Representation Matters

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Autumn 2009

The Oranges Puzzle

GOAL Order the oranges by size: largest-to-smallest, left-to-right

RULE 1 Only one orange can be transferred at a time

RULE 2 An orange can only be transferred to a plate on which it will be the largest

RULE 3 Only the largest orange on a plate can be transferred to another plate

The Donuts Puzzle

GOAL Order the donuts by size: largest-to-smallest, left-to-right

RULE 1 Only one donut can be transferred at a time

RULE 2 A donut can only be transferred to a peg on which it will be the largest

RULE 3 Only the largest donut on a peg can be transferred to another peg

The Coffee Cups Puzzle

GOAL Order the coffee cups by size: largest-to-smallest, left-to-right

RULE 1 Only one cup can be transferred at a time

RULE 2 A cup can only be transferred to a plate on which it will be the largest

RULE 3 Only the largest cup on a plate can be transferred to another plate

What Did We Learn?

What Did We Learn?

GOAL Order the coffee cups by size: largest-to-smallest, left-to-right

RULE 1 Only one cup can be transferred at a time

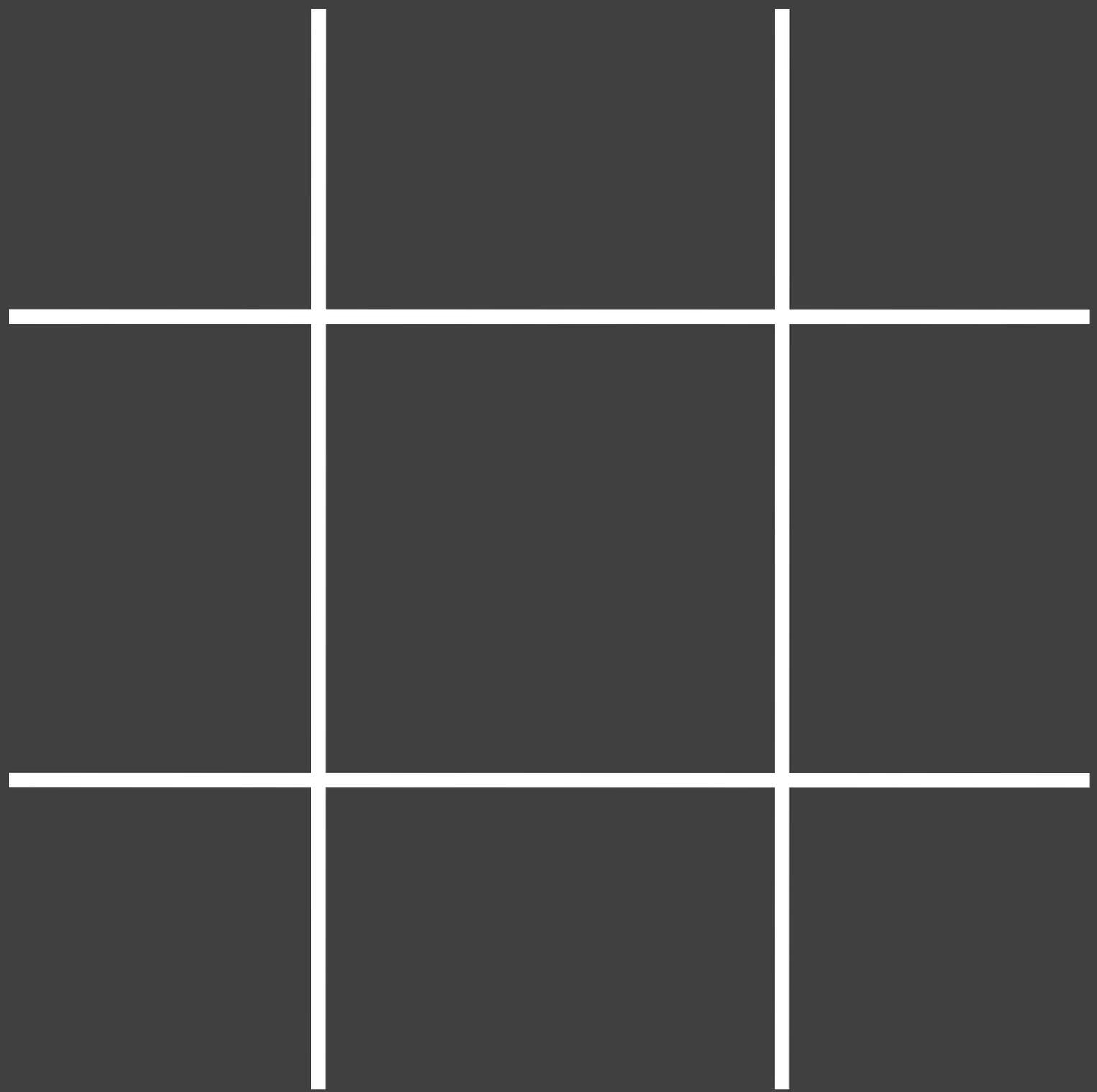
RULE 2 A cup can only be transferred to a plate on which it will be the largest

