Current AISE is too narrow!

(Need general, always-on, integrated ISE)

2013-05-26 @ RAISE, San Fransisco

Robert Feldt

Chalmers University of Technology &

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Raymond Cattell

John L. Horn

John Carroll

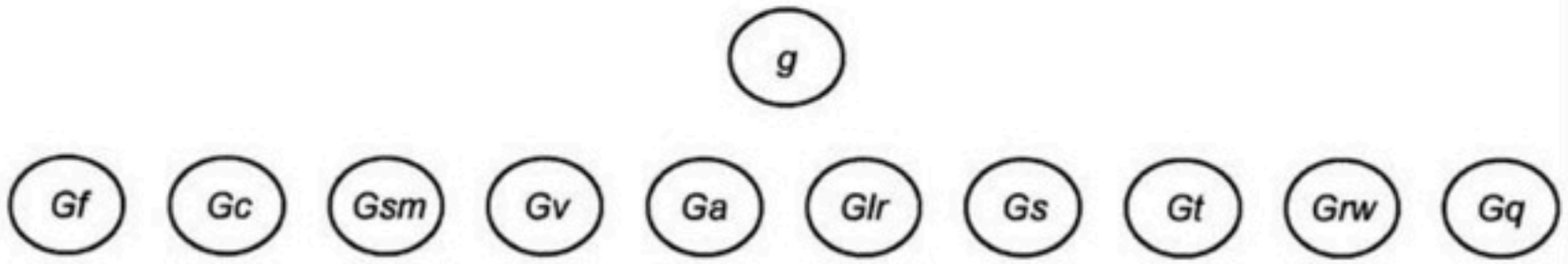
Raymond Cattell

John L. Horn

John Carroll

CHC integrated theory of General Intelligence

C. Cattell-Horn-Carroll (CHC) Integrated Model



D. Tentatively identified Stratum II (broad) domains

(Missing *g*-to-broad ability arrows acknowledges that Carroll and Cattell-Horn disagreed on the validity of the general factor)

CHC Broad (Stratum II) Ability Domains

Gf	Fluid reasoning	*Gkn*	General (domain-specific) knowledge
Gc	Comprehension-knowledge	*Gh*	Tactile abilities
Gsm	Short-term memory	*Gk*	Kinesthetic abilities
Gv	Visual processing	*Go*	Olfactory abilities
Ga	Auditory processing	*Gp*	Psychomotor abilities
Glr	Long-term storage and retrieval	*Gps*	Psychomotor speed
Gs	Cognitive processing speed		
Gt	Decision and reaction speed	(see Table 1 for definitions)	
Grw	Reading and writing		
Gq	Quantitative knowledge		

CHC integrated model of Cognitive Abilities

Gardner´s Multiple Intelligences Theory

Linguistic Intelligence

- Good in reading and writing
- Memorize words and dates
- Skillful in oration and persuasive speaking

Kinesthetic Intelligence

- People who are good at physical activities
- Good at building and making things
- Good at sports

Interpersonal Intelligence

- They care about people feelings
- Are good giving advices
- Communicate easily with others

Intrapersonal Intelligence

- Prefer to work alone
- Are good in understanding their own emotions
- Have high motivation to reach goals

Logical Mathematical Intelligence

- Good in math, chess and computers
- Usually learn better by analyzing things
- Good with numbers

Musical Intelligence

- Higher sensibility to sounds
- Enjoy to listen to music
- Easily learn how to play an instrument

Naturalist Intelligence

- High sensitivity to nature and the place within it
- Enjoy activities outside
- Are good interacting with animals

Visual Intelligence

- Good at visualizing and mentally manipulating objects
- Have good sense of direction
- Strong visual memory

- Gottfredson et al, 1994, “Mainstream Science on Intelligence”

“A very general mental capability that,
among other things, involves the ability to
reason, plan, solve problems, think abstractly, comprehend
complex ideas, learn quickly and learn from experience.

It is not merely book learning, a narrow academic skill, or
test-taking smarts. Rather, it reflects a broader and deeper
capability for **comprehending our surroundings**
—"catching on," "making sense" of things, or
"figuring out" what to do.”

- Gottfredson et al, 1994, “Mainstream Science on Intelligence”

TECHNICAL REPORT IDSIA-07-07

A Collection of Definitions of Intelligence

Shane Legg
IDSIA, Galleria 2, Manno-Lugano CH-6928, Switzerland
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Marcus Hutter

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15 June 2007

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15 June 2007

"Intelligence measures an agent's ability to achieve goals in a wide range of environments"

"**Software Engineering Intelligence** measures the ability of
(a) an (SE solution) agent
(b) to achieve goals
(c) in a wide range of software development situations"

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+

Integrated Env.

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(a) an (SE solution) agent
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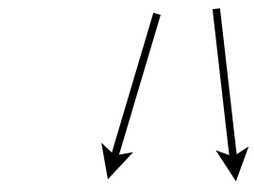
Integrated Env.



← Narrow ISE

"**Software Engineering Intelligence** measures the ability of
(a) an (SE solution) agent
(b) to achieve goals
(c) in a wide range of software development situations"

\+

Integrated Env. ⟵ General ISE

⟵ Narrow ISE

But what about Wisdom, Creativity and all that?

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Not only to achieve known goals; find and formulate new ones!

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“Covered” by: “wide range of development situations”,
implies creativity and adaptability.

