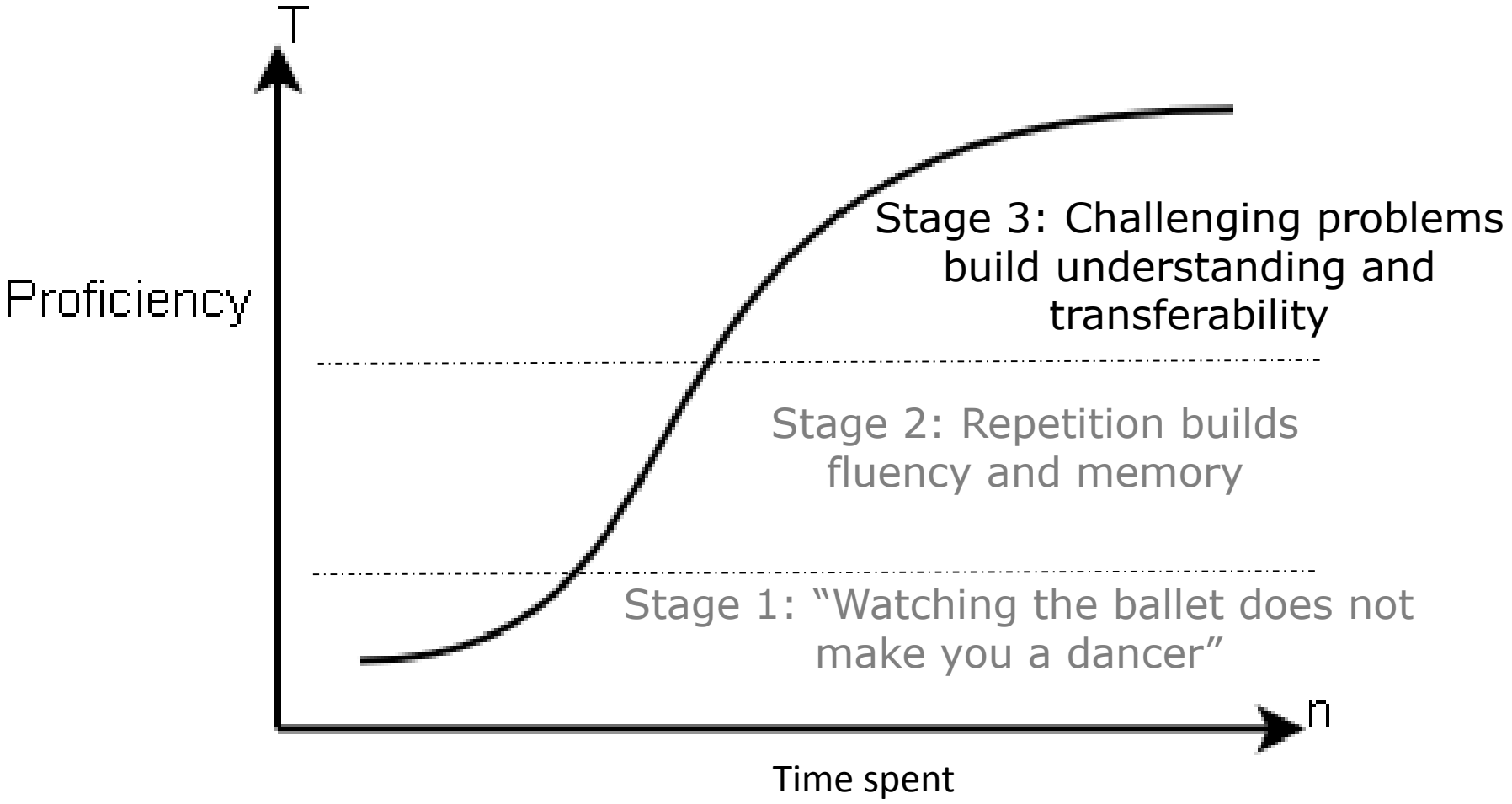
- The Magic Number 7(±2)
- How do we cope?
  - Automatization of mental processes
  - Unlimited use of resources in LTM



