WPI

Some Issues in Computational Design Creativity

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WPI

Private university,
mostly science & technology.

Founded 1865, as Worcester Country Free Institute of Industrial Science.

Cambridge, 1266?
Harvard, 1636
WPI, 1865
MIT, 1865

One hour west of Boston, MA

3750 undergrads,
1560 post-grads,
425 teaching/research staff.

My Interests

- AI, Design, AI in Design
- Design Computing & Cognition
- Human Computer Interaction & Intelligent Interfaces

Not just “Creativity”

- **Computational Design Creativity** (CDC) of engineered products.

Specifically, *creativity evaluation*

- What are the appropriate evaluation methods and measures?

Current Activities

- Study existing design creativity evaluation methods.
- Possible alternative methods?

Evaluation: when?

- Very difficult - *During* designing:
  Evaluation of decisions made during designing in terms of their likely contribution to the creativity of product.

- Partial designs are hard to evaluate
  -- requires accurate expectations

Evaluation: when?

- Difficult - *After* designing:
  Evaluation of the creativity of product after it has been designed.

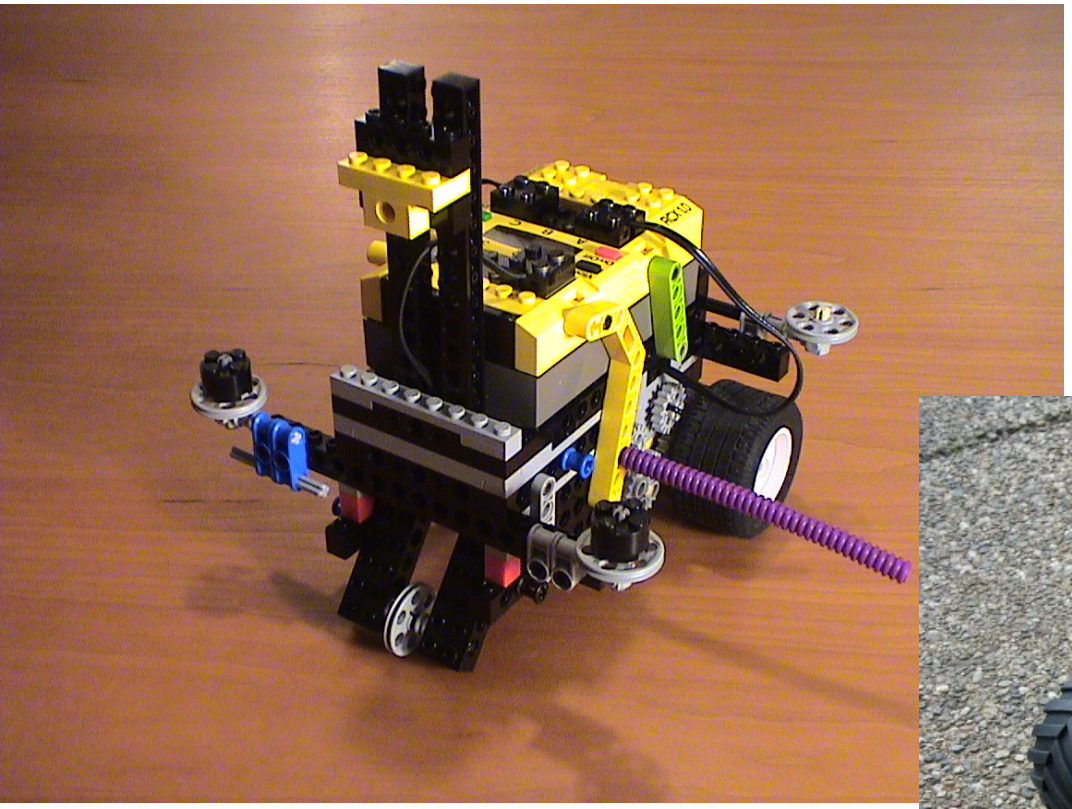
Evaluation: when?