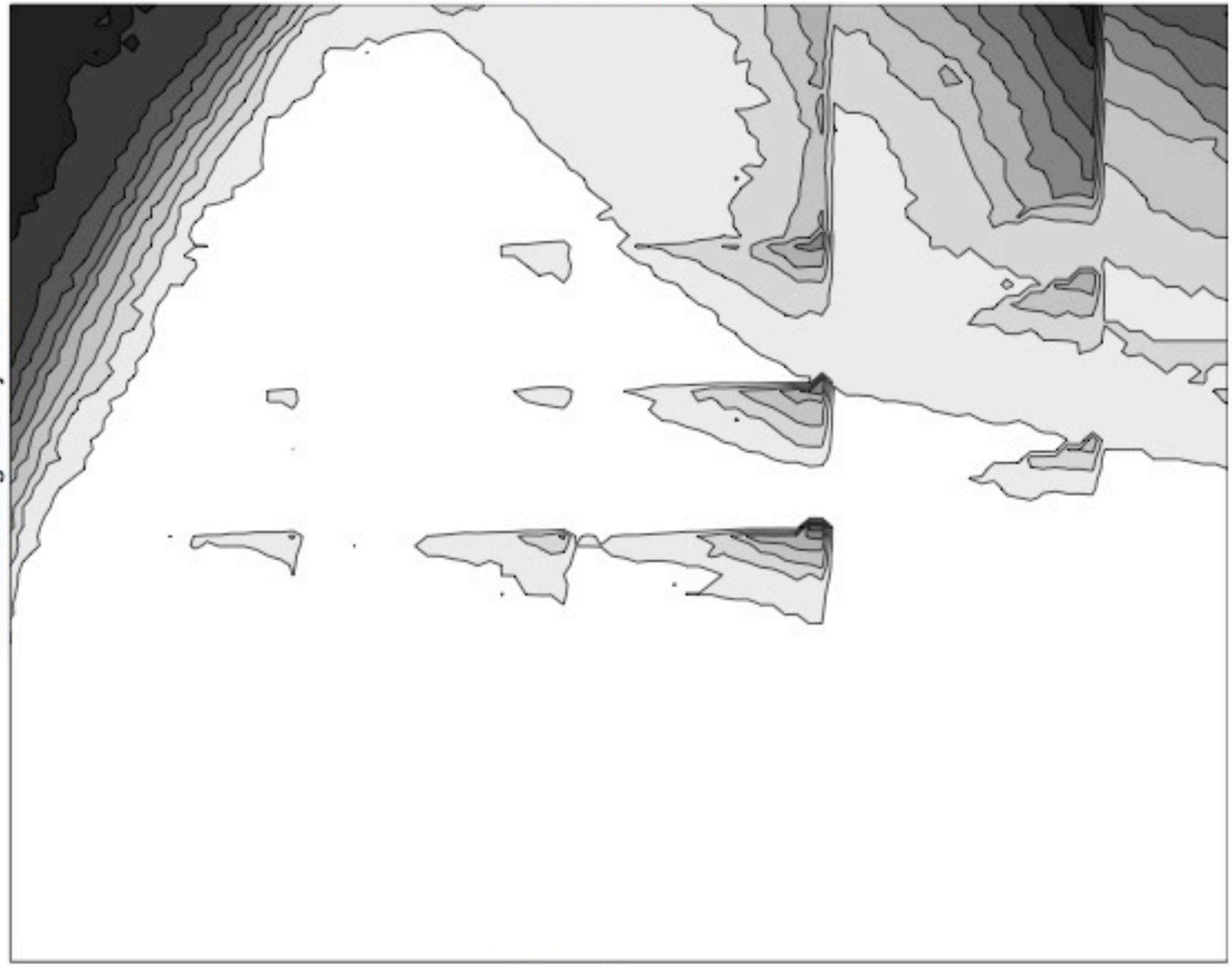
But what about Wisdom, Creativity and all that?

Not only to achieve known goals; find and formulate new ones!

"Covered" by: "wide range of development situations",
implies creativity and adaptability.