Right challenge at the right time



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« Maintainance of Knowledge: Question of Memory We forget to Ask»

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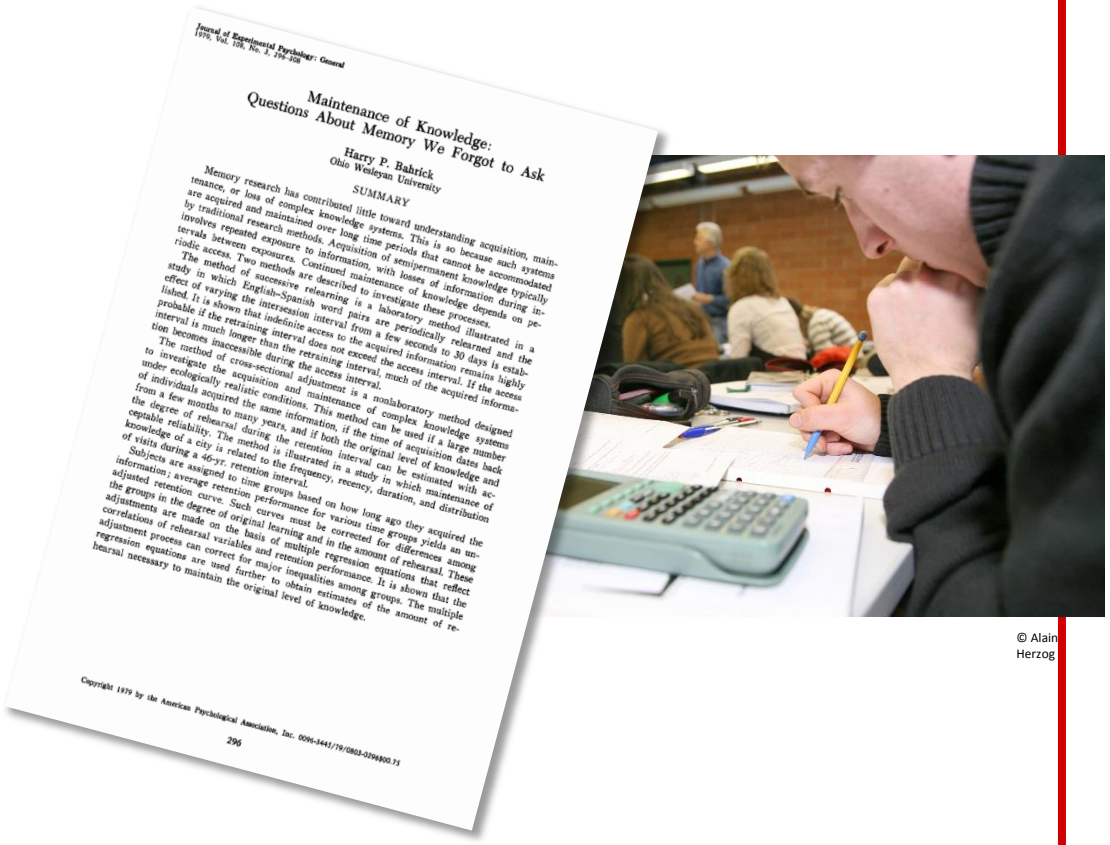
Harry Barhick

Journal of Experimental Psychology (1979)



Journal of Experimental Psychology: General
1979, Vol. 108, No. 3, 296-308

Maintenance of Knowledge:
Questions About Memory We Forgot to Ask

Harry P. Bahrick
Ohio Wesleyan University

SUMMARY

Memory research has contributed little toward understanding acquisition, maintenance, or loss of complex knowledge systems. This is so because such systems are acquired and maintained over long time periods that cannot be accommodated by traditional research methods. Acquisition of semipermanent knowledge typically involves repeated exposure to information, with losses of information during intervals between exposures. Continued maintenance of knowledge depends on periodic access. Two methods are described to investigate these processes.

