Hypothesis formation and testing in an interpretive domain

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Outline

• What is a hypothesis? What are hypotheticals?
• Examples from Supreme Court oral arguments
• Role of hypotheticals in legal reasoning
• Why is this kind of reasoning important?
• Sketch of three on-going research approaches.

Research sponsored by NSF Award IIS-0412830
Definitions

**Hypothesis** ≡ tentative assumption made in order to draw out and test its normative, logical or empirical consequences.

**Hypothetical** ≡ an imagined situation that involves a hypothesis; used to help draw out those consequences.

- In Supreme Court oral arguments, hypotheticals perform an important function.
- The *hypotheses* are an advocate’s proposed test or standard for deciding a case.
- Justices pose *hypotheticals* to probe advocates’ tests: their meaning, consistency, legal and policy implications.
Example

*California v. Carney, 105 S. Ct. 2066 (1985)*

**Issue:** Legality, under 4th Amendment, US Constitution, of warrantless search of a motor home.

**Facts:** Police suspected def. Carney of trading drugs for sex in motor home located in downtown San Diego parking lot. After questioning a boy leaving Carney’s motor home, agents entered without a warrant or consent, observed drugs, and arrested Carney.

**Conflicting principles:**

a. Prevent loss of evidence in emergency situation.

b. Constitutional right of autonomy and privacy in ones home.

c. Bright line rule that police can apply.

**Proposed tests:**

State of CA (Mr. Hanoian): Like automobile exception. If place-to-search has wheels and is self-propelling → no warrant.

Carney (Mr. Homann): If place to be searched has indicia of home then warrant is required.
<table>
<thead>
<tr>
<th>Argument excerpt – Carney -1-</th>
<th>Self-expl. prompt</th>
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<tbody>
<tr>
<td><strong>48. MR. HANOIAN:</strong> I think I would, Your Honor, yes. That would provide a bright line. But I am looking a little bit more beyond just wheels. We are looking for self-locomotion, self-propelling.</td>
<td>What is Mr. Hanoian's proposed test?</td>
</tr>
<tr>
<td><strong>61. QUESTION:</strong> Well, what if the vehicle is in one of these mobile home parks and hooked up to water and electricity but still has its wheels on?</td>
<td>How does this hypothetical relate to Mr. Hanoian's test?</td>
</tr>
<tr>
<td><strong>62. MR. HANOIAN:</strong> If it still has its wheels and it still has its engine, it is capable of movement and it is capable of movement very quickly.</td>
<td>Do you think Mr. Hanoian's response is effective?</td>
</tr>
<tr>
<td><strong>63. QUESTION:</strong> Even though the people are living in it as a home and are paying rent for the trailer space, and so forth?</td>
<td>Why are the Justices adding these features to the hypothetical?</td>
</tr>
<tr>
<td><strong>66a. MR. HANOIAN:</strong> Well, I am not suggesting that there is no expectation of privacy in those circumstances, Your Honor.</td>
<td>By conceding expectations of privacy in the hypotheticals, does Mr. Hanoian reduce his chances of winning the case at hand?</td>
</tr>
<tr>
<td><strong>66b. MR. HANOIAN:</strong> What I am suggesting is that society -- this Court has determined that society is not willing to recognize that expectation of privacy as justifying a different rule from another motor vehicle; and that, because of its mobility, the capacity for it to move --</td>
<td>Does Mr. Hanoian make an effective argument in 66a/66b?</td>
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</table>
### Attack test with disanalogous hypo – Carney example

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Propose test ( t ) s.t. applying ( t ) to cfs yields outcome ( x ); give reason(s)</td>
</tr>
<tr>
<td>2</td>
<td>Attack ( t ): pose disanalogous hypo ( h ) s.t. applying ( t ) to ( h ) yields ( x ), and give reasons why that should not be so for a suitable test.</td>
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<tr>
<td>3</td>
<td>Hanoian rejects modifying ( t ).</td>
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<td></td>
<td>Abandon test ( t )</td>
</tr>
<tr>
<td></td>
<td>Modify test ( t ) to ( t' ) s.t. applying ( t' ) to cfs yields ( x ) and applying ( t' ) to ( h ) does not yield ( x ).</td>
</tr>
<tr>
<td></td>
<td>Save ( t ): attack “should not be so” by analogizing (cfs, ( h )).</td>
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</table>

#### t: If place-to-search has wheels and is self-propelling → no warrant.
Motorhome in cfs has wheels and is self-propelling.
Pa: Prevent loss of evidence.

#### h: Well, what if the vehicle is in one of these mobile home parks and hooked up to water and electricity but still has its wheels on?...But what about a self-propelled vehicle that's plugged into the plumbing and the electricity?
Pb: Privacy; Pb > Pa

Analogize cfs, \( h \): “MR. HANOIAN: What I am suggesting is that society -- this Court has determined that society is not willing to recognize that expectation of privacy as justifying a different rule from another motor vehicle; and that, because of its mobility, the capacity for it to move…”

