How the Brain Wants to Learn:
Cognitive Science Informing Interactive Exhibit Design

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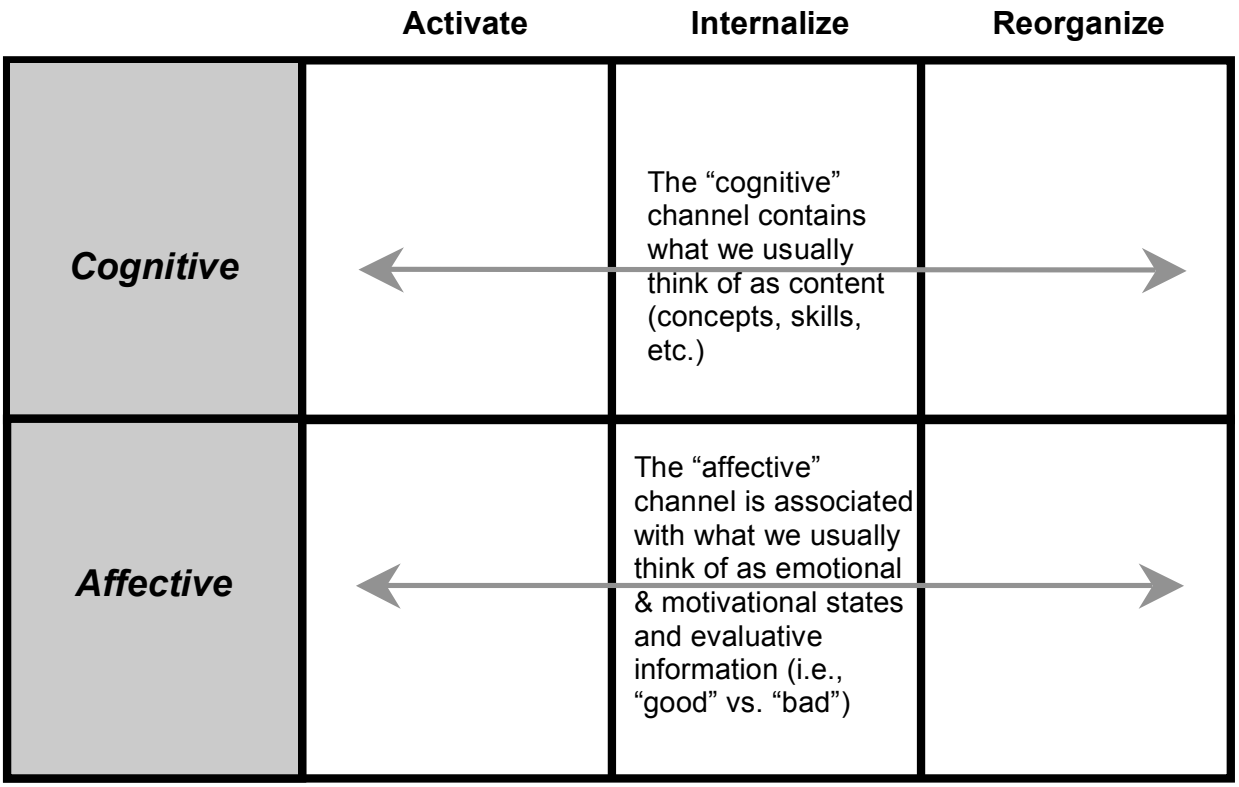
Exhibit Design: How The Brain Wants To Learn