The method of successive relearning is a laboratory method illustrated in a study in which English–Spanish word pairs are periodically relearned and the effect of varying the intersession interval from a few seconds to 30 days is established. It is shown that indefinite access to the acquired information remains highly probable if the retraining interval does not exceed the access interval. If the access interval is much longer than the retraining interval, much of the acquired information becomes inaccessible during the access interval.

The method of cross-sectional adjustment is a nonlaboratory method designed to investigate the acquisition and maintenance of complex knowledge systems under ecologically realistic conditions. This method can be used if a large number of individuals acquired the same information, if the time of acquisition dates back from a few months to many years, and if both the original level of knowledge and the degree of rehearsal during the retension interval can be estimated with acceptable reliability. The method is illustrated in a study in which maintenance of knowledge of a city is related to the frequency, recency, duration, and distribution of visits during a 46-yr. retention interval.

Subjects are assigned to time groups based on how long ago they acquired the information; average retention performance for various time groups yields an unadjusted retention curve. Such curves must be corrected for differences among the groups in the degree of original learning and in the amount of rehearsal. These adjustments are made on the basis of multiple regression equations that reflect correlations of rehearsal variables and retension performance. It is shown that the adjustment process can correct for major inequalities among groups. The multiple regression equations are used further to obtain estimates of the amount of rehearsal necessary to maintain the original level of knowledge.

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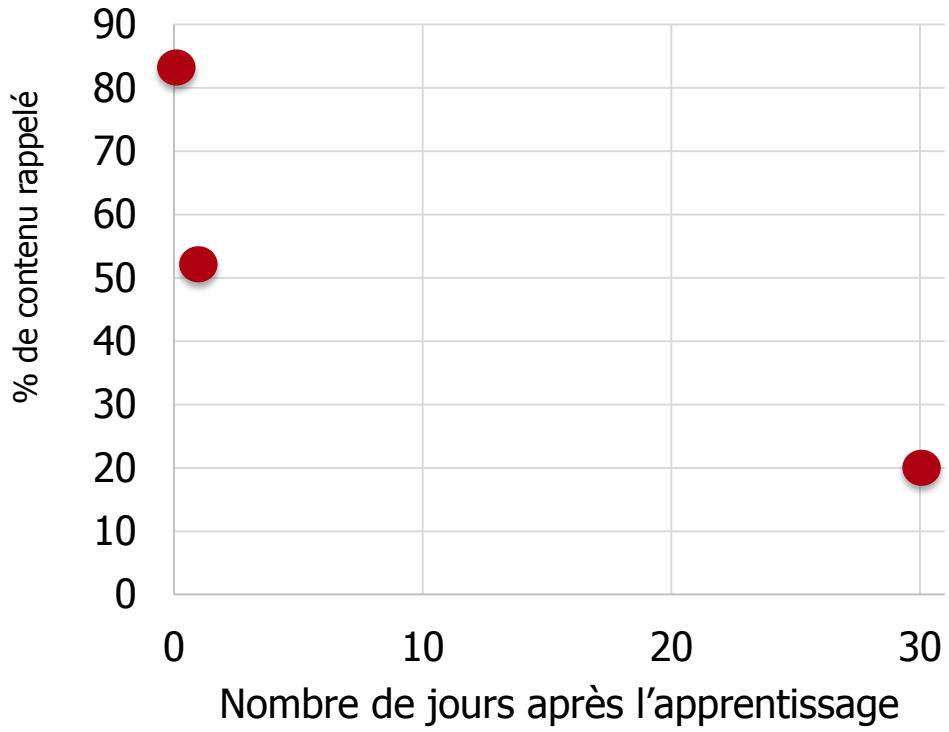
Quelle quantité d'information oublions-nous au cours du temps ?