But wisdom involves balancing and trading off alternatives

Test case difficulty



--- Increasing velocity -->

--- Increasing mass -->

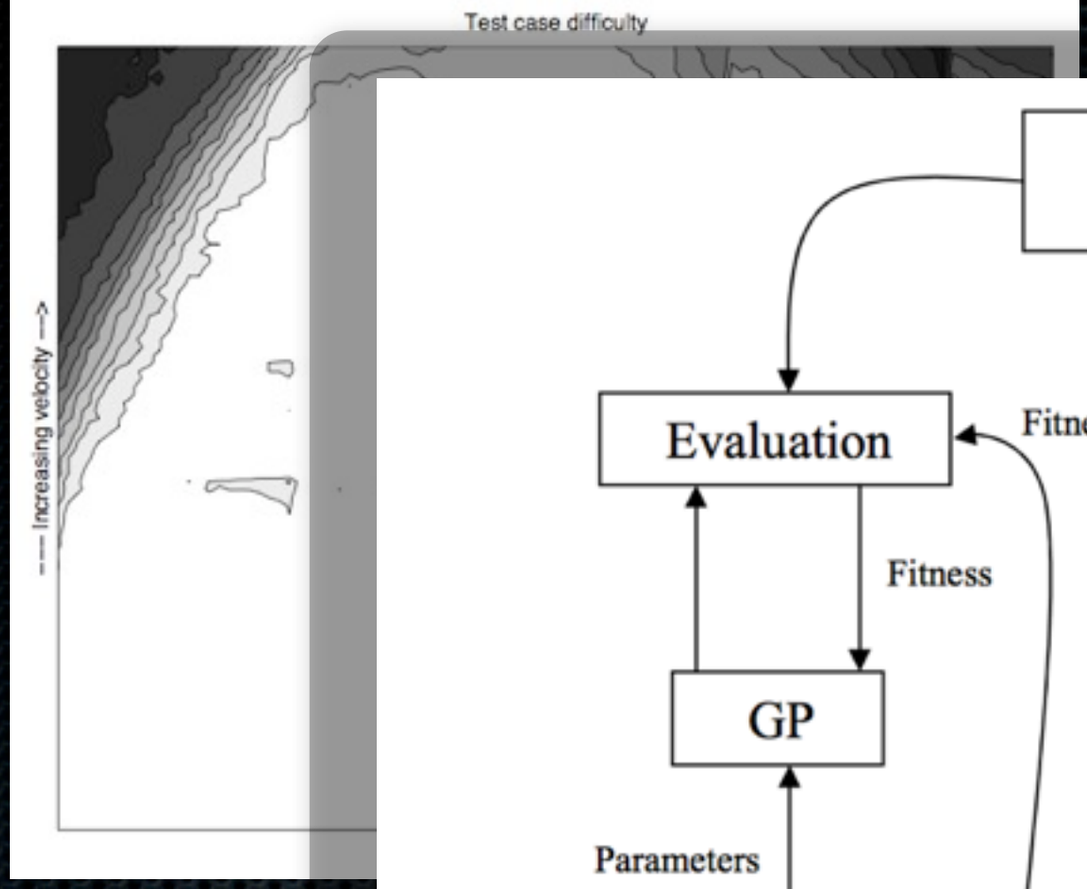
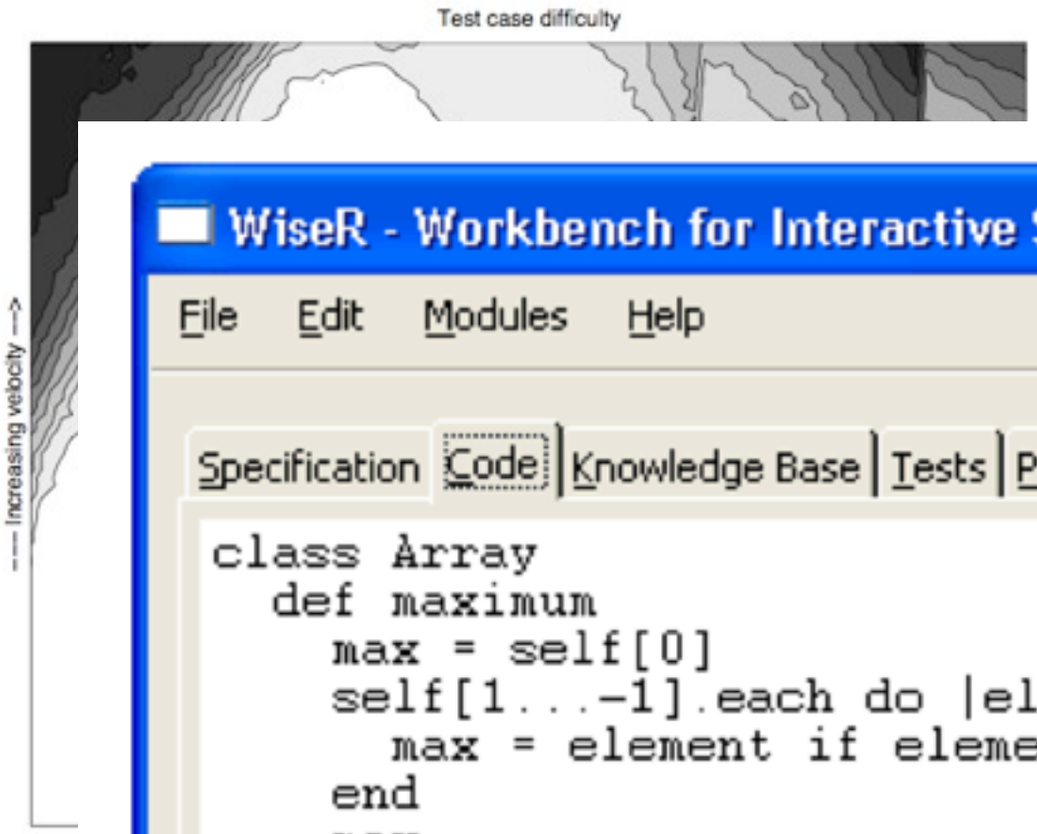
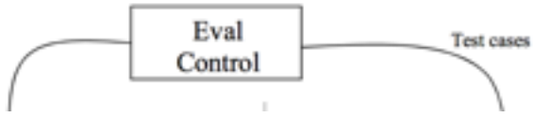