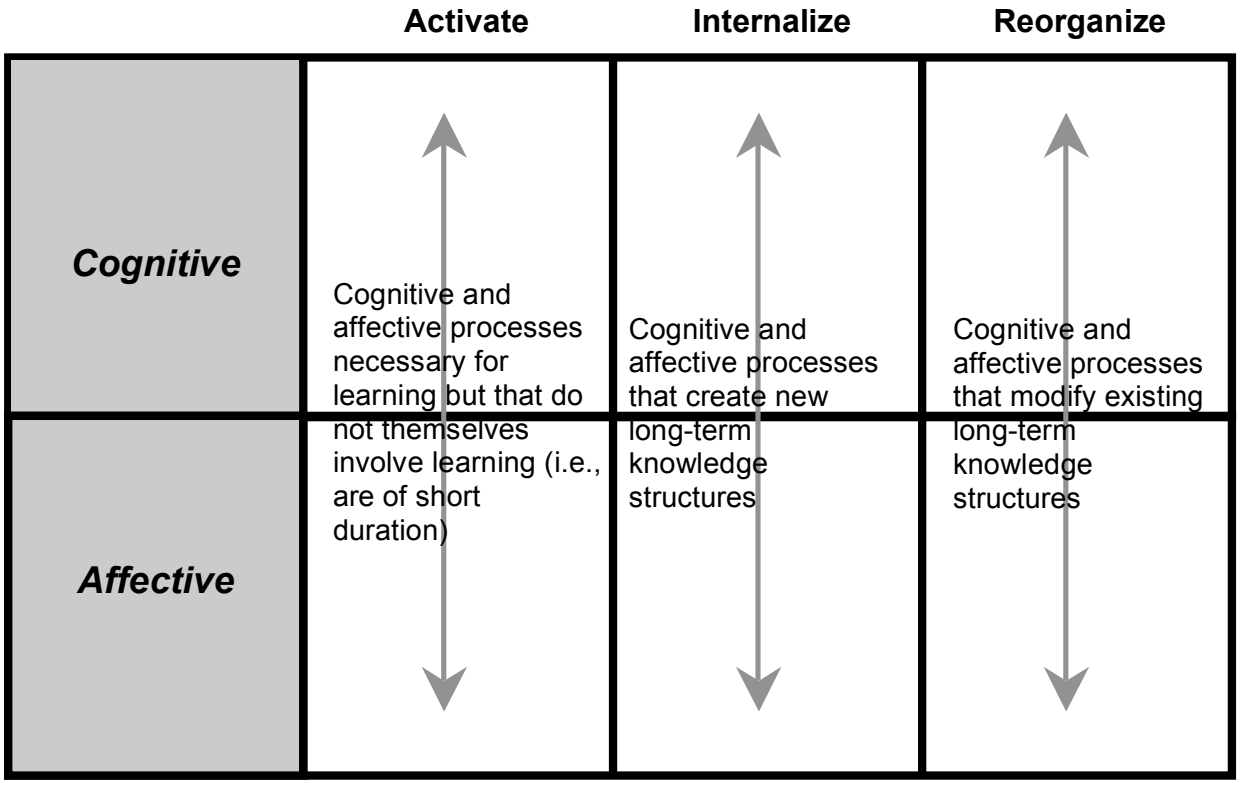
Abstract
The use of cognitive science in exhibit design has not been widely implemented in the museum field; however, cognitive science has informed learning design in other domains—such as K-12 curricula, educational software design, and adult vocational learning—and its effectiveness has been studied and documented. We intend to take the knowledge and outcomes gained from this research and propose parallel strategies for using cognitive science to inform exhibit development and design.

In applying an understanding of cognitive science, we know that the brain makes inferences about an exhibit's subject matter from the *structure* or *design* of the exhibit, not just from the exhibit content. Exhibit design can work *with* or *against* the brain's learning agenda. We will translate cognitive theories into a practical explanation of exhibit design based on current research, using case studies from exhibit design and other domains.

Learning Objectives
At the end of this workshop, participants should…

- …recognize that cognitive science has something useful to offer exhibit designers
- …be confident they can learn and apply the useful cognitive science insights
- …be motivated to engage in an ongoing dialogue between cognitive science and museum practice and/or explore these ideas on their own





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Knowledge Design Matrix: Recognizing the Building Blocks

At home evaluation exercise: Use the matrices below to help you characterizes the primary types of cognitive or affective process involved in your exhibits and briefly note your reasoning in the space provided.

	A	I	R
Cog			
Aff			

	A	I	R
Cog			
Aff			

	A	I	R
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	A	I	R
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	A	I	R
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	A	I	R
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Designing for Engagement: Overview and Worksheet

Research in cognitive science reveals that the brain has its own "hidden learning agenda," which means that what people find engaging and what they take away from a museum exhibit may be surprisingly different from what the designers expected and intended. There are many design principles that follow from cognitive research. Today we're going to focus on one: Designing for Engagement.

"Intrinsic motivation" is not actually an intrinsic property of the visitor, but a product of the visitor's interactions with certain kinds of exhibit designs. In particular, exhibits with the following features can generate sustained engagement better than exhibits that lack one or more of them:

- Clear and non-trivial goals for the visitor to pursue
- Clear actions the visitor can take to pursue the goals
- Clear and immediate feedback on whether they are approaching the goals

Engagement = Goal(s) + Actions + Immediate Feedback

Worksheet: Designing for Engagement

1. Name or brief description of the exhibit.

2. Analyze the challenge inherent in the activity.
   - Goal: What is the visitor's ultimate goal? What are the sub-goals (if any)?