- Gap betwen tests:
  - Later same day
  - 1 day later
  - 30 days later

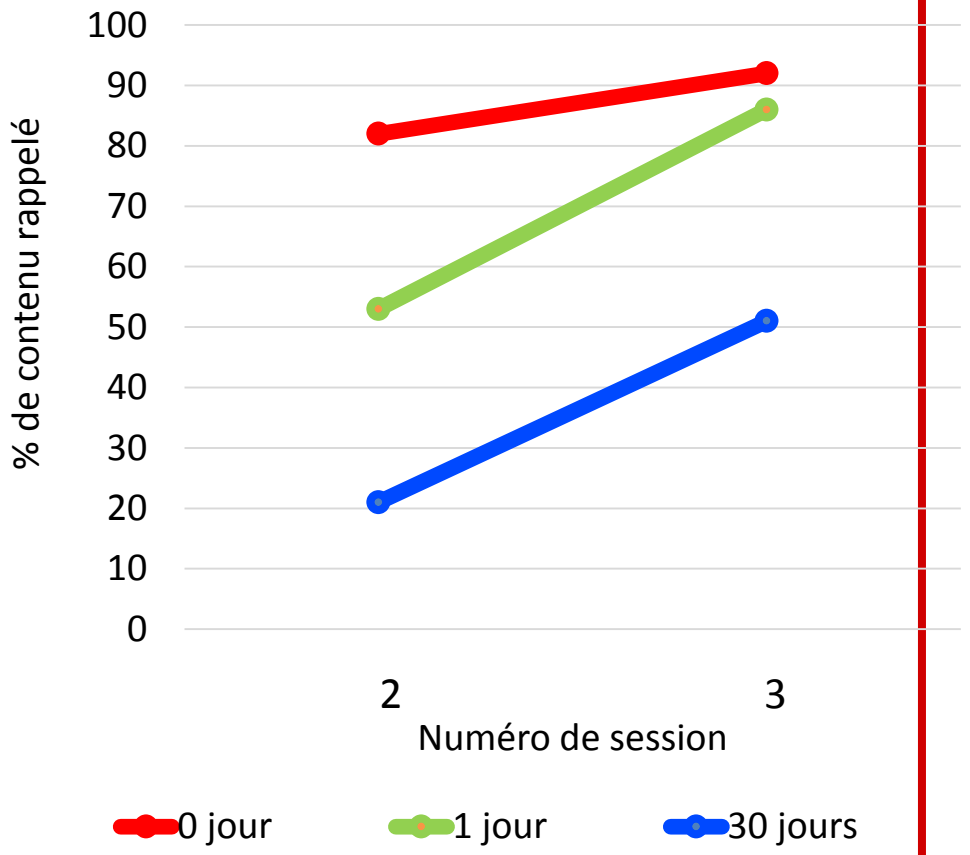
- We forget in an exponential way



A quel point la répétition facilite-t-elle l'apprentissage ?

- Intervalles entre sessions :
  - **Later the same day**
  - **1 day later**
  - **30 days later**