And you would apply it, even if it had been parked there three months or so, because your officer wouldn't really know how long it had been parked? Yes.
Pc: Bright-line Rule; Pa, Pc > Pb.
<table>
<thead>
<tr>
<th>Argument excerpt – Carney -2-</th>
<th>Model explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>182. MR. HOMANN:</strong> The motor home was parked; the drapes were closed. It contained upholstered furniture. It contained a table, kitchen features, a refrigerator. It contained all of the indicia of a home.</td>
<td>Proposed test 1: If place to be searched has the indicia of a home then a warrant is required.</td>
</tr>
<tr>
<td><strong>231. QUESTION:</strong> We're getting closer to your case. Suppose somebody drives a great big stretch Cadillac down and puts it in a parking lot, and pulls all the curtains around it, including the one over the windshield and around all the rest of them. Would that be a home?</td>
<td>Hypo focuses on determining when a vehicle exhibits sufficient indicia of being a home.</td>
</tr>
<tr>
<td><strong>236. MR. HOMANN:</strong> Does it have a bed? 237. Q: Yes, yes. 238. MR. HOMANN: If it is reasonably objectively observable that it has the attributes of a home in it, then I think we have to give it those -- I think we have to give it the same protections that we ordinarily give dwelling compartments.</td>
<td>Proposed test 2: If vehicle has the &quot;reasonably objectively observable attributes of a home&quot; then it requires a warrant to search.</td>
</tr>
<tr>
<td><strong>275. QUESTION:</strong> Mr. Homann, what about a van? …In order to help you out, the van is running down the road at 55 miles per hour.</td>
<td>This flips over to Mr. Hanoian’s test. Mr. Homann’s concession suggests a modification of his test:</td>
</tr>
<tr>
<td><strong>276. MR. HOMANN:</strong> That helps me tremendously, because the rule that I've proposed at least is not going to preclude the police from entering the van or the motor home, for that matter, when it is speeding down the highway in most circumstances.</td>
<td>Proposed Test 3: If a vehicle has the &quot;reasonably objectively observable attributes of a home&quot; then it requires a warrant to search unless it is imminently capable of motion.</td>
</tr>
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</table>
Series of attacks and modifying rule

1. Propose test \( t \) s.t. applying \( t \) to cfs yields outcome \( x \); give reason(s)

   \( t_1 \): If place to be searched has indicia of home then warrant is required.  
   \( P_b \): privacy

2. Attack \( t \): pose disanalogous hypo \( h \) s.t. applying \( t \) to \( h \) yields \( x \), and give reasons why that should not be so for a suitable test.

   \( h_1 \): Suppose somebody drives a great big stretch Cadillac down and puts it in a parking lot, and pulls all the curtains around it, including the one over the windshield and around all the rest of them.  
   \( P_c \): bright-line rule; \( P_c > P_b \)

3. Modify test \( t \) to \( t' \) s.t. applying \( t' \) to cfs yields \( x \) and applying \( t' \) to \( h \) does not yield \( x \).

   \( h_2 \): What about a van? ...In order to help you out, the van is running down the road at 55 miles per hour.  
   \( P_a \): Prevent evidence-loss; \( P_a > P_b \)

4. Attack \( t \): pose disanalogous hypo \( h \) s.t. applying \( t \) to \( h \) yields \( x \), and give reasons why that should not be so for a suitable test.

   \( h_3 \): If a vehicle has the "reasonably objectively observable attributes of a home" then it requires a warrant to search unless it is imminently capable of motion.
Example

*SONY Corp. v. Universal City Studios*, 464 U.S. 417 (1984)

**Facts:** Some members of the general public used Sony Betamax VTRs to record copyrighted broadcasts.

**Issues:**

1. Does SONY’s sale of video tape recorders contribute to infringement of plaintiff owners’ copyrights in television programs by enabling consumers to infringe those copyrights directly?
2. What is the appropriate standard for contributory liability for copyright infringement?

**Proposed test:**

Mr. Kroft (for Universal): if there were only one show on the air that was copyrighted and which could not be copied without objection, if SONY sold this device with knowledge that it would be used to copy that show, the Petitioners would be liable.
106. **QUESTION:** Suppose the evidence in the case put on by witnesses that your friend referred to indicated, just suppose it indicated, that about ten percent of all programming could be copied without any interference by the producer or whoever owned the program. Suppose that there was at least ten percent that a homeowner could copy without violating anybody's copyright.

107. Would you think that would make any difference in this case?

108. **MR. KROFT:** I don't think that would make any difference. I think ten percent is too small of an amount.

109. **QUESTION:** Well, what about 50?

110. **MR. KROFT:** I'll go you one better, Justice White. If there was only one show on the air that were copyrighted and which could not be copied without objection, if the Petitioners sold this device with knowledge that it would be used to copy that show, under the Inwood test laid down by this Court in the trademark area I believe the Petitioners would be liable.

111. However, I would concede that I think it might be very difficult for us to prove if there was only one show.

112. **QUESTION:** Well, let's take 50 percent. You certainly would argue that Sony would be liable if it sold this machine knowing that homeowners would copy a good many of the 50 percent that are copyrighted, in which there would be an infringement.

113. **MR. KROFT:** Yes, I would, and the reason I would --
125. QUESTION: Well, specifically for copying purposes. Under your test, supposing somebody tells the Xerox people that there are people who are making illegal copies with their machine and they know it. Must they -- what are they supposed to do?

126. MR. KROFT: I think that probably now puts the cart before the horse, Justice Stevens. That wasn't happening when Xerox began selling its machine. Xerox first started selling the machine for business applications. We can all remember what they looked like. You'd have to put one page in. You couldn't run through pages and pages and pages like you can today.

127. And over the years I suppose people have come to use Xerox for different reasons. Xerox has tried to protect itself -- and I don't know if it's doing it adequately or not -- by giving every Xerox renter -- and I believe most of these machines are rented -- a little list of do's and don't's. And one of the don't's is don't copy copyrighted material.

128. QUESTION: But you