Figure 2. Conceptual diagram of a SPE-GP environment



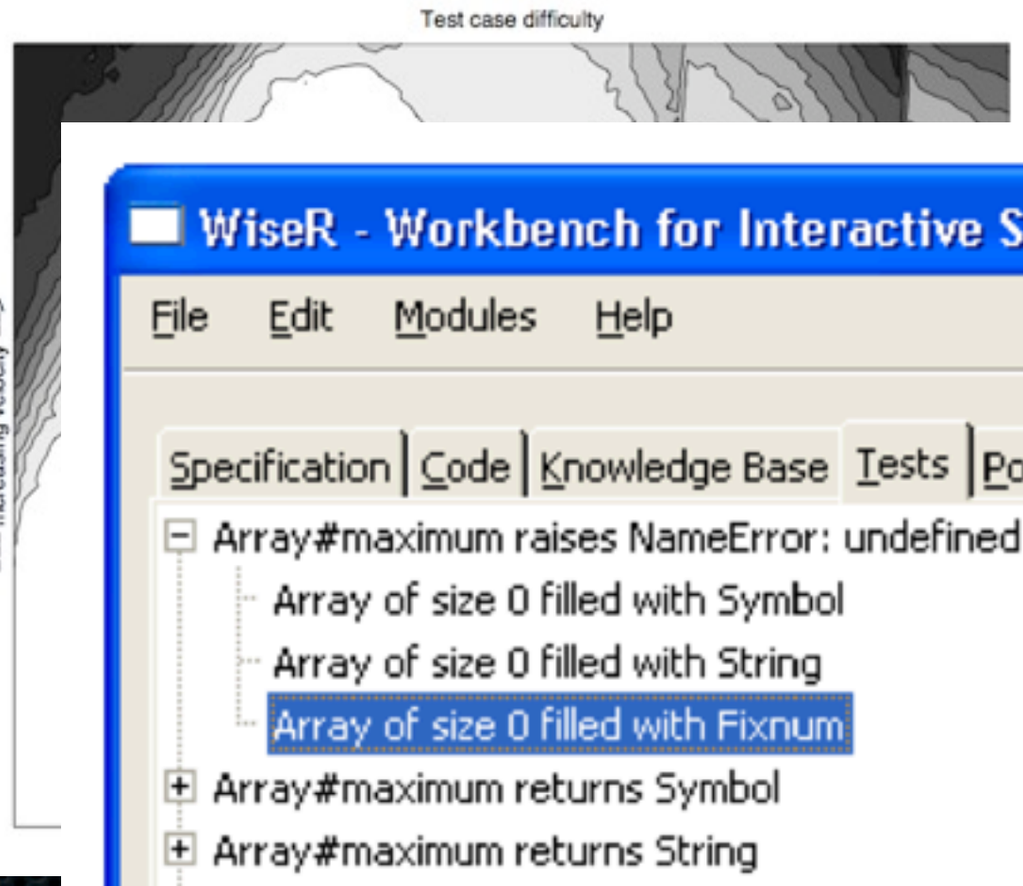


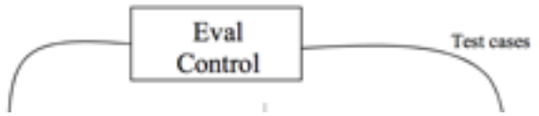
WiseR - Workbench for Interactive Software Engineering in Ruby

File Edit Modules Help

Specification | Code | Knowledge Base | Tests | Pools

```
class Array
  def maximum
    max = self[0]
    self[1...-1].each do |element|
      max = element if element > max
    end
    max
  end
end
```





WiseR - Workbench for Interactive Software Engineering in Ruby

File Edit Modules Help

Specification | Code | Knowledge Base | Tests | Pools

- Array#maximum raises NameError: undefined method `each´ for nil
  - Array of size 0 filled with Symbol
  - Array of size 0 filled with String
  - Array of size 0 filled with Fixnum
- Array#maximum returns Symbol
- Array#maximum returns String
- Array#maximum returns Fixnum

```
def test_15
  # Calling Array#maximum on
  # Array of size 0 filled with Fixnum
  [].maximum #=> raises NameError: undefined method `each´ for nil
end
```

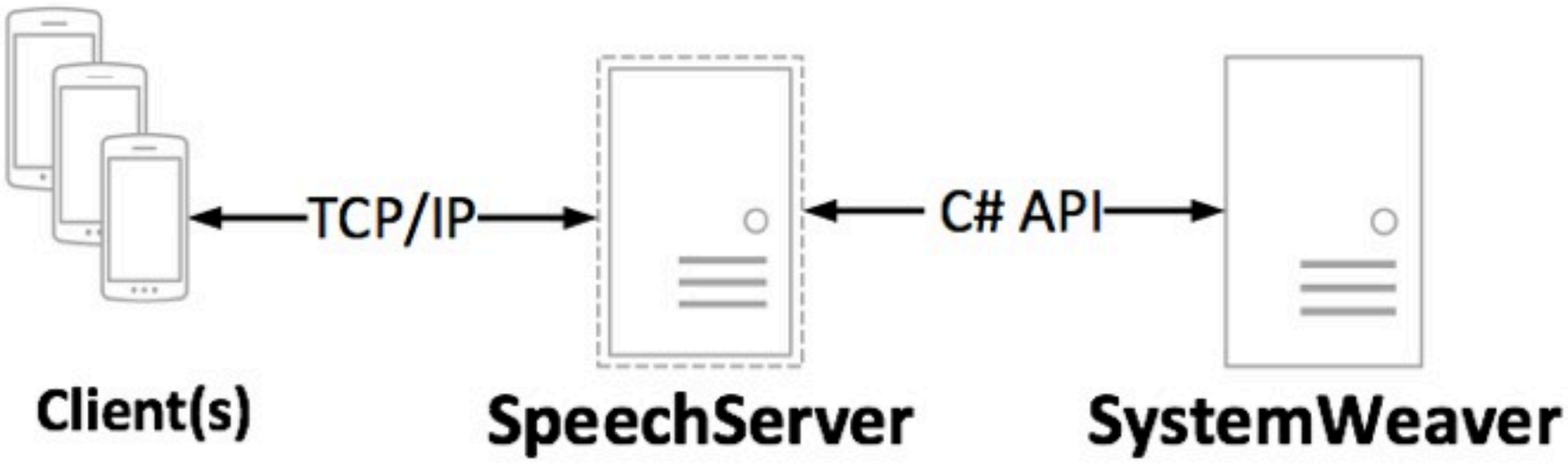
Lightweight Requirements Annotation through Mobile Speech Recognition

Ola Petersson, Viktor Mellgren, Robert Feldt, and Emil Alegroth
Division of Software Engineering, Dept. of Computer Science and Engineering
Chalmers University of Technology, Sweden
robert.feldt@chalmers.se

***Abstract*—Requirements are crucial in software engineering and there is ample support for how to elicit and document them; however, relatively little support exist for requirements maintenance. We argue that lightweight methods for annotating requirements are needed and present a system based on speech recognition to enable it. This paper describes the system design and a set of experiments and user tests to validate its use. For more realistic evaluation our system has been adapted to the commercial requirements management tool SystemWeaver. Results show that the accuracy of free text speech input is not high enough to enable free-form addition and edits to requirements. However, requirements identification and annotation is practical by extending the system with string distance calculations to the set of requirements being matched. Lookup**

We believe that using speech recognition can be one way to lower the time needed and perceived barriers to query and update requirements during software maintenance and during the evolution of requirements understanding in a development project. This could act as a lightweight access mechanism for potentially large requirements databases and allow more active ways of working with requirements. There is a risk that much information is currently lost, and even forgotten, if it is not updated or recorded immediately. There is also a risk that navigating large requirements databases takes longer time and requires more effort than more lightweight interactions would allow.