- Longer intervals have a bigger effect on learning/retention



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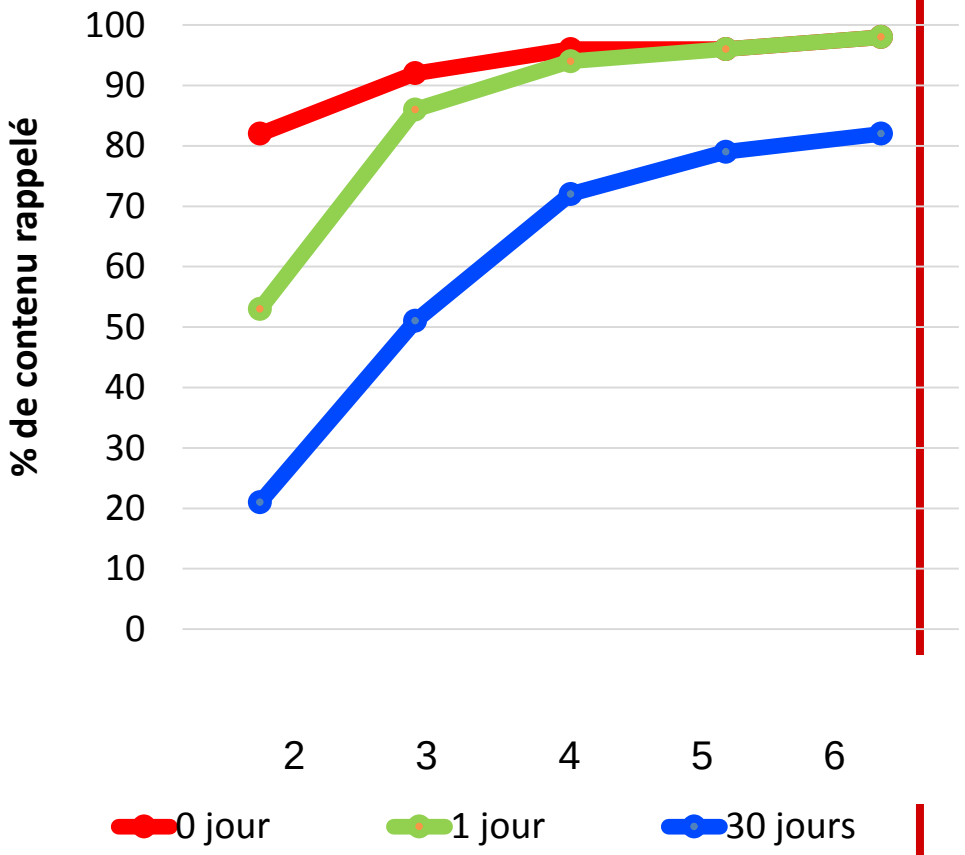

Interval between traning sesions	Score on final test
0 days	68
1 day	86
30 days	95

- Final test was 30 days after the last training sesion
- The group with the spaced training sessions performed best
- Spaced practice effectg

- Key findings:
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Plan, Monitor, Debug, Review

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<table>
<tr><th colspan="3">Metacognition
'thinking about thinking' across memorising, problem-solving and emotion regulation
Meta-Knowing (Kuhn, 2000)</th></tr>
<tr><td rowspan="2">Metacognitive knowledge

(What to do,
How to do it,
When to do it)</td><td colspan="2">Metacognitive Regulation</td></tr>
<tr><td>Regulation of Self and Executive Control
(Planning, Monitoring, Debugging, Evaluating)</td><td>Metacognitive Feelings/ Judgements
(Prospective, Concurrent and Retrospective)</td></tr>
</table>

Source: After Schraw and Dennison (1994) (shaded component), but informed by Schneider (2008), Schraw (2009) and Tarricone (2011)

Are students metacognitive?

- 169 2nd year students, **spring 2014**
- Test of whether they re-check results
- **60.4%** did not check all answers carefully.
- They were also asked to rate their skills at re-checking
- Self report was not correlated with objective score
- **…although many students are weak at monitoring their work, they are not particularly aware of this weakness**

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Beliefs about self

- Self-efficacy
  - I am good at this kind of thing
- Locus of Control
  - I can prepare better next time
  - Sometimes you are just unlucky
- Mastery Goals
  - I want to show how good I am
  - I want to avoid failing
  - I want to improve

Conclusion

- Evidence exists
  - even if teachers and learners often don't use it

- Highlights key features
  - Working
  - Prior Knowledge
  - Feedback systems
  - Appropriate Challenge
  - Spread over time
  - Independence
  - Beliefs about self and material