RULE 3 Only the largest cup on a plate can be transferred to another plate

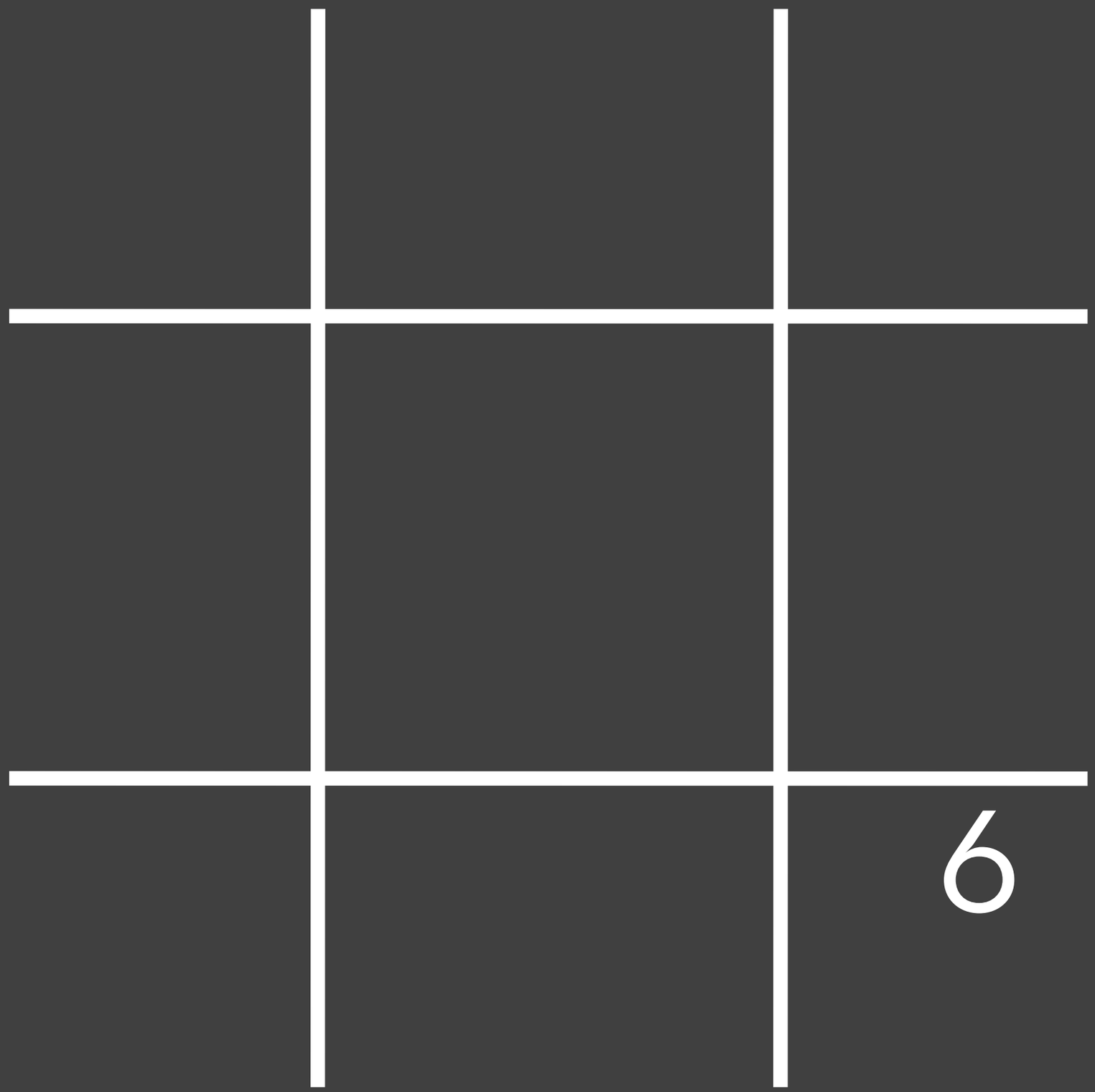
Let's play a card game!

- Two players
- One the table, there are nine cards, numbered 1 to 9
- Players draw alternately
- The objective is to make a "book" – a set of 3 that adds to 9

How ‘bout Tic-Tac-Toe?



These Games are Isomorphs



These Games are Isomorphs

4	9	2
3	5	7
8	1	6

Problem Solving as Representation

"Solving a problem simply means representing it so as to make the solution transparent"

