

Towards affordance-based solving of object insight problems

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Outline



- Motivation
- The two-string problem
- Theoretical framework – knowledge organization for support of creative search processes
- Three levels of creative object problems
- Insight object problems
 - object-composition and problem re-representation

Motivation

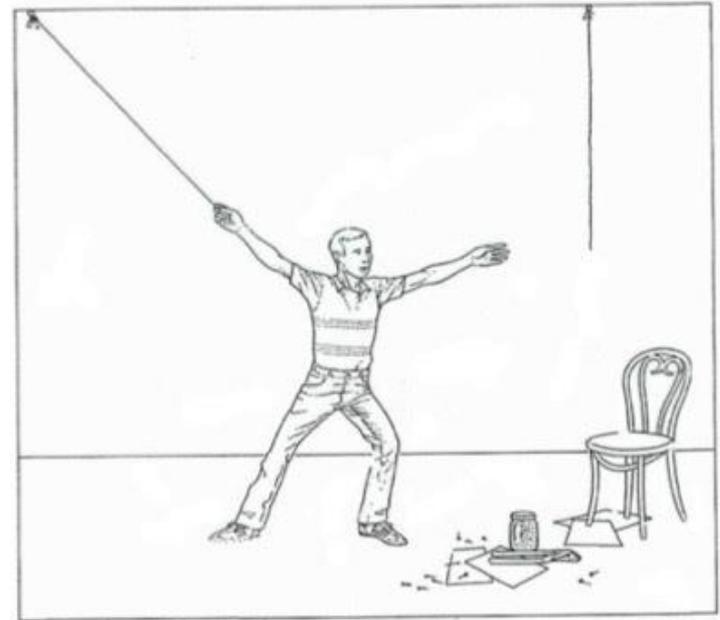


- Humans can use knowledge about object affordances creatively to solve problems
- Cognitively-inspired affordance inference mechanism
 - ⇒
- More versatile, flexible, independent artificial systems
 - with incomplete knowledge
 - with ill-structured problems
 - make new affordance hypotheses
 - construct new objects

The two-string problem



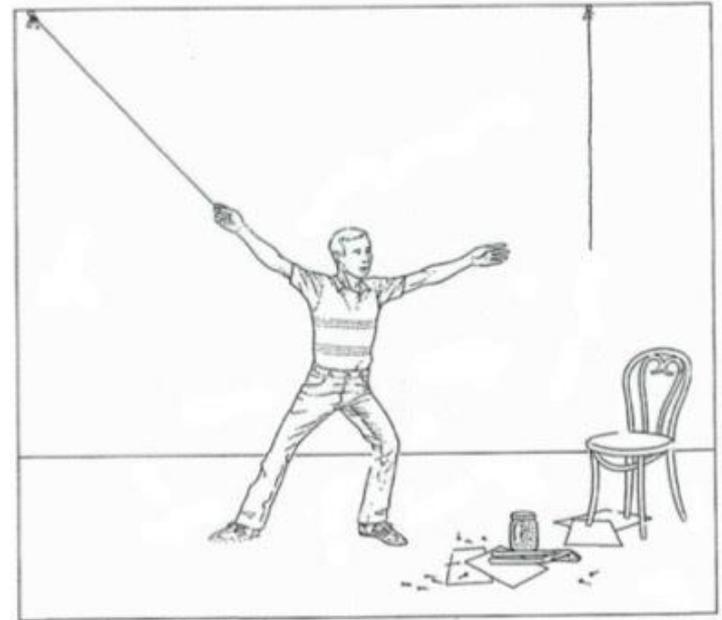
- Maier (1931)
- Task: tie strings together
- impossible to reach one string while holding the other