Lightweight Requirements Annotation through Mobile Speech Recognition



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SpeechWeaver Annotations	Annotation Count	%
Ambiguous	10	3.3%
Incorrect	20	6.7%
Incomplete	60	20%
Inconsistent	5	1.6%
Unprioritized	15	5%
Unverifiable	110	36.7%
Unmodifiable	30	10%
Untraceable	50	16.7%
Total: Annotations	**300**	

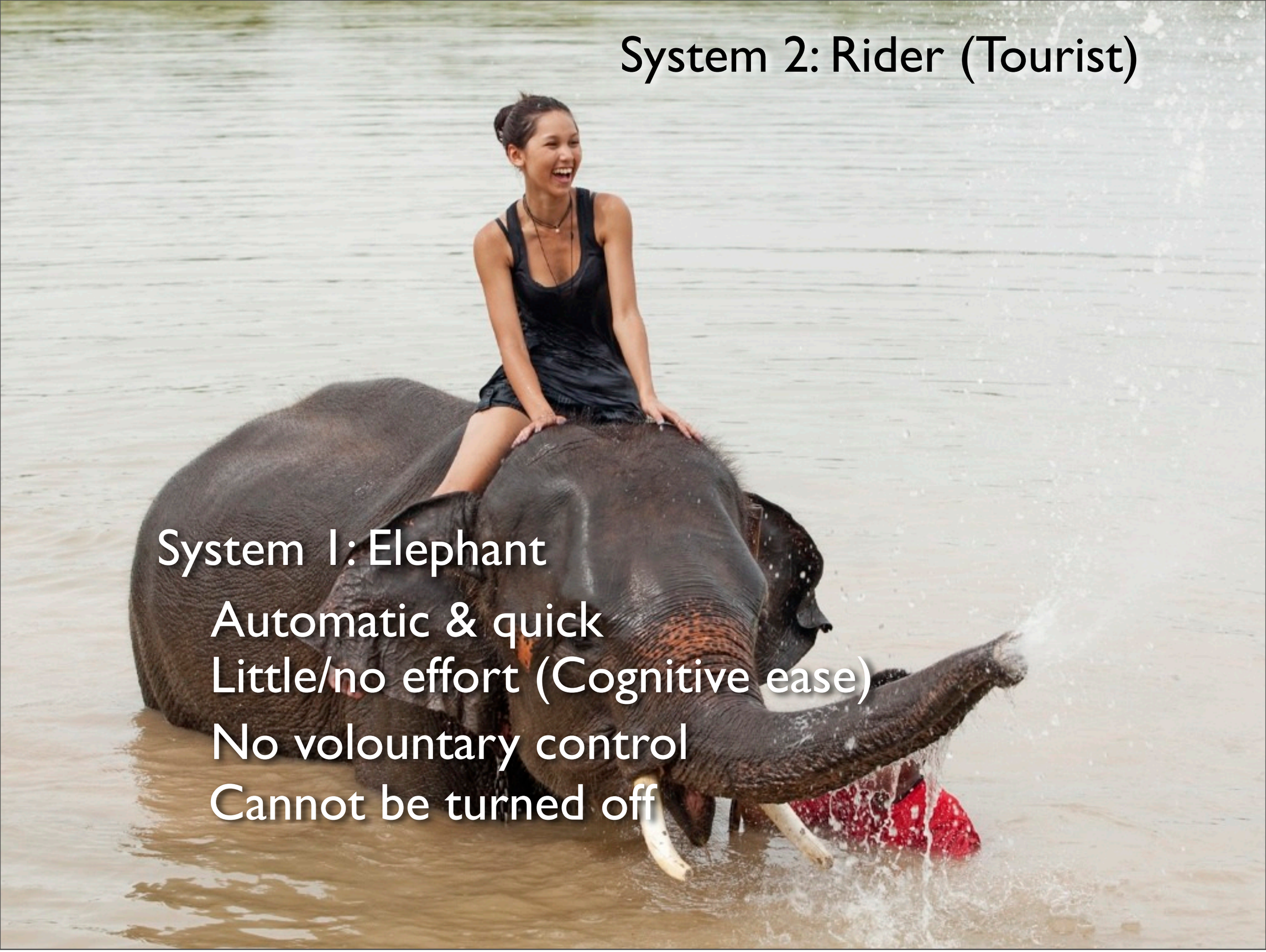
Report


System 1: Elephant


System 1: Elephant
Automatic & quick


System 1: Elephant
Automatic & quick
Little/no effort (Cognitive ease)

