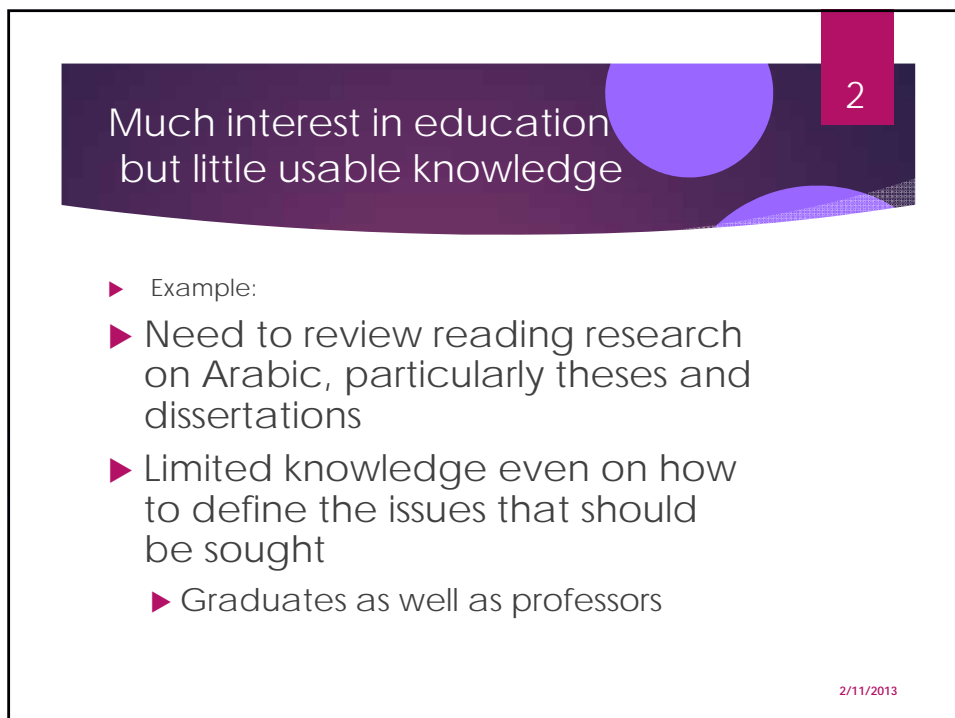


1

Basic research skills: Old problems and new methods

HELEN ABADZI
RESEARCHER
UNIVERSITY OF TEXAS AT ARLINGTON
NOVEMBER 1, 2013
BEIRUT



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Much interest in education but little usable knowledge

- ▶ Example:
- ▶ Need to review reading research on Arabic, particularly theses and dissertations
- ▶ Limited knowledge even on how to define the issues that should be sought
 - ▶ Graduates as well as professors

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Much demand for robust educational research but student supply is not usable

3

- ▶ Limited understanding of hypothesis testing
 - ▶ Implicit hypotheses made and not tested
 - ▶ students often test the wrong concepts and find invalid answers.
- ▶ Limited mathematical and statistical preparation needed to handle research designs.
- ▶ Few available methods students can use to answer educational questions.
 - ▶ Dissertations: often descriptive, "ethnography"
- ▶ No coursework to support better options

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What problems should graduate-level "education specialists" be able to solve?

4

WHAT IS MISSING FROM THEIR EDUCATION?

Confusion between personal beliefs and research hypotheses

5

- ▶ If you teach students letters, they will be bored
- ▶ No one learns certain info unless they are interested in it
- ▶ Constructivist classrooms are the best. Students:
 - ▶ Must work in groups (social learning?!)
 - ▶ Must not be tested often
 - ▶ Must feel happy in school
 - ▶ Must express themselves freely
 - ▶ Must have high self-esteem
- ▶ Implicit: then they perform best

- ▶ How do we know???
- ▶ none of the above are questioned

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Difficulties in establishing causality

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- ▶ What logic is used to explain effects or lack thereof?
 - ▶ Piaget, Vigotsky, Montessori, John Dewey
- Cognitive psychology is to education what biology is to medicine**
- if you go to a hospital you expect doctors to know basic biology
- Do educators know basics about memory functions?
- Or research on motivation and emotions?