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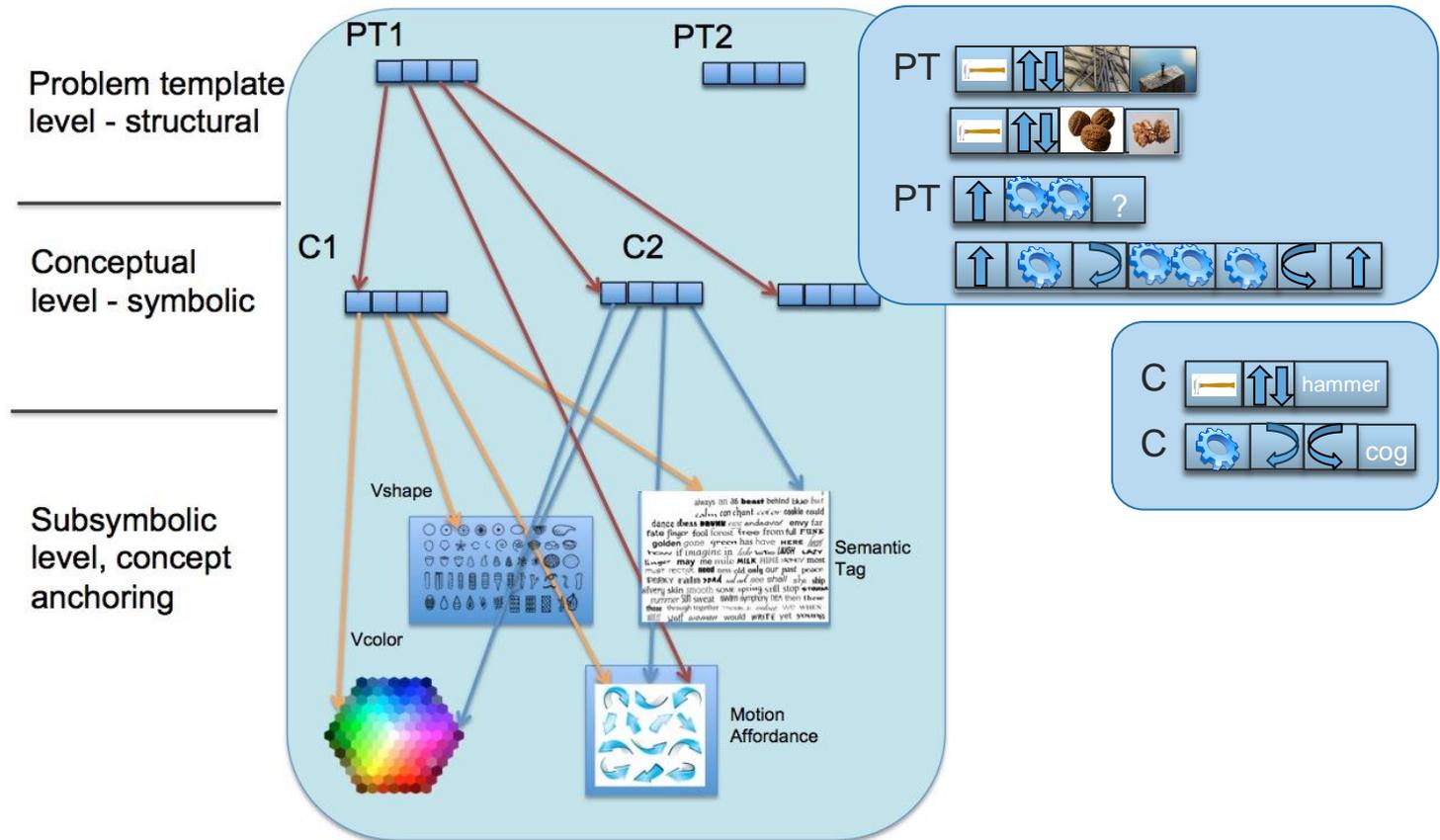
- Uses: Pendular motion affordance
- Requires: Object composition
- Affordance can be triggered (together with productive representation)



Framework (Olteteanu, 2014)

- Cognitively-inspired framework (shape bias, sensorimotor grounding, distributed concept encoding)
- Knowledge organization to support creative substitution and re-representation processes
- Support for:
 - Visuospatial inference
 - Creative affordance-use problem-solving
 - Creative concept matching and generation
 - Problem structure transfer
 - Re-representation for Insight problems