- Both needed for CDC systems
  - *During*
  - *After*

Strong Beliefs

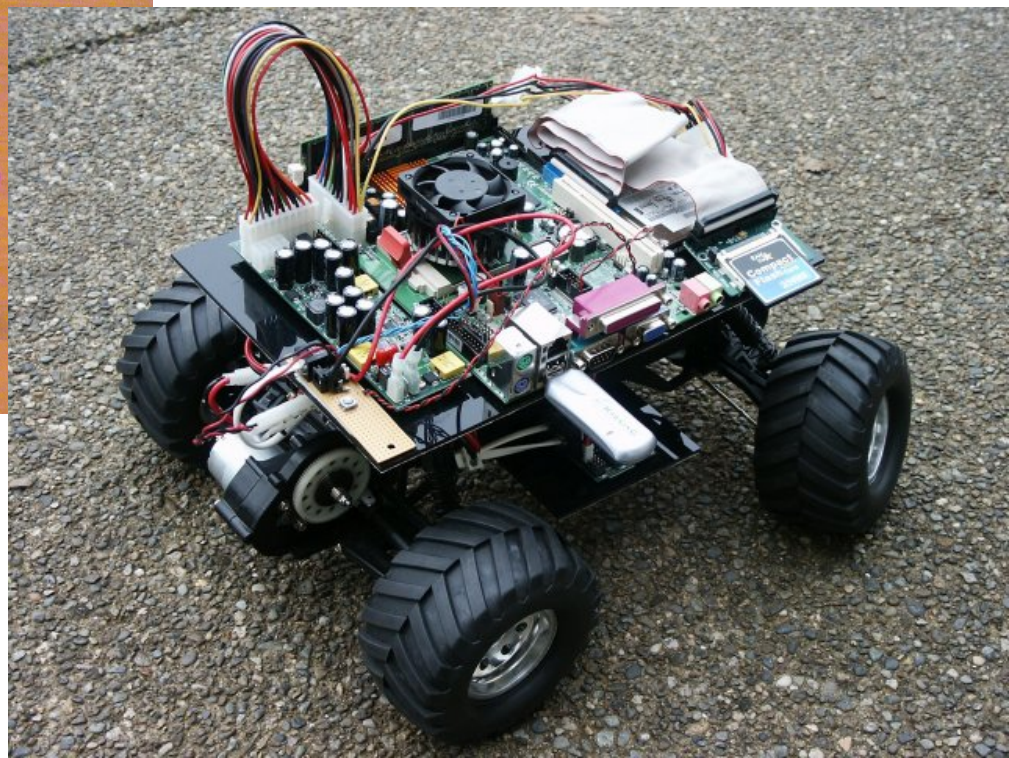
- Artifacts (and processes) are labeled as creative based on *evaluation*.

e.g., evaluator knowledge



Lego knowledge

More expert



e.g., exposure

Read, See, Touch, Manipulate, Use (Ludden)

