



The Role of Oppositions in a Cumulative Science

1. Nature versus nurture
3. Continuous versus all-or-none
7. Serial versus parallel
10. Analog versus digital
12. Contextual versus independent interpretations
18. Grammars versus associations
19. Conscious versus unconscious.



Allen Newell, Pittsburgh, May 18th, 1972:

“Suppose that in the next thirty years we continued as we are now going. Another forty oppositions will have been posited and their resolution initiated. Will psychology then have come of age? Will it provide the kind of encompassing of its subject matter that we all posit as a characteristic of a mature science?

As I examine the fate of our oppositions, it seems to me that clarity is never achieved. Matters simply get muddier and muddier as we go down through time. Thus, far from providing the rungs of a ladder by which psychology gradually climbs to clarity, this form of conceptual structure leads rather to an ever increasing pile of issues, which we weary of or become diverted from, but never really settle.



Los Angeles, May 4th, 1992:

Rodney King:

“Can’t we all just get along?”

1. What if Jay and I were shipwrecked together on an island and had to learn how to survive together and catch prey?
2. Arrows: Powerful, controlled, clean.
3. Nets: Flexible, error-tolerant, parallel
4. We would wind up using both as appropriate and in combination.



PDP versus ACT-R

1. Parallel versus Serial
2. Distributed versus Symbolic?
3. See our BBS reply for discussion of issues of approximation and unitary theories (where the real differences may lie).





Parallel versus Serial

Newell: Every cognitive system has a level of analysis where a lot of processing is happening in parallel followed by a level where a single commitment is made and a discrete action is taken -- e.g., physiology of eye movements.

Therefore, the issue cannot be whether processing is parallel or serial but rather where the transitions from parallel to serial are.



Parallelism and Seriality in ACT-R and PDP

1. There are numerous modules -- visual, manual, declarative which all operate in parallel and asynchronously.
2. Within each module there is massively parallel computation. For instance, when a retrieval request is made there is a massive parallel search through the entire data base looking for the best match.
3. Within each module there are points where the system converges on a decision -- e.g., a memory is retrieved.



The Serial Bottleneck PDP versus ACT-R?

1. ACT-R the path of communication between modules is through the central production system. The central production system (basal ganglia) is a module like others with massive parallelism converging in a single decision but because it is the path of communication among modules it adds an extra layer of seriality.
2. But in fact, ACT-R is not restricted to this constraint -- Salvucci's EMMA is properly conceived of as a direct path between the vision system and the oculomotor system.
3. On the other hand, such basal ganglia gating of cortical communication is part of many connection models such as Randy O'Reilly's PBWM model.



Google's Top 10 "Distributed versus" (out of 1020)

10. Parallel (20)
9. Frameworks (1)
8. Prototype (8)
7. Blocked (16)
6. Lumped (28)
5. Stochastic (5)
4. Compartment (5)
3. Local (38)
2. Centralized (434)
1. Massed (42)

No hits on "Distributed versus symbolic"





Google's Top 10 "Symbolic versus" (out of 726)



10. Analog (1)
9. Distributed (9)
8. Numeric (54)
7. Sub-symbolic (82)
6. Non-symbolic (39)
5. Quantitative (7)
4. Statistical (13)
3. Natural (7)
2. Connectionist (146)
1. Real (109)



Google's Top 10 "Connectionism/ist versus" (out of 173)

10. Computational (1)
9. Serial (1)
8. Socio-biology (1)
7. Rule (5)
6. Language (1)
5. Cognitivism (2)
4. Classical (3)
3. Modular (2)
2. Procedural (2)
1. Symbolism/ist (109)

ACT-R's Symbolic versus Subsymbolic

Symbolic:

?(dm p1)

P1

isa COMPREHEND-SENTENCE

relation In*

arg1 Hippie*

arg2 Park*

Subsymbolic:

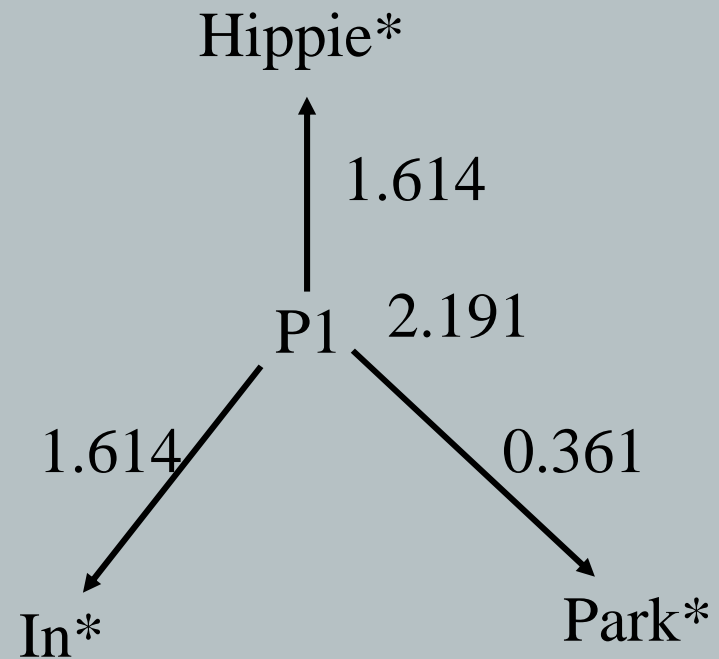
? (sdp p1)