—Herbert Simon, The Sciences of the Artificial

Working Memory

Getting Things Done

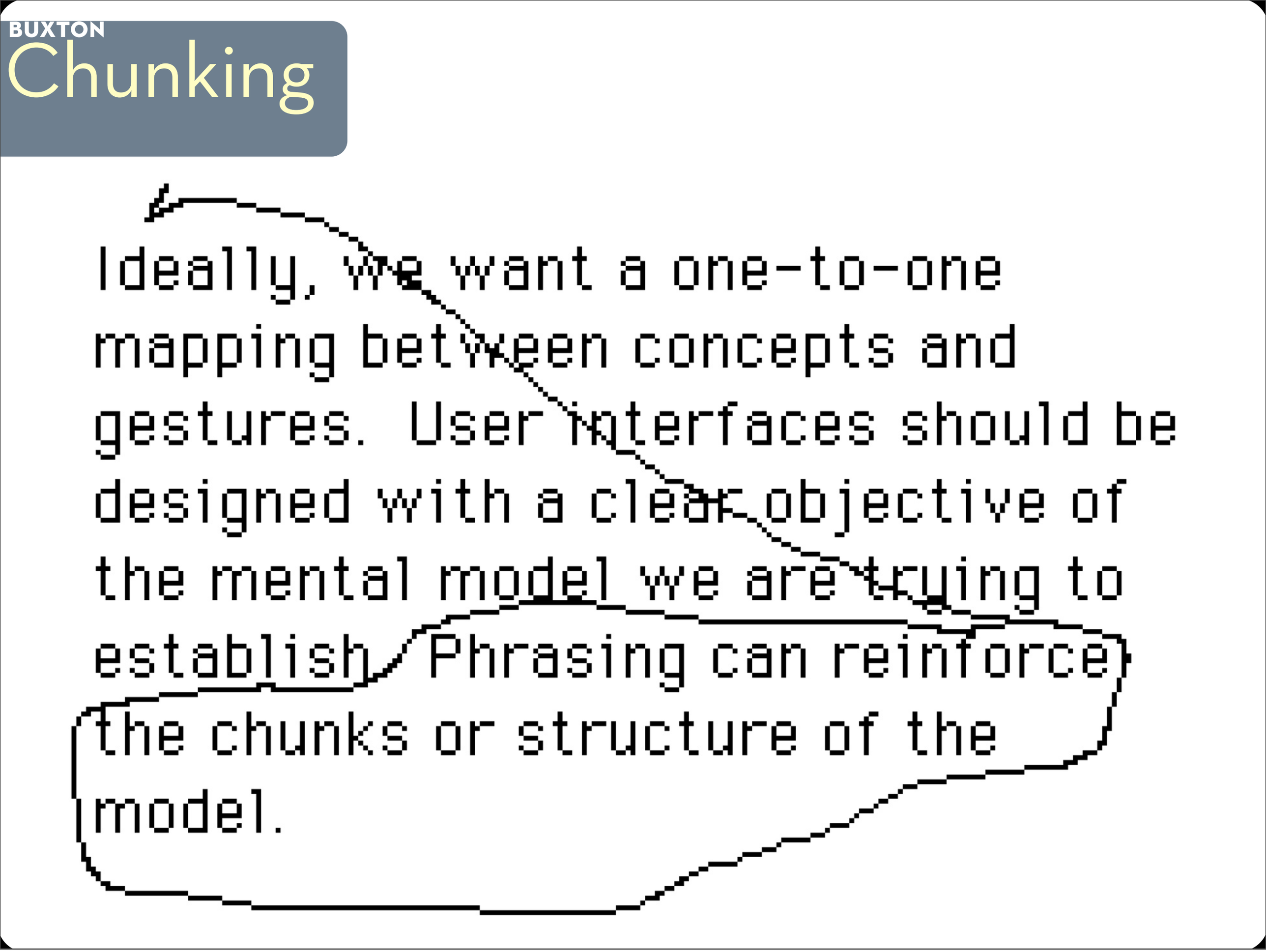
A Good Representation...

...shows all of the relevant information, and nothing else. Should enable:

- Comparison
- Exploration
- Problem solving

BUXTON

Chunking



Friday, October 9, 2009

Once again where does that lead us?

While we do not advocate that shock plates be included with the next version of office productivity suites, this artwork shows that risk, attention, and engagement are intertwined.

Naturalness Principle

- Experiential cognition is aided when the properties of the representation match the properties of the thing being represented

Perceptual Principle

- Perceptual and spatial representations are more natural and therefore to be preferred over nonperceptual, nonspatial representations, but only if the mapping between the representation and what it stands for is natural -- analogous to the real perceptual and spatial environment

Stanford Academic Calendar 2009–10

An online version of this calendar is available at the University Registrar's web site: http://registrar.stanford.edu/academic_calendar/

AUTUMN QUARTER

AUGUST

1 (Sat)	Axess opens for course enrollment.
27 (Thu)	M.D. students, first day of instruction.

SEPTEMBER

11 (Fri, 5:00 p.m.)	Course enrollment deadline to receive stipend or refund check on first day of term.
15 (Tue)	New undergraduates arrive; Convocation.
21 (Mon)	First day of quarter; instruction begins.
21 (Mon, 5:00 p.m.)	Preliminary Study List deadline Students must be "at status"; i.e., students must have a study list with sufficient units to meet requirements for their status, whether full-time, 8-9-10 units (graduate students only), or approved Special Registration Status.
21 (Mon, 5:00 p.m.)	Deadline to submit Leave of Absence for full refund. A full refund schedule is available here.
24 (Thu)	Conferral of degrees, Summer Quarter.
28 (Mon)	Yom Kippur (classes held: some students will be observing Yom Kippur and are not expected to attend classes; some faculty will not be holding classes).

OCTOBER

9 (Fri, 5:00 p.m.)	Final Study List deadline. Last day to add or drop a class; last day to adjust units on a variable-unit course. Students may withdraw from a course until the Course Withdrawal deadline and a 'W' notation will appear on the transcript.