Framework (Olteteanu, 2014)



- Grounding, similarity navigation and replacement, structure, re-representation, associative;
- problem re-representation \approx object re-representation

Three levels of creative object problems



- a) Simple object replacement
creative problems

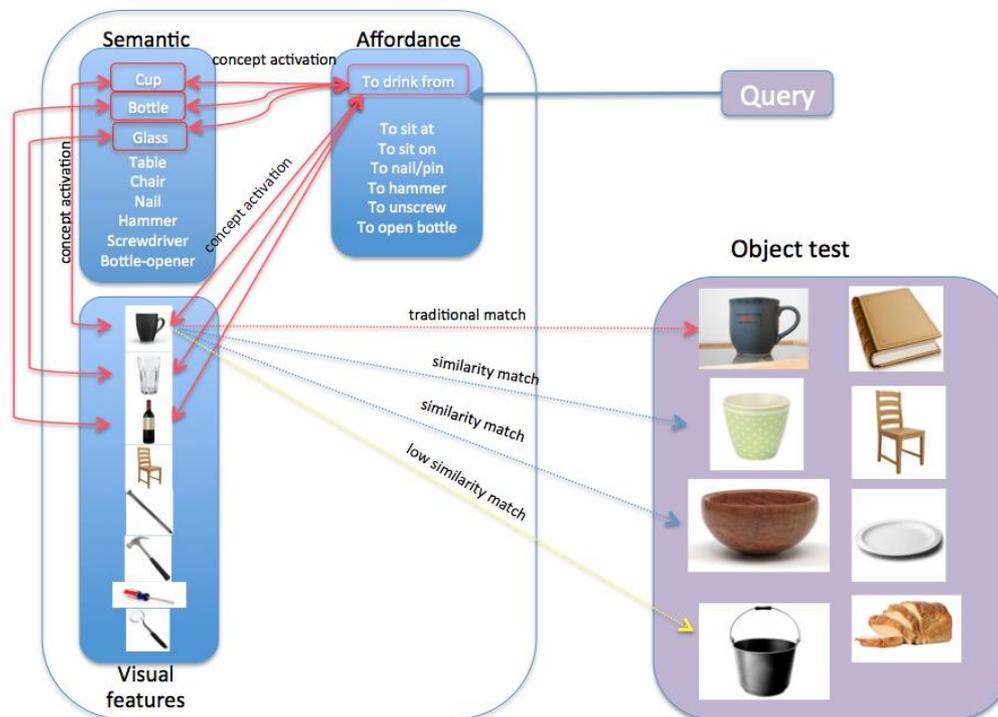
- b) Object composition problems

- c) Object composition insight problems
(wrapped problems)

a) Simple object replacement creative problems



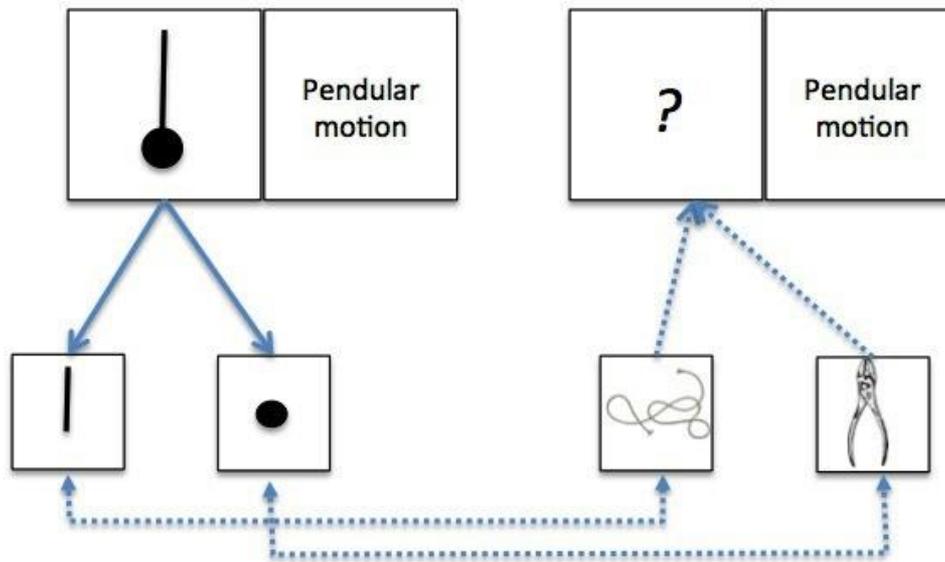
- Problem form – agent needs an object (for a specific affordance), object is not present;
- Task – search for “creative” object replacement