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Education faculties do not teach how people learn

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- ▶ Learning is used as a commonsense word
 - ▶ No rules, research on memory are typically evoked
 - ▶ Total ignorance about the practicalities of working memory
- ▶ How many courses does your department teach in cognitive science?
- ▶ Information processing:
 - ▶ Explains, predicts, & controls educational effects
 - ▶ Focuses attention on cognitive networks, working memory
- ▶ Other psychological research informs about student motivation, beliefs, social learning

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Students have limited knowledge of the relevant research

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- ▶ Education dissertations often limit research review to education theories and journals
- ▶ Students do not know the vast amounts of experimental research in psychology
- ▶ If they knew, they would write better informed dissertations and theses

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Faculty sometimes lack sufficient knowledge or rigor

- ▶ A US student writing about the achievements of a certain educator:
- ▶ "He is the most famous educator in the world"
- ▶ Professor:
- ▶ "Aren't you exaggerating a bit?"
- ▶ **Instead, what should the professor answer?**
 - ▶ ask the student to do?

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Issue: Students may know little math, hard to teach statistics

- ▶ Dissertations have ethnography
- ▶ Qualitative analyses
 - ▶ Discourse analysis etc.
- ▶ Students collect data through through questionnaires rather than experiments
 - ▶ Often survey methodology unknown
- ▶ Little if any data analyses

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Practical vs. statistical significance distinction needed

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- ▶ Would you recommend these methods to the relevant governments?
- ▶ A reading method applied in Kenya led to:
 - ▶ 40% of students scoring above 50%
 - ▶ Vs. control of 32% students scoring above 50%
- ▶ A reading method in Mali raised words per min. From 0.75 to 3
- ▶ Triumph! Statistical significance !
 - ▶ But 50% is very limited reading!
 - ▶ We need 45-60 wpm to make sense, not 3 !

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Experimental and quasi-experimental designs for research and evaluation

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- ▶ Often statements about the above are general
- ▶ Big words and little knowledge on evaluation



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The One Shot Case Study

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- ▶ A single group studied only once

X O

- ▶ examples

- Does it establish a cause-effect relationship?
- *Internal validity issues?*

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One Group Pre-Posttest Design (no random assignment)

14

▶ O_1 X O_2

- Does it establish a cause-effect relationship?
- *Internal validity issues?*

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The Static Group Comparison (no random assignment)

15

X O₁ O₂

- Does it establish a cause-effect relationship?
- *Internal validity issues?*

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The Pretest-Posttest Control Group Design

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▶ (diff in diff)

▶ R O₁ X O₂

▶ R O₃ O₄

- Does it establish a cause-effect relationship?
- *Internal validity issues?*

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The Solomon Four-Group Design

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For the testing threat of internal validity

▶ R	O_1	X	O_2	<ul style="list-style-type: none"> Does it establish a cause-effect relationship? <i>Internal validity issues?</i>
▶ R	O_3		O_4	
▶ R		X	O_5	
▶ R			O_6	

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The Posttest-Only Control Group Design

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▶ R	X	O_1	<ul style="list-style-type: none"> Does it establish a cause-effect relationship? <i>Internal validity issues?</i>
▶ R		O_2	

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More complex designs

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R O₁ X O₂ -X O₃

Start and end treatment

R O₁ X O₂

R O₁ X O₂

R O₁ X O₂

Stack treatment

Regression discontinuity

etc

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Students need a much better statistical sense

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- ▶ No good sense of variance
 - ▶ Prediction that "the students will do x.." is there no variability??

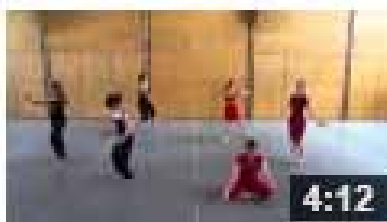
- ▶ Currently ritualistic recital of alpha and beta error, p values, confidence intervals
- ▶ Currently ritualistic null hypothesis
- ▶ Women unfortunately have less training
 - ▶ Less interest
 - ▶ More difficulty getting jobs

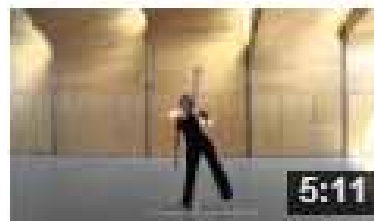
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One solution: Dancing statistics !

- ▶ dancing statistics on Youtube
- ▶ E.g.
- ▶ <http://www.youtube.com/watch?v=orLSv0g9-lk>

A group of people, including men and women in traditional Arab attire, are dancing in a courtyard. The scene is captured in a video frame with a timestamp of 4:12 in the bottom right corner.