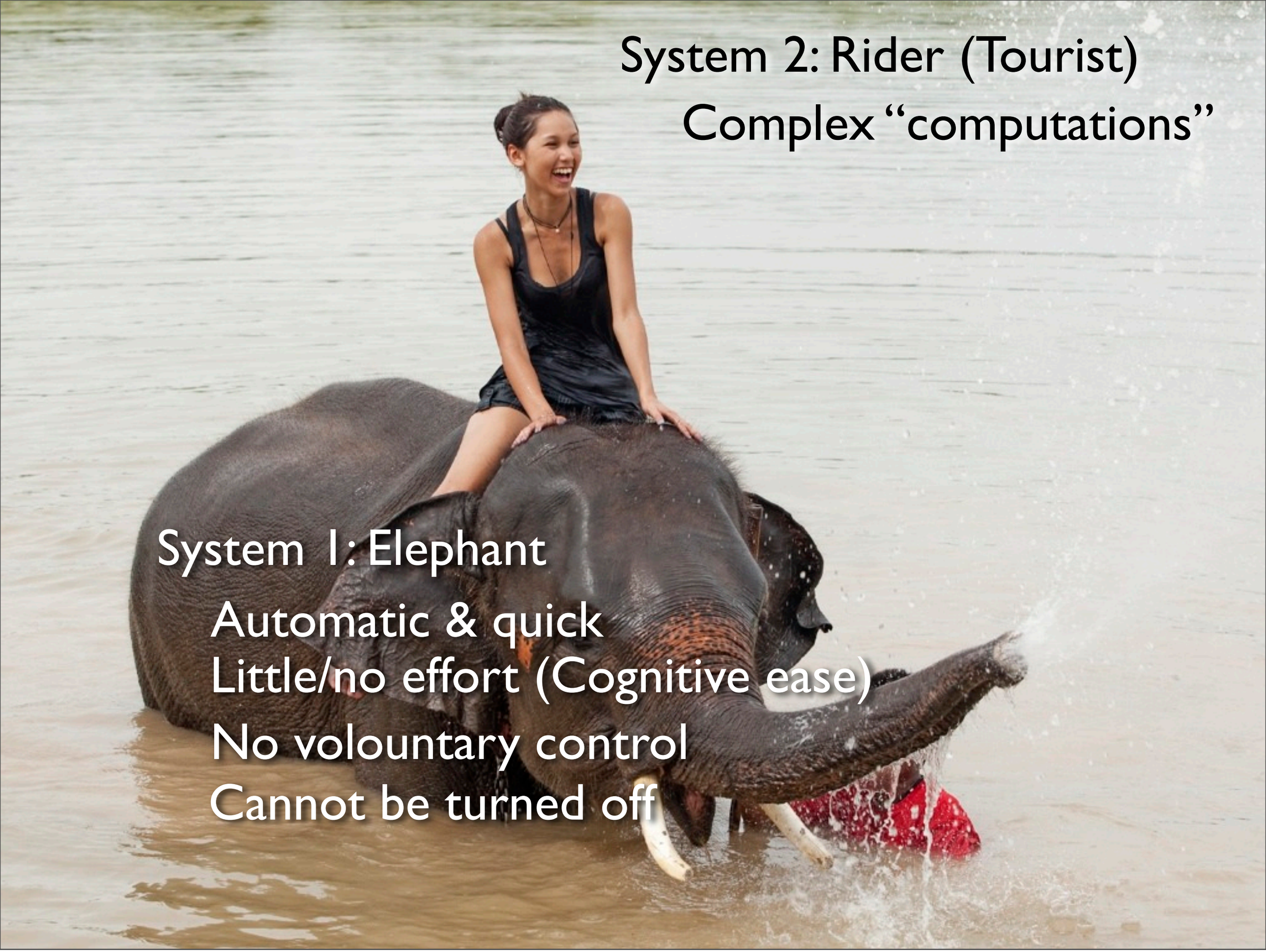

System 1: Elephant
Automatic & quick
Little/no effort (Cognitive ease)
No volountary control
Cannot be turned off



System 2: Rider (Tourist)