b) Object composition problems

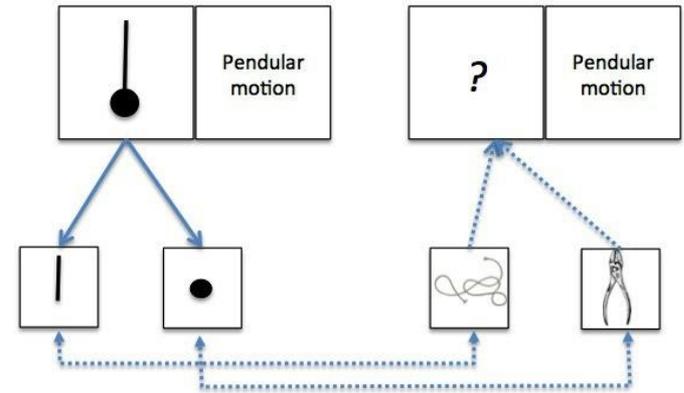
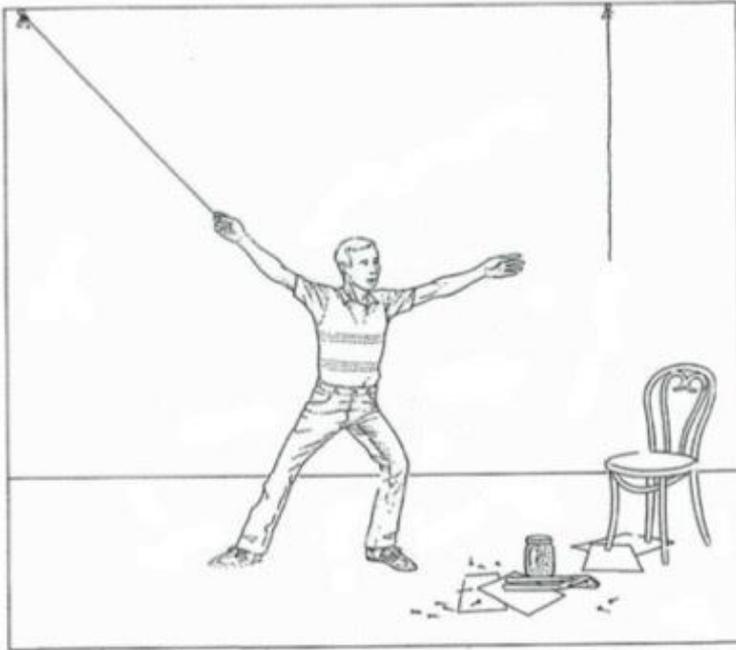
- Agent needs a certain object, but neither the object nor a direct replacement can be found in the environment
- Task: Compose object out of similar object parts
- Object part encoding and re-representation



c) Object composition insight problems (wrapped problems)



- Problem re-representation + Object re-representation



From problem representation:

“tie strings together” and “make strings longer”

to problem representation:

“I can’t reach string”, “I can’t move towards string”,

“make string move towards me”

What object can move towards me?

How do I create that object out of the string?



Conclusion

- Use of knowledge organization principles from a previous theoretical framework
 - problem re-representation \approx composed object re-representation
- Three levels of object creative problem-solving
 - a) Simple object replacement creative problems
 - b) Object composition problems
 - c) Object composition insight problems (wrapped problems)
- Affordance inference in practical problem-solving
 - Object replacement
 - Object composition