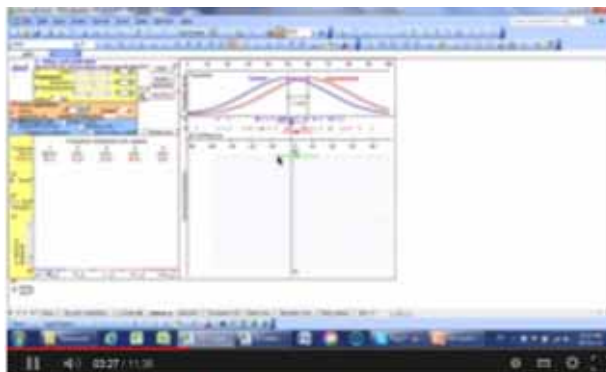
A person is dancing in a courtyard. The scene is captured in a video frame with a timestamp of 5:11 in the bottom right corner.

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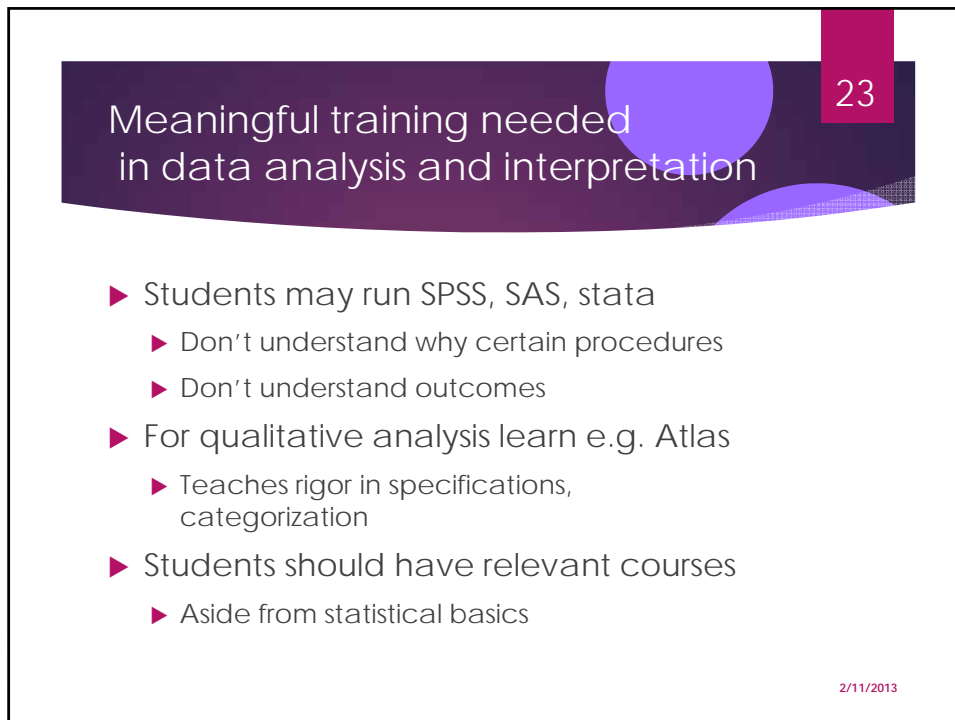
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Dancing statistics!

ESCI software
etc

A screenshot of the ESCI software interface, showing a complex diagram with various nodes and connections, likely representing a statistical model or data structure. The interface includes a toolbar at the top and a status bar at the bottom.

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Meaningful training needed in data analysis and interpretation

- ▶ Students may run SPSS, SAS, stata
 - ▶ Don't understand why certain procedures
 - ▶ Don't understand outcomes
- ▶ For qualitative analysis learn e.g. Atlas
 - ▶ Teaches rigor in specifications, categorization
- ▶ Students should have relevant courses
 - ▶ Aside from statistical basics

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What new methods can students use in dissertations?

STRICTLY EDUCATIONAL METHODS HAVE REACHED THEIR LIMITS

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It is now feasible to measure neurocognitive variables

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- ▶ Potential questions to answer:
- ▶ How to speed up reading and math?
- ▶ How to develop textbooks that are read and understood most easily?
 - ▶ Event-related potentials routinely used
 - ▶ Eye trackers
 - ▶ Psychophysics displays
- ▶ Costs involved, trainers needed

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Eye tracker unit and processor University of Rome