NOVEMBER

9 (Mon, 5:00 p.m.)	Term withdrawal deadline; last day to submit Leave of Absence to withdraw from the University with a partial refund. A full refund schedule is available here.
13 (Fri, 5:00 p.m)	Change of grading basis deadline.
13 (Fri, 5:00 p.m.)	Course withdrawal deadline.
13 (Fri, 5:00 p.m.)	Application deadline for Autumn Quarter degree conferral.
23-27 (Mon-Fri)	Thanksgiving Recess (no classes).
30-December 6 (Mon-Sun)	End-Quarter Period.

DECEMBER

4 (Fri)	Last day of classes (unless class meets on Sat.)
4 (Fri)	Last opportunity to arrange Incomplete in a course, at last class.

SPRING QUARTER

FEBRUARY

7 (S	nt.
19 (	eceive stipend or n.
29 (	begins.
29 (	Students must be ve a study list with ients for their status, (graduate students stration Status.
29 (	sence for full refund. A here.

APRIL

1 (T	arter.
9 (Fr	Quarter degree con-
16 (	y to add or drop a class; last day to adjust units on a variable-unit course. Students may withdraw from a course until the Course Withdrawal deadline and a "W" notation will appear on the transcript.

MAY

12 (Wed, 5:00 p.m.)	Term withdrawal deadline; last day to submit Leave of Absence to withdraw from the University with a partial refund. A full refund schedule is available here.
21 (Fri, 5:00 p.m.)	Change of grading basis deadline.
21 (Fri, 5:00 p.m.)	Course withdrawal deadline.
28-June 3 (Fri-Thu)	End-Quarter Period.
31 (Mon)	Memorial Day (holiday, no classes) .

JUNE

2 (Wed)	Last day of classes.
2 (Wed)	Last opportunity to arrange Incomplete in a course, at last class.
2 (Wed, noon)	University thesis, D.M.A. final project, or Ph.D. dissertation, last day to submit.
2 (Wed, 5:00 p.m.)	Late application deadline for Spring Quarter degree conferral ($50 fee).
3 (Thu)	Day before finals, no classes.

General terms: Design, Human Factors

Keywords: Design by example.

INTRODUCTION

Many users learn web design by viewing and modifying the source code from other pages on the web. For its ability to scaffold learning, the "view source" option in web browsers is a pinnacle of interface design. Leveraging examples of previous work is an established technique in design [3, 32]. Many design education programs teach students to think like experts by exposing them—and encouraging them to draw upon—examples of previous work. Merging and adapting past solutions to fit the current context can facilitates creativity in new situations [20, 21]. Design compendiums such as *The Big Book of Logos* [5] serve as valuable resources for inspiration, and the advent of prolific, searchable Web content has provided ready access to a broad array of work created by other designers. When appropriate, example designs can offer pragmatic value as well as inspirational value. Starting with an existing design and modifying it can provide a lower barrier to entry than starting with a blank slate. Amateurs, prototypers, and
create a new design quickly find reusing
cially valuable [2, 17, 27].

Designers' current practices for working w
largely informal and ad hoc [19, 28]. Can

draw on multiple examples when creating new designs. While the software tool and empirical results in this paper examine the specific context of Web page design, the intuitions this work draws upon—most notably, the importance of analogy in creative cognition [13, 40]—suggests these findings likely have broader import.

The Existing and Potential Role of Examples

While it sometimes seems like ideas arise out of thin air, creativity is necessarily the result of applying existing knowledge [1]. Our prior experiences provide the scaffold upon which we create new ideas [13, 30, 36], and copying someone else's successful actions is more efficient than reinventing them from scratch. As Gick and Holyoak succinctly put it, "analogy pervades thought" [16]. Despite the centrality of experience to creativity and insight, people often neglect to draw on relevant knowledge, even when encouraged to do so through summarizing the relevant experience, stating the principle it embodies, or creating a diagram [15, 16]. People are much more likely to draw on analogous experiences and infer the underlying principle when provided with multiple examples, or when presented
case, and asked to compare them
'comparison processes can reveal
mbine partial structures and thus
rly in learning when neither ex-
" [14]. The benefits of principle-

case comparison may help explain the value of design patterns in architecture and software engineering [11, 29]. Similarly, software developers frequently copy example software code from web tutorials, and the tutorials' descriptions help developers locate and comprehend relevant examples [2].

While working with examples can provide important benefits for both learning and outcome, there is the danger of over-learning from at-hand examples. Sometimes, people interpret the current situation exclusively in terms of at-hand or in-mind previous situations [4]. This is known as a conformity effect, and it has been demonstrated empirically for creative tasks [34].

by extending the Firefox browser's built-in graphical HTML editor. The prototype's example corpus comprises 250 Web pages that we manually harvested and tagged with faceted metadata. Adaptive Ideas introduces an optimization-based approach to selecting, presenting, and browsing design material. The core of this approach is a *subset selection algorithm* that chooses examples from a corpus to display so as to maximize estimated design value.