   - Options for Action: How do visitors get started? How do they proceed?

   - Feedback: When visitors take action, do they get feedback on their progress toward the goal? Do they know how to make sense of the feedback?

3. Skill-challenge match: Does the challenge seem generally well-matched to the target audience's expected range of skill or knowledge levels? Can you explain why or why not in terms of the configuration of goal, options, and feedback?

4. Leveling: How might you adjust goal, options, and/or feedback in this design to make it more engaging for the target audience?

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Additional Reading

Memory (Types of memory, etc.)
Relates to the distinction between "Activation" and "Internalization" processes
http://en.wikipedia.org/wiki/Memory

Relationship of cognition to affect
Pertains to the two main dimensions of cognition and affect and their relationship to each other
http://en.wikipedia.org/wiki/Affective_neuroscience

Emotion and Memory
Describes how emotion influences what is remembered (and how) and what is not
http://en.wikipedia.org/wiki/Emotion_and_memory

Integration of cognition and affect in the frontal lobes, and relation to decision making
Relevant to the "informational" aspect of affective encoding – that is, how the evaluative affective information (e.g., about "good" and "bad") is integral to intelligent behavior
http://en.wikipedia.org/wiki/Orbitofrontal_cortex
http://en.wikipedia.org/wiki/Phineas_Gage

Metacognition
Relevant for the definition of the "Reorganization" column in the KDM
http://en.wikipedia.org/wiki/Metacognition

Motivation
Discusses what motivation is, its relationship to emotion, difference between intrinsic and extrinsic motivation, applications in education, etc.
http://en.wikipedia.org/wiki/Motivation

Flow (Engagement and Motivation)
Csikszentmihalyi, M. (1990). *Flow: The Psychology of Optimal Experience*. New York: Harper Collins.

Nakamura, J., and Csikszentmihalyi, M. (2005), The Concept of Flow, in the *Handbook of Positive Psychology* (C. R. Snyder and Shane J. Lopez, Eds.), Chapter 7, pp. 89-105.

Presenters' Bios

Michael W. Connell, Ed.D., holds a M.S. in Computer Science from M.I.T. and a doctorate in Education from Harvard University. He has been a Software Design Engineer at Microsoft Corporation, Sunburst Communications, Inc., and Lexia Learning Systems, Inc.; an Instructor at the Harvard Graduate School of Education; a Visiting Assistant Professor in the Educational Neuroscience program at Dartmouth College; and an educational consultant to schools, non-profit organizations, the federal government, and corporations. In his research and consulting, Dr. Connell focuses primarily on methods for translating insights from brain and cognitive science into useable knowledge for educators while preserving scientific validity. He has applied insights from his theoretical research to develop applications in a variety of domains, including adult learning, intelligence analysis, the psychology of storytelling, museum exhibit design, management and leadership training, and intelligent tutoring systems for K-12 classrooms. Representative publications include "On Abilities & Domains" (in *The Psychology of Abilities, Competencies & Expertise*, co-authored with Kim Sheridan and Howard Gardner); "Individual Cognitive Factors" (in A Handbook of the Psychology of Analysis: for Intelligence Analysis, Managers, and Teachers, in press); and "Two Motivational Systems that Shape Development" (with Kurt Fischer, 2003).

Sari Boren holds a Master in Education from Harvard University, with a concentration in Technology in Education. She has worked as an exhibit developer and an exhibit educator for 16 years, first on staff at The Computer Museum in Boston and for the past twelve years as a founding principal of the exhibit design firm Wondercabinet Interpretive Design, Inc. in Lexington, MA. Her clients nationwide have included children's museums, science museums, natural history museums, history museums, cultural museums and visitor centers. http://www.wondercabinet.com

Brad Stefl has worked as the Exhibits Manager/Director for the Children's Discovery Museum in Normal, IL. for the past five years. With a background in science education and design he has been involved in and contributed to the formulation, design and installation of many exhibits from small table top interactives to million dollar galleries. He has also helped develop and design many of the museums outreach programs and exhibits. http://www.childrensdiscoverymuseum.net