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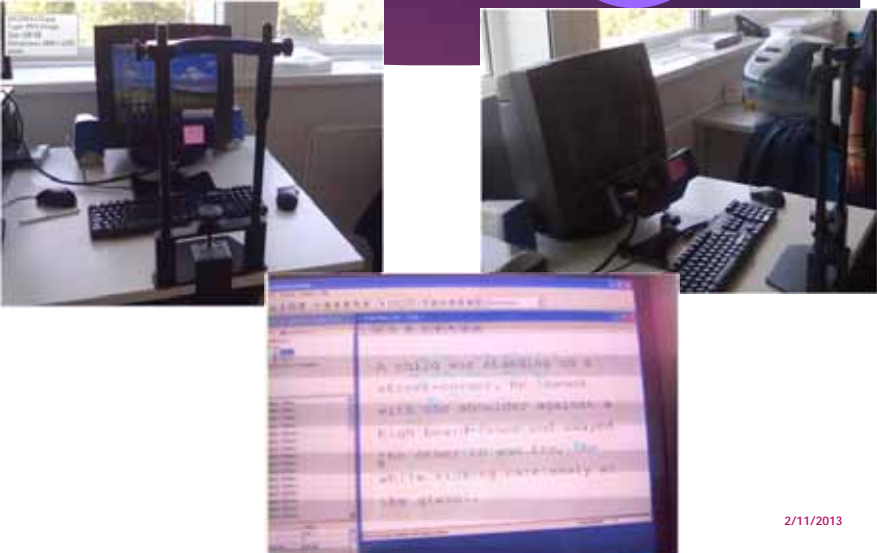


M. Martelli, G. Zoccolotti

2/11/2013

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Eye tracker monitors where the eyes move
Screen shows where they rested on a page

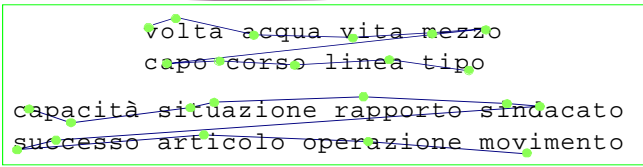


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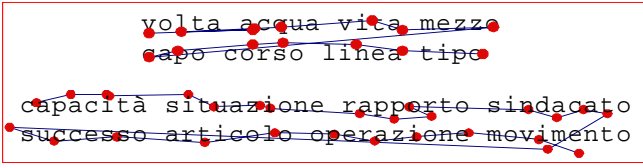
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Eye movements as a function of word length
Between a proficient and dyslexic reader

Proficient reader



Dyslexic reader




G. Zoccolotti, U. of Rome

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Event-related potentials monitor voltage in brain areas known to be related to reading proficiency


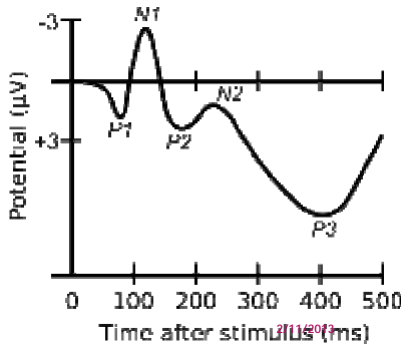
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Specialized Electroencephalogram (EEG) Event-Related potentials (ERPs) Relatively inexpensive research tool for monitoring reading acquisition

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Brain imaging techniques

functional magnetic resonance imaging (fMRI)

Example

Brain activation patterns of literates and illiterates



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Some recommendations

- ▶ New coursework needed
 - ▶ Updated educational psychology, 2-3 courses
 - ▶ Including memory, social, perception, neuroscience
 - ▶ Popularizing cognitive psychology
- ▶ New and attractive statistics courses
- ▶ Rigorous training in research designs
 - ▶ Specific focus on implicit hypothesis formation
- ▶ Training in critical thinking ?
 - ▶ Some effects for law students

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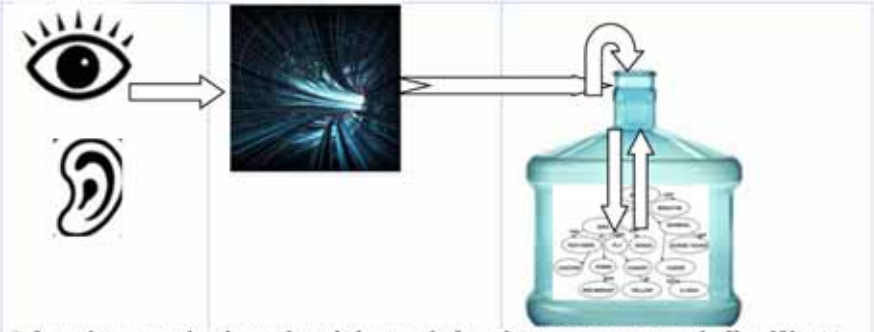
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How to make these new courses more comprehensible, applicable?