The Adaptive Ideas interface comprises an editing pane, an examples gallery, and a preview pane (see Figure 1). The user can begin with a complete example by selecting one from the gallery. The preview pane enables users to see an example in greater detail and select a feature of it to bor-

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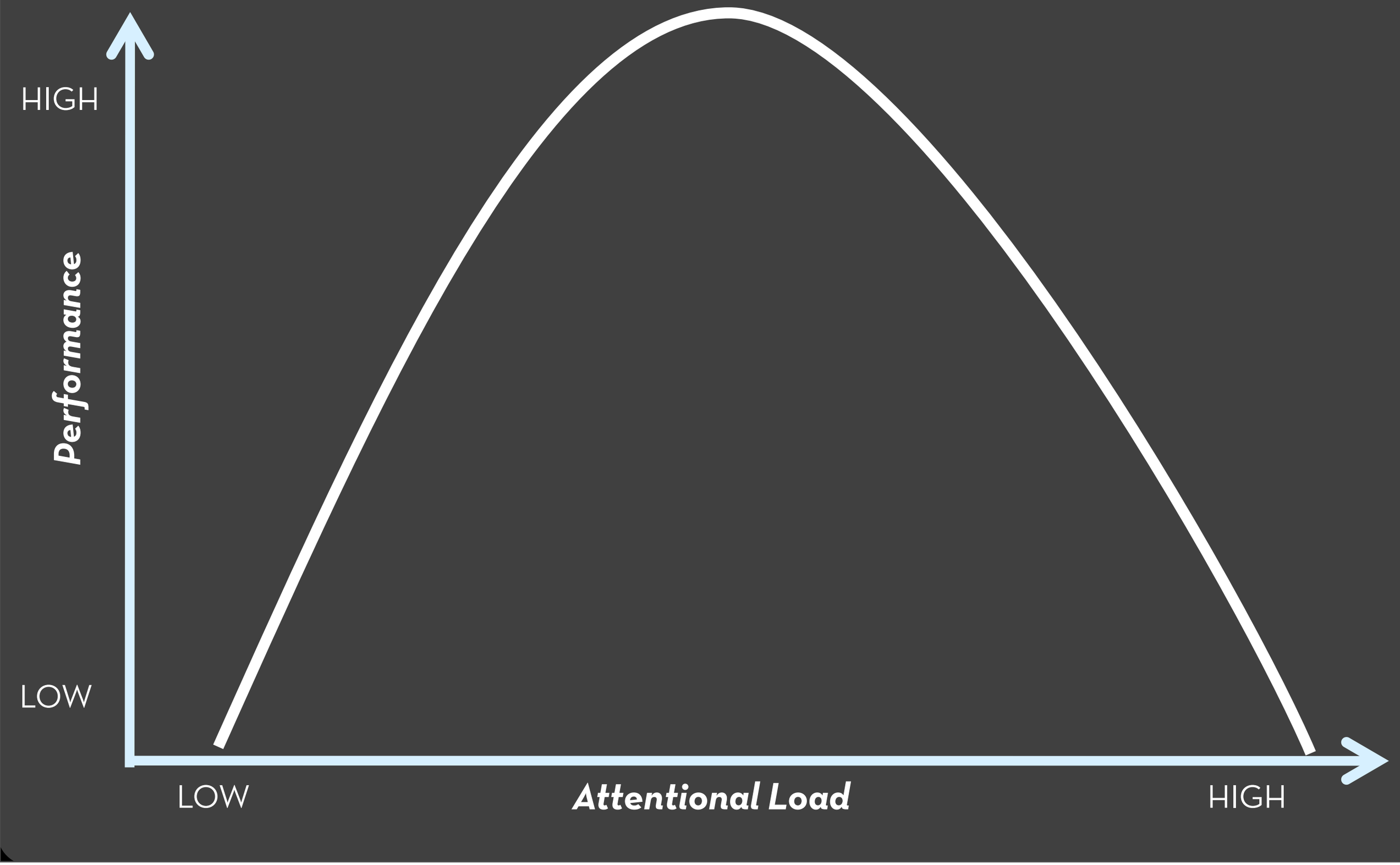
Table 3.1

Information flow in sensory systems and conscious perception

Sensory system	Total bandwidth (bits/s)	Conscious bandwidth (bits/s)
Eyes	10,000,000	40
Ears	100,000	30
Skin	1,000,000	5
Taste	1,000	1
Smell	100,000	1

Source: Tor Norretranders, *The User Illusion: Cutting Consciousness Down to Size* (New York: Viking, 1998).

Attention, Stress, and Risk



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Overload, Underload

Yerkes Dodson curve.

This peak of this curve is dependent on the

EXAMPLE

Smart Cars

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If a car can be fully automated, that's great! But if it can't, is it preferable to be mostly automated?

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Risk

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Acting in the physical world is always characterized by uncertainty and an awareness of one's own vulnerability Dreyfus argues that this leads to a constant preparedness for danger and surprises, and that this readiness shapes one's experience and interactions in the world. *Individually*, bodies can suffer harm if one chooses the wrong course of action (*e.g.*, taking a step sideways in the image above).