Parameters for chunk P1:

:Activation 1.666

:Base-Level 2.191

:IAs ((Park* . 1.614) (Hippie* . 1.614) (In* . 0.361))

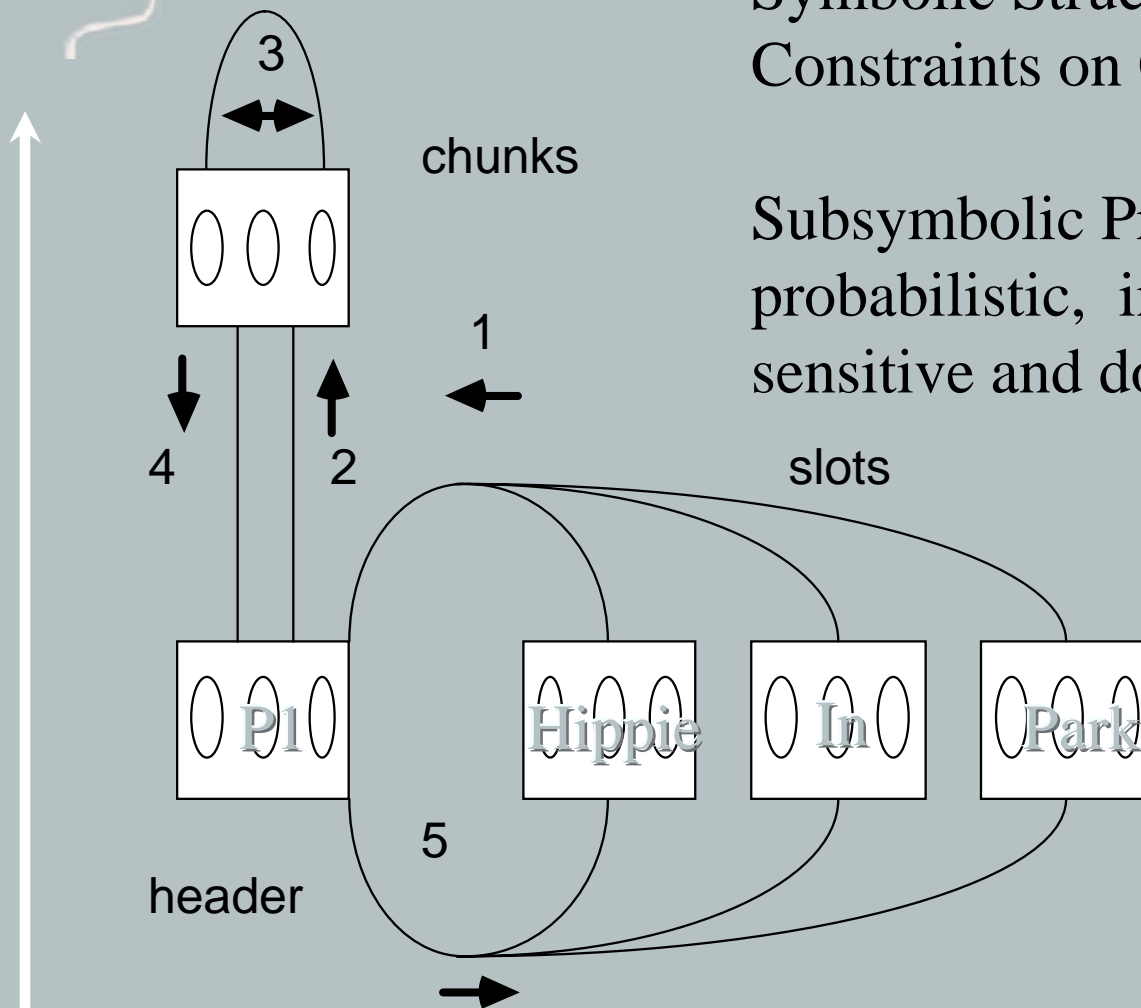


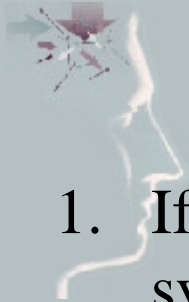
The symbolic enables the coherence of knowledge; the subsymbolic enables the right performance properties

Connectionist versus Symbolic?

Symbolic Structures Represent Constraints on Connections.

Subsymbolic Processes are “graded, probabilistic, interactive, context-sensitive and domain-general”





Connectionism versus Symbolic?

1. If ACT-R is capable of being realized as a connectionist system, why don't we do our simulations in real connectionist systems?
2. If PDP reflects real neural computations why are the models not performed as simulations of real neurons?
3. The answer in both cases is that for certain purposes of understanding certain phenomena, this is a level of detail that is not of relevance.
4. Thus, the difference among the approaches is in part the set of phenomena that they are interested but since these are not disjoint sets of interests, the approaches are relevant to one another and should be used in best combinations. One of our goals in ACT-R development is to facilitate the integration of ACT-R with other approaches.



PDP versus ACT-R

1. Parallel versus Serial -- the differences are more apparent than real.
2. Distributed versus Symbolic -- The opposition is all about terminology. Although that terminology does serve to sort important concepts it does not serve as a theoretical dividing point.
3. Can't we all just get along? -- It seems like this is a dispute in name only -- we do get along as citizens and our theories agree quite closely (and have since 1983).
4. There would be more cumulative progress if there is recognition of this fact -- it is a remarkable convergence and points to the way for research to be aggregated