e.g., population norms

Design description from an excellent kid

From an excellent Architect

Norms: P- and H-Creative

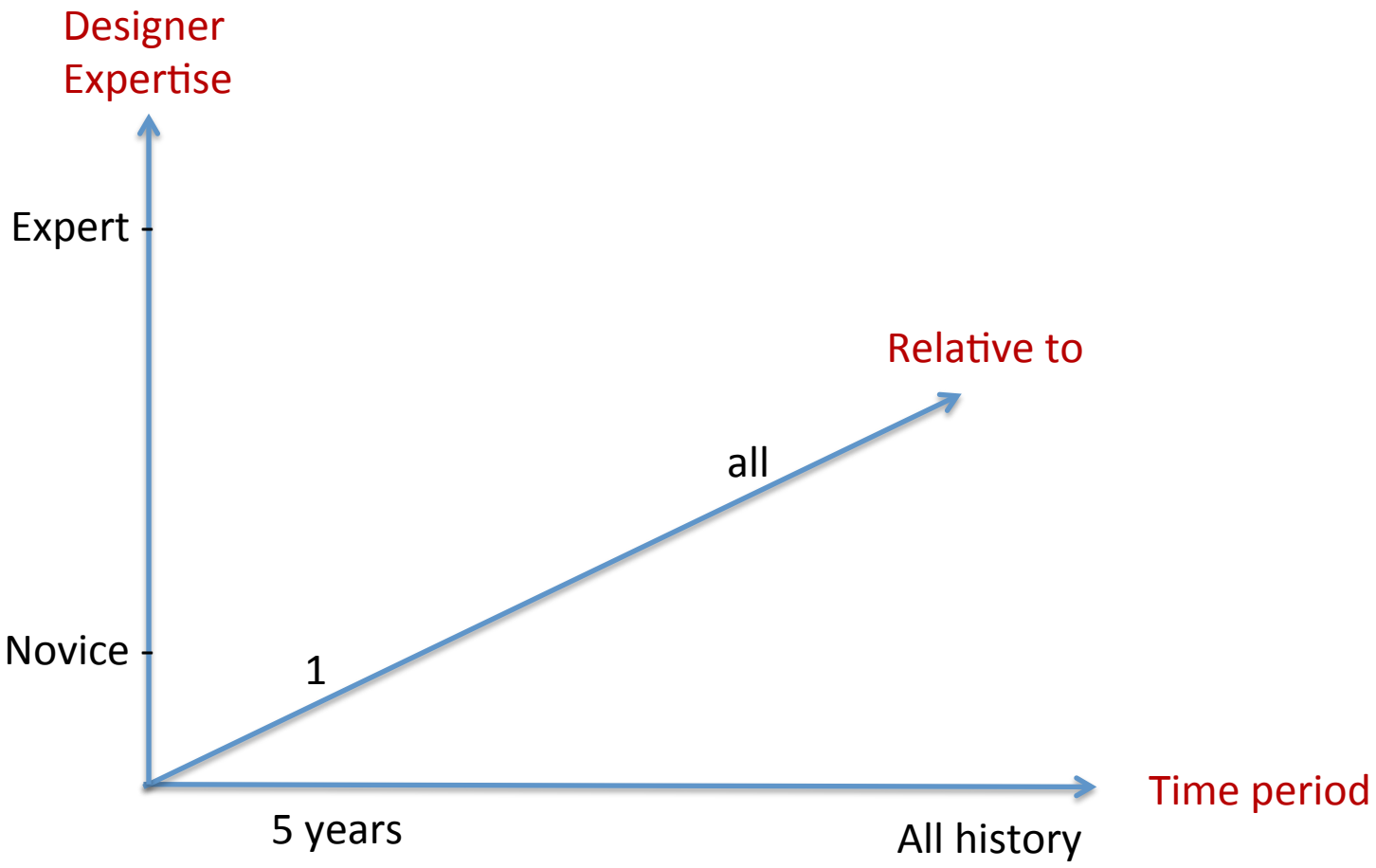
P-Creative: An excellent kid might be very creative relative to what *they've* already done.

P = Psychological ("Personal")

H-Creative: An excellent architect might be very creative relative to what *everyone else* has already done.

H = Historical

P & H Scope (partial)



Evaluation Basis

Evaluation is based on at least:

- the knowledge, experiences, context, and feelings of the *evaluator*
- the type and degree of *exposure* to the thing being evaluated
- the *norms* for the relevant population to which the designer belongs

It's all relative

The consequence is that it's all relative…

- How creative an artifact is may only be *properly* stated if the full context of the evaluation is included.
  - i.e., designer, evaluator, user, etc.

Beliefs continued

- There is no such thing as a "creative computational design system", only one that produces artifacts that are evaluated as creative.

- i.e., the system must design for evaluation

Beliefs continued

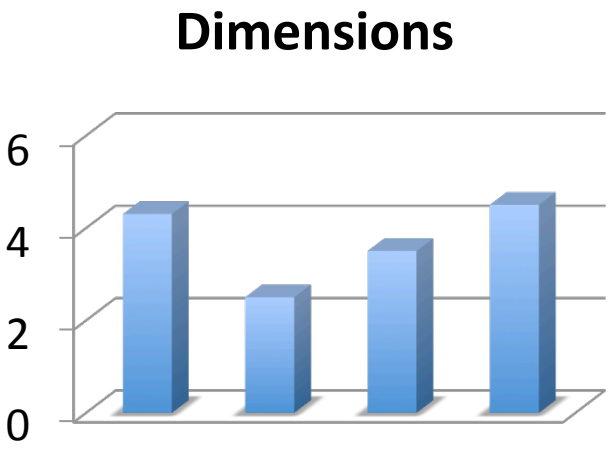
- Evaluations have strengths, therefore artifacts may be seen as more, or less, creative.
  - i.e., it isn't Boolean

Routine Creativity

4 colors → 5 colors

Beliefs continued

- The evaluation of creativity is *multidimensional*.



- Any evaluation in a single dimension results from the evaluator's biases about how to combine dimensions.

Beliefs continued

- Creative activity is strongly tied to the main types of reasoning in synthesis, so its study should begin there. If you don't you will lack *meaningful explanations*.
  - E.g., selection, planning, evaluation, constraint testing, patching, failure handling, etc.