In social situations, risk comes from the requirement to act in the presence of others. we cannot not communicate — the absence of communicative effort is itself a message <be silent for 10sec>

And even 10 seconds silence can be pretty awkward

Let's look at some of the axes where risk plays a role:

RISK

Tradeoffs

LOW RISK

HIGH RISK

Divergent Thought

Convergent Thought

Exploration/Simulation

Concentration/ Commitment

Safety/Playfulness

Exhilaration

Freedom to Act

Forced to Act

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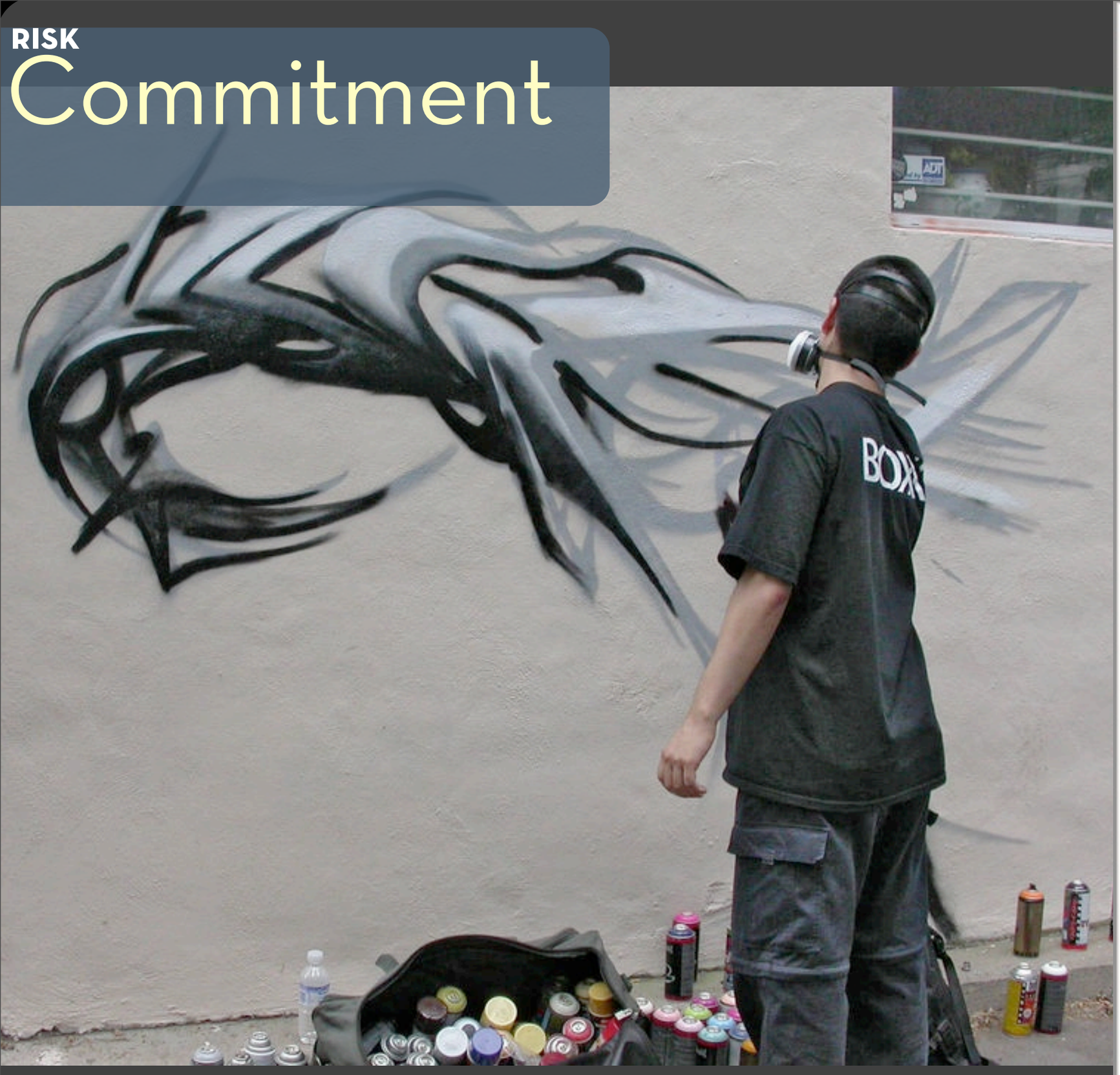
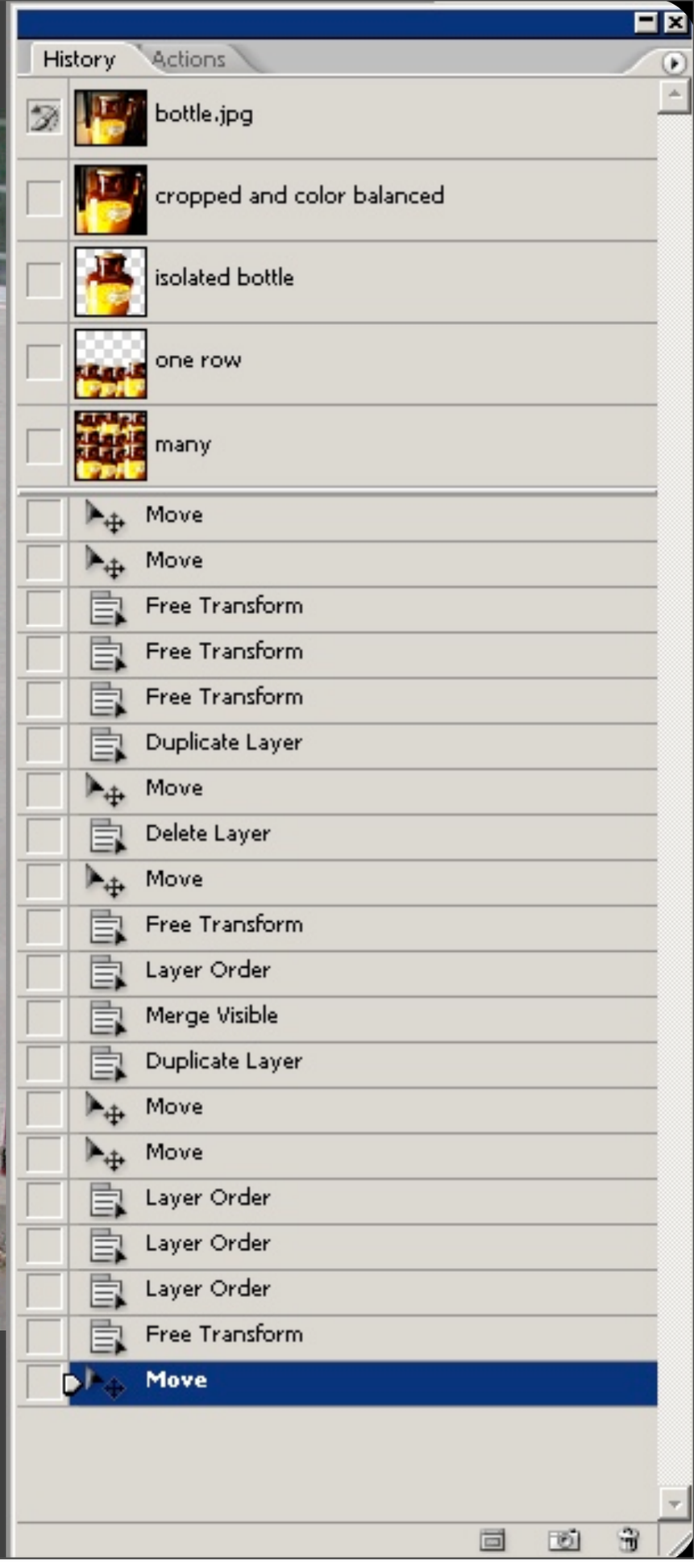
Low risk is good for prototyping