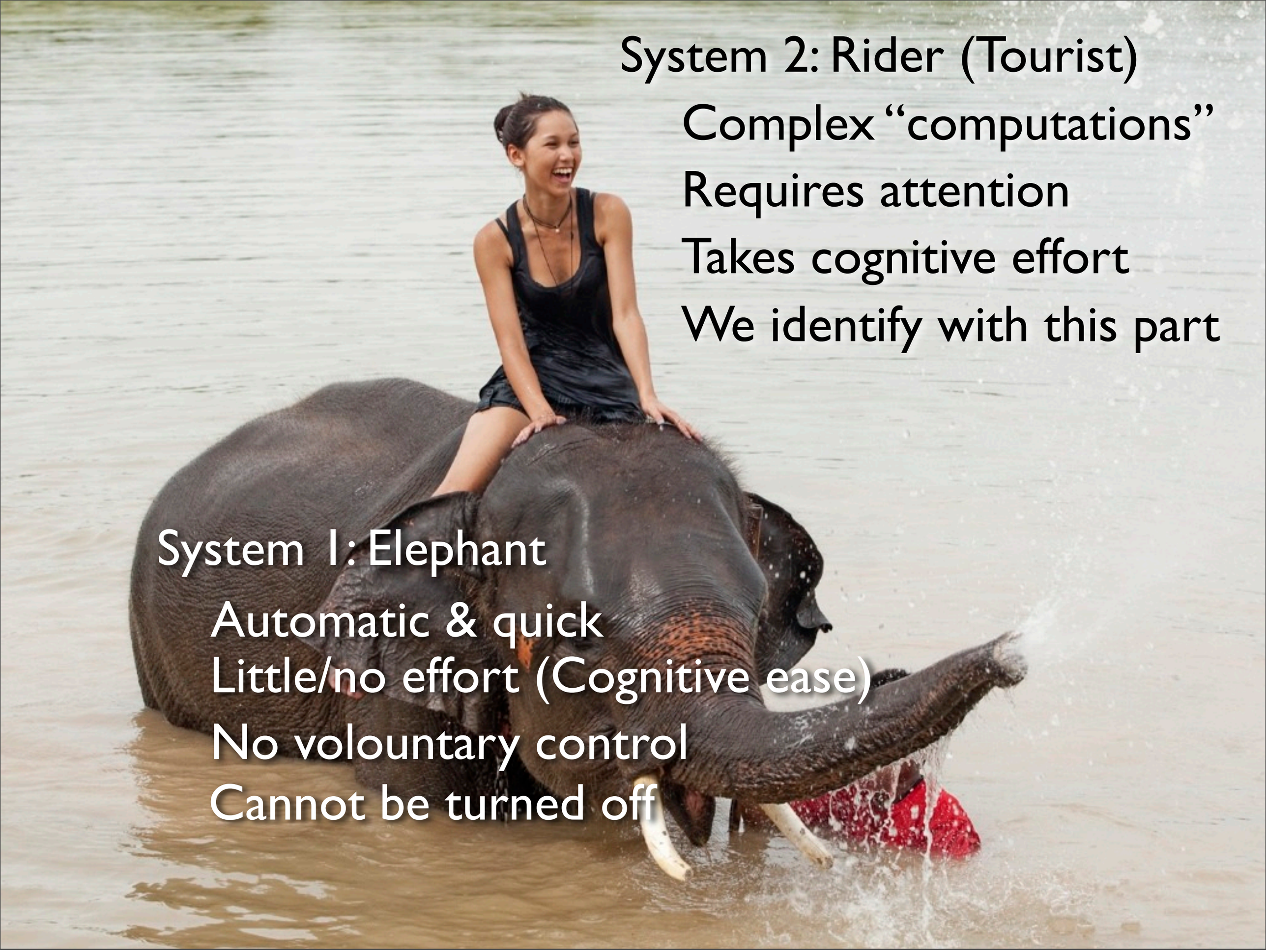
System 1: Elephant

- Automatic & quick
- Little/no effort (Cognitive ease)
- No volountary control
- Cannot be turned off


System 2: Rider (Tourist)
Complex “computations”
System 1: Elephant
Automatic & quick
Little/no effort (Cognitive ease)
No volountary control
Cannot be turned off


System 2: Rider (Tourist)
Complex “computations”
Requires attention
System 1: Elephant
Automatic & quick
Little/no effort (Cognitive ease)
No volountary control
Cannot be turned off


System 2: Rider (Tourist)
Complex “computations”
Requires attention
Takes cognitive effort
System 1: Elephant
Automatic & quick
Little/no effort (Cognitive ease)
No volountary control
Cannot be turned off


System 2: Rider (Tourist)
Complex “computations”
Requires attention
Takes cognitive effort
We identify with this part
System 1: Elephant
Automatic & quick
Little/no effort (Cognitive ease)
No volountary control
Cannot be turned off

A BSE hypothesis

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Q: Why are not formal methods used more in practice?

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Academia has praised its virtues for long. Industry does not seem to listen.

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Example: Haskell is a conceptually clean & very powerful programming language.

A BSE hypothesis

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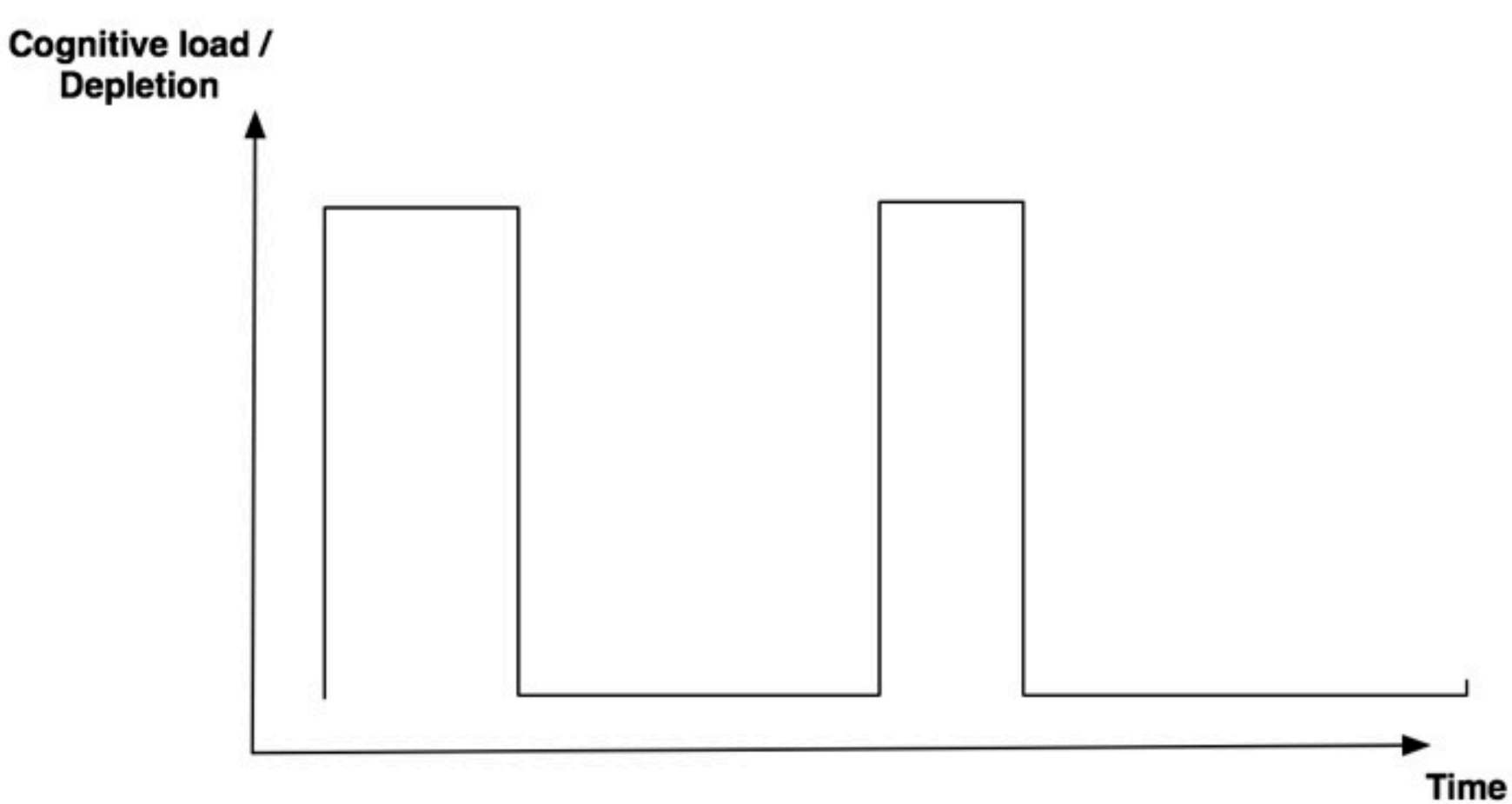
Academia has praised its virtues for long. Industry does not seem to listen.