Beliefs continued

- General theories of creativity are *too general* to be useful without more refinement when building design systems.

- Powerful general techniques (e.g., CSPs, Neural Nets, or Evolutionary Computing) are *too powerful* to be very useful when building design systems.

A Strong Influence

Susan Besemer, Ph.D.

- studied people evaluating products for their creativity
- analyzed the characteristics that influenced their evaluations
- statistical analysis, grouping & refining (CPAM)
- tool for evaluating products (CPSS)
- subsequent use in consulting practice

Model's Dimensions

NOVELTY	RESOLUTION	STYLE
The degree of newness in the product in terms of the number and extent of new materials, new processes, and/or concepts included.	The degree to which the product fits or meets the needs of the problematic situation.	The degree to which the product combines unlike elements into a refined, developed, coherent whole.

Novelty

- Surprising
  - Contains unexpected information
- Original
  - Infrequently seen

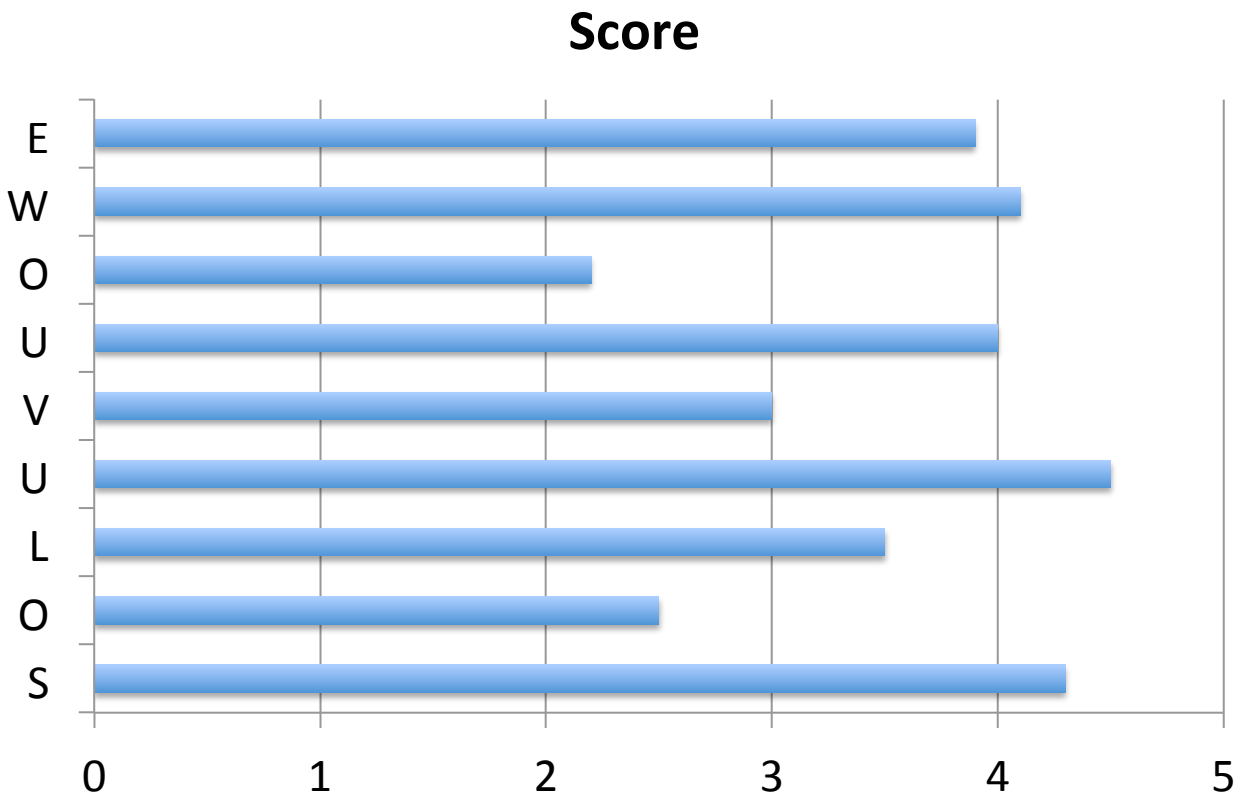
Resolution

- Logical
  - Follows acceptable rules
- Useful
  - Clear practical applications
- Valuable
  - Fills financial, physical, social or psychological need
- Understandable
  - Self-disclosing, “user friendly”

Style

- Organic
  - Harmonious sense of wholeness/completeness
- Well-Crafted
  - Worked with care; highly developed
- Elegant
  - Refined and understated

Creativity Fingerprint



Other Issues

- Role of emotion in the evaluation of creativity?
  - e.g., do fun, cuteness, cleverness, memories, or jokes play a role in evaluation?