There's stuff you can do in the studio that you just can't do live.
But putting yourself on the line also forces creativity in some ways, like jazz improvisation.

RISK

Commitment





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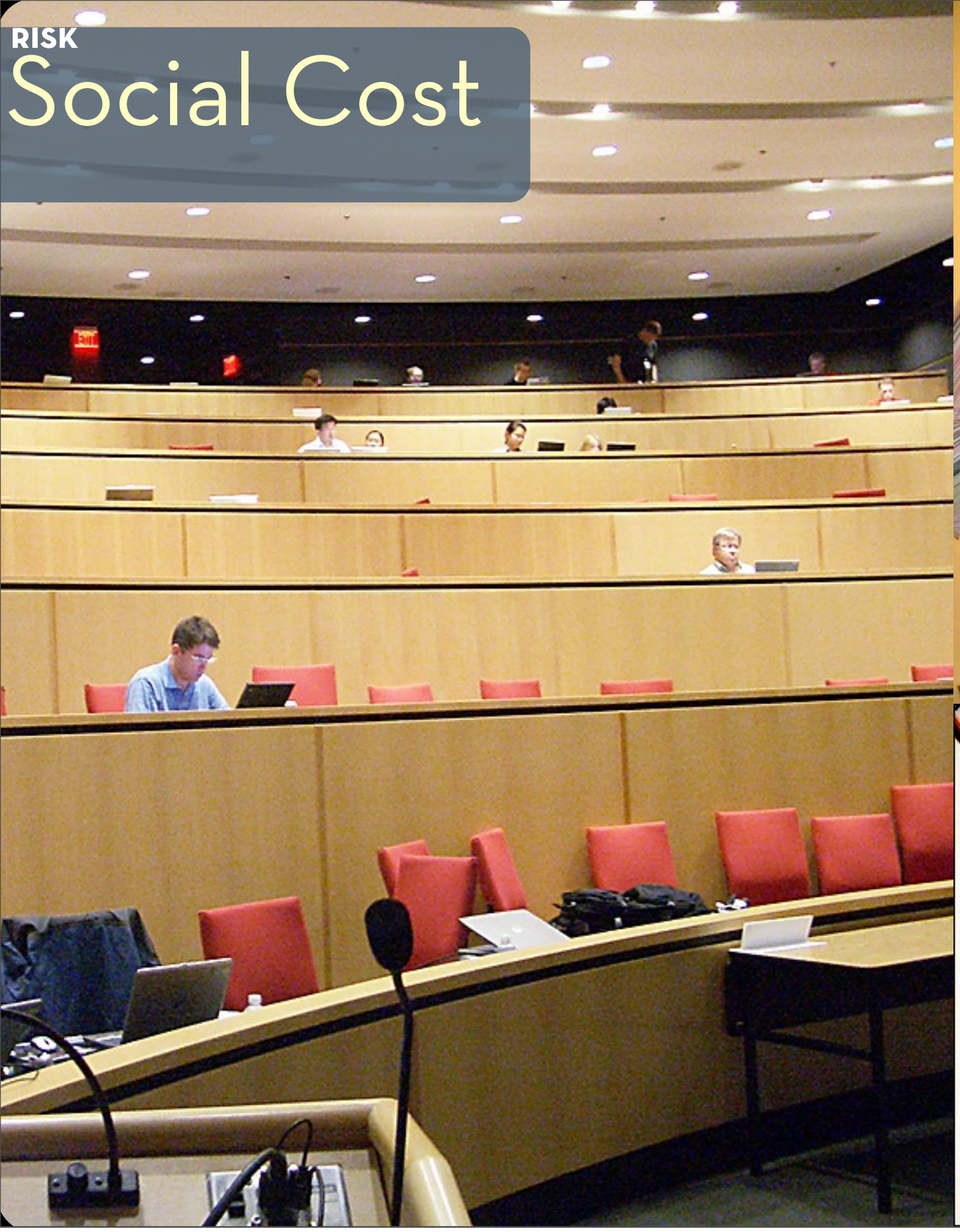
To illustrate some of these tradeoffs, consider art