Example: Haskell is a conceptually clean & very powerful programming language.

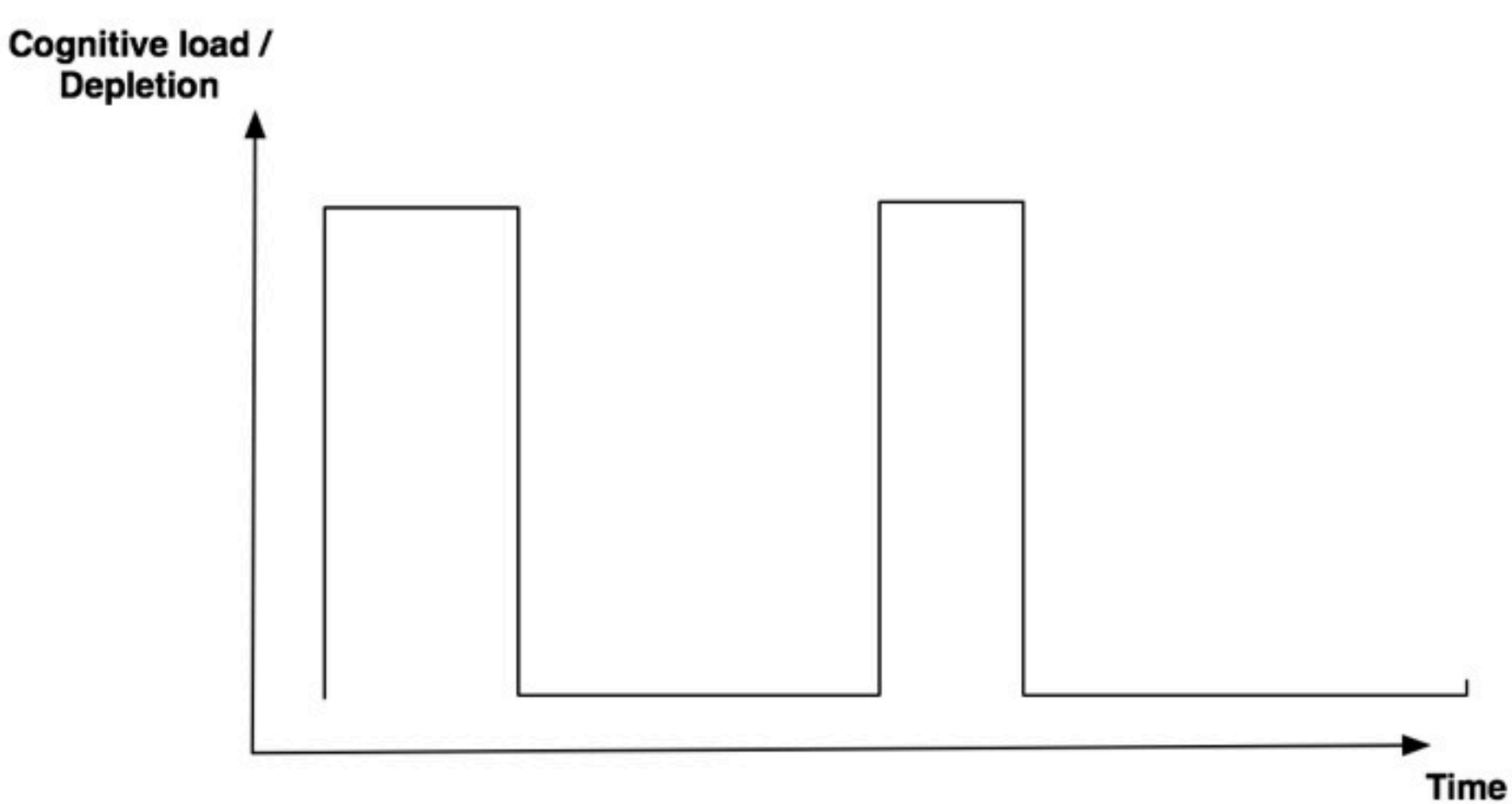
Why do industry keep using messier and more chaotic alternatives such as Java?

A BSE hypothesis



A BSE hypothesis

BSE Hypothesis: Messiness of language allows for intermittent periods of reduced cognitive load while programming => less depletion => more adapted to system 1 and the brain.



Now back and building WISE

Now back and building WISE

http://www.robertfeldt.net/presentations/feldt_130423_interactive_adaptive_autotest_environments.pdf

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http://crest.cs.ucl.ac.uk/cow/26/videos/COW26_Feldt_360.mp4

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http://crest.cs.ucl.ac.uk/cow/26/videos/COW26_Feldt_360.mp4

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Short video

Backup slides

It’s only a (one) theory!

Contents lists available at ScienceDirect

Intelligence

Editorial

CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research

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Woodcock-Muñoz Foundation, University of Minnesota, United States

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ABSTRACT

During the past decade the Cattell–Horn Gf–Gc and Carroll Three-Stratum models have emerged as the consensus psychometric-based models for understanding the structure of human intelligence. Although the two models differ in a number of ways, the strong correspondence between the two models has resulted in the increased use of a broad umbrella term for a synthesis of the two models (Cattell–Horn–Carroll theory of cognitive abilities—CHC theory).

It's only a (one) theory!

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such research. It is hoped that serious scholars of intelligence accept the CHC framework for what it is—a well-reasoned (and partially empirically tested) psychometric taxonomic framework (grounded in the extant factor analytic research that produced the Carroll and Cattell–Horn models) that can improve research vis-à-vis the use of a common nomenclature.

It's only a (one) theory!