- Evaluation must match the context, knowledge & judgment of the *target audience* for the evaluation (e.g., experts reviewing for novices).

Other Issues continued

- Do the ‘requirements’ for the product need to be known to evaluate creativity? Does the intended function?

- How much of the knowledge needed for computational evaluation can be expressed by people and how much needs to be inferred?

Other Issues continued

- What role does explanation play?
  - i.e., does the evaluation need to be explained? What effect does that have on the methods used?

- What role does the evaluator's knowledge of the actual design process play in evaluation of the creativity of a product?

Other Issues continued

- Evaluation of product creativity can be influenced by function, behavior or structure.
- What are the relationships?
  - Creative F → creative product
  - Creative B → creative product
  - Creative S → creative product

FBS Example

- Spinning teacup
  used as an egg timer

✧ F – not creative (many egg timers)

✧ B – creative (spinning teacups!?)

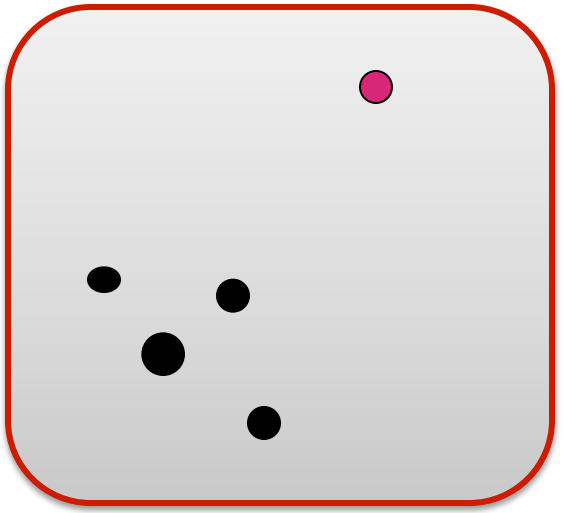
✧ S – not creative (it's still a teacup)

✧ Overall? Creative? (but weak wrt usefulness!)

Exploratory Creativity

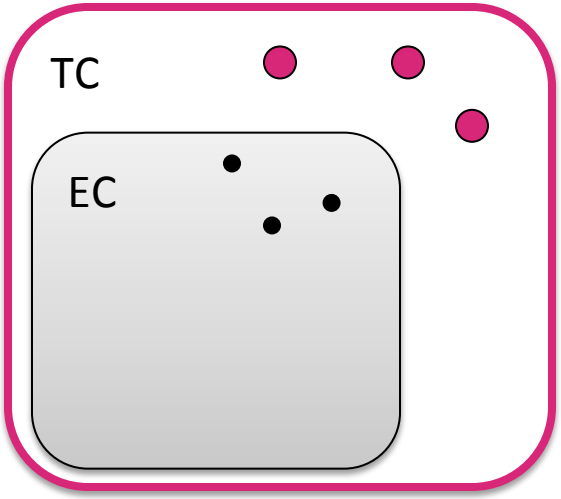
- *Exploratory Creativity (EC).*
  - Explore the "conceptual space".

- *First-time Newness.*
  - New, from exploration.
  - Not "truly creative".
  - But can still be surprising.



"Radical Originality"

- Need to transform the conceptual space
  - e.g., by constraint relaxation
- *Transformational Creativity (TC)*
  - Designs from transformed space



What *can* be done Computationally?

- *Novelty*
  - Surprising.....expectation violation
  - Original.....newness

- *Resolution*
  - Logical.....rules (knowledge base)
  - Useful.....utility (user's task history)
  - Valuable.....functionality (fills need)
  - Understandable....user experiences (e.g., analogy)

- *Style*
  - Organic.....user experience
  - Well-crafted.....physical (design description)
  - Elegant.....artistic (esthetics)

Conclusion

- Some computational creativity evaluation *can* be done
- The rest is difficult!