Visual art in physical media requires commitment to every stroke

RISK

Social Cost



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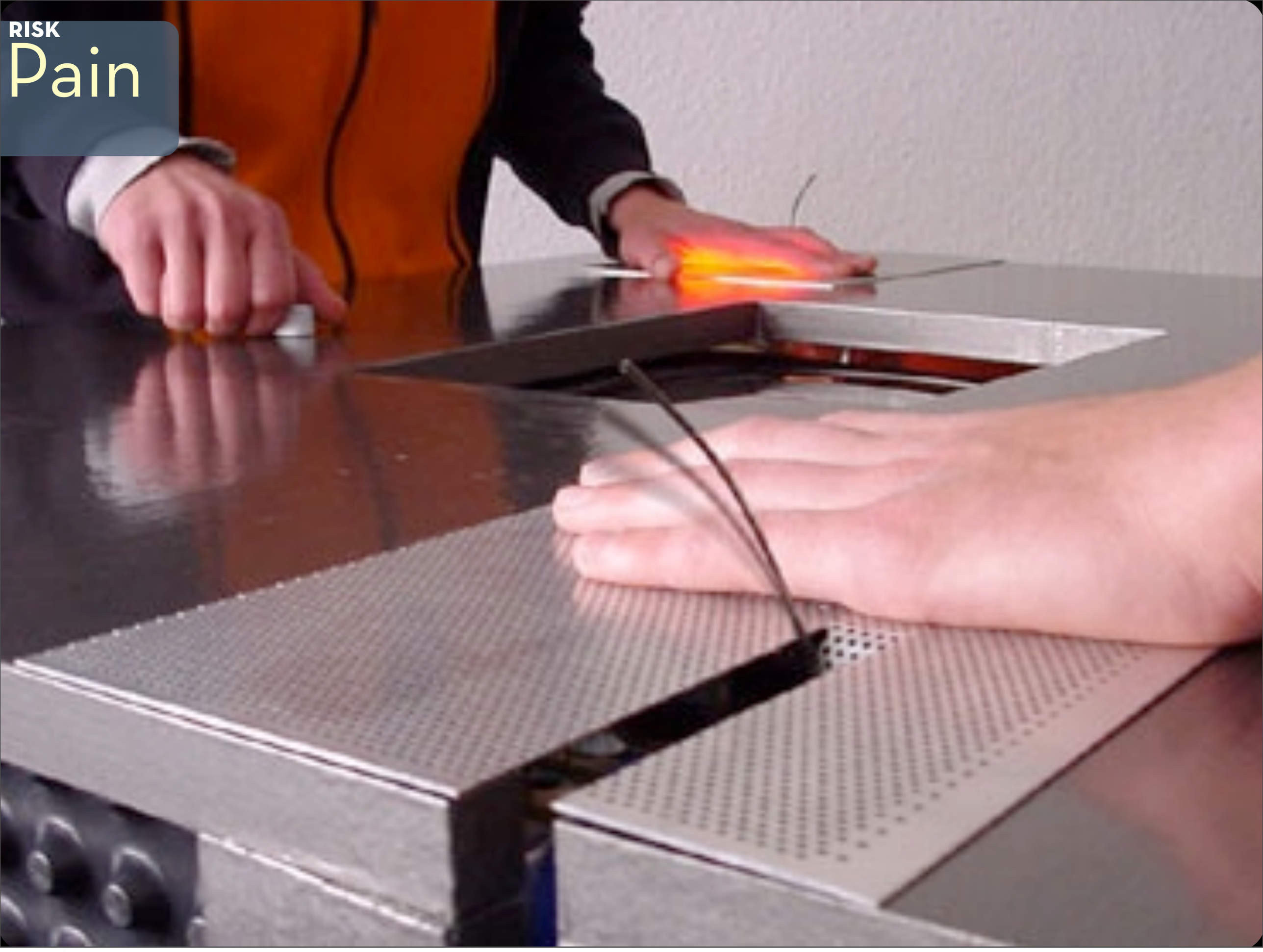
Dressing up at home in front of a mirror is a low-risk way to explore – it's easy to change your mind, look like a fool.

Speaking in front of an auditorium filled



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