POPULARIZING MEMORY FUNCTIONS

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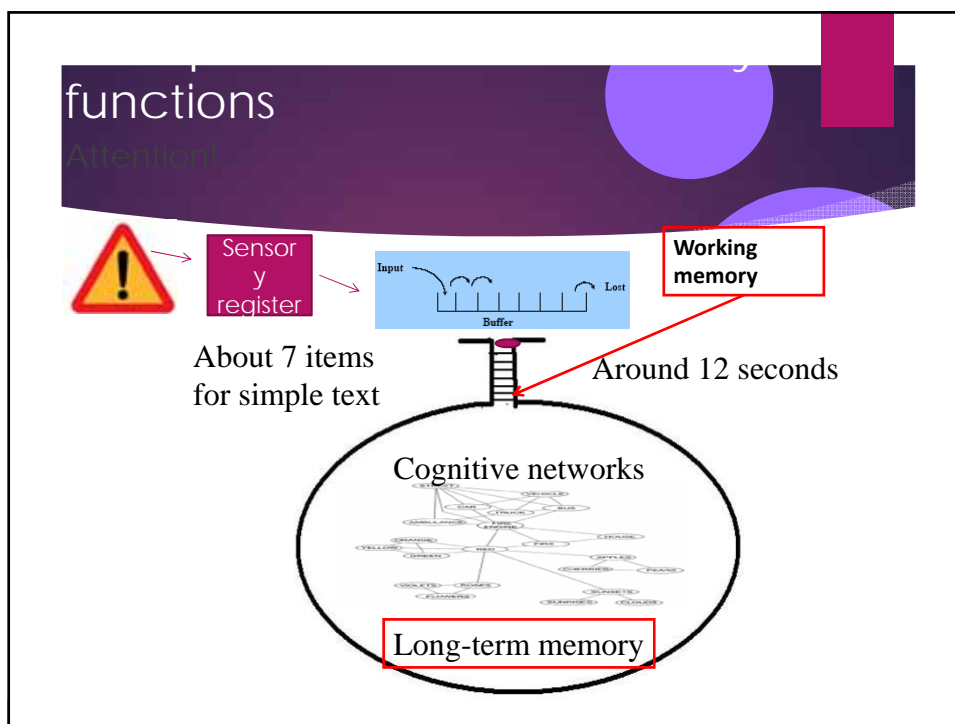
Information processing theory



The diagram illustrates the flow of information through three stages: 1. Senses (represented by an eye and an ear icon) send information to a central 'sensory buffer' (represented by a glowing blue cube). 2. Information moves from the sensory buffer to 'working memory' (represented by a blue bottle). 3. Working memory is connected to 'long-term memory' (represented by a large blue bottle containing many small circles). Arrows indicate the direction of flow, and a feedback loop arrow shows information returning from long-term memory to working memory.

Information processing theory: knowledge travels from the senses to a sensory buffer ; if it gets attention, it moves on to working memory which has very limited capacity. Surviving items get attached to cognitive networks that are in long-term memory. Knowledge from there travels back to working memory to be used in decisions as needed.

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How big "chunks" do we start with?

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Phonics

Phonics, single letters are small chunks

A young girl with blonde hair, wearing a pink shirt, is sitting at a table and eating a bunch of green grapes. She is holding a grape in her mouth and looking at the camera.

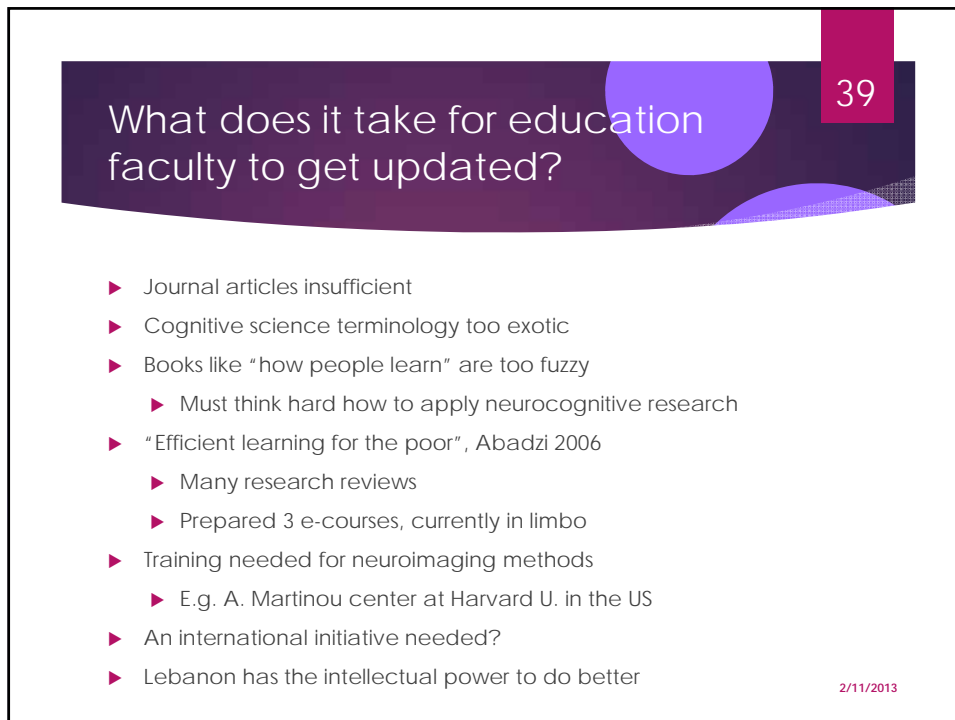
Whole Words are big chunks

► These are big chunks

A man in a white shirt and black tie is sitting at a table and eating a bunch of green grapes. He is holding a large bunch of grapes in his mouth and looking at the camera.

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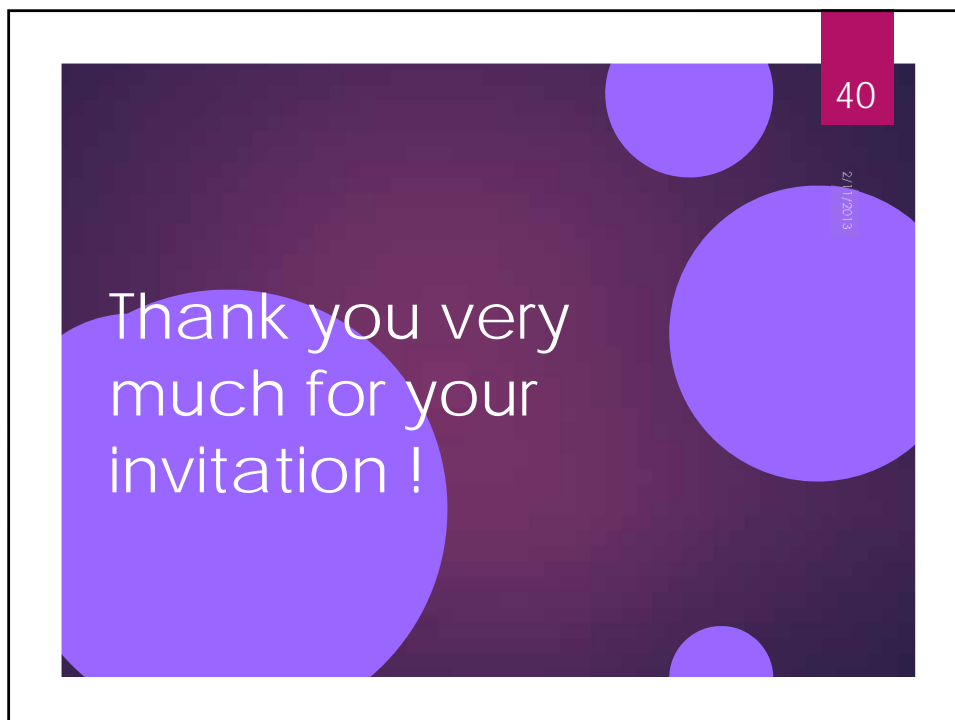


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What does it take for education faculty to get updated?

- ▶ Journal articles insufficient
- ▶ Cognitive science terminology too exotic
- ▶ Books like "how people learn" are too fuzzy
 - ▶ Must think hard how to apply neurocognitive research
- ▶ "Efficient learning for the poor", Abadzi 2006
 - ▶ Many research reviews
 - ▶ Prepared 3 e-courses, currently in limbo
- ▶ Training needed for neuroimaging methods
 - ▶ E.g. A. Martinou center at Harvard U. in the US
- ▶ An international initiative needed?
- ▶ Lebanon has the intellectual power to do better

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Thank you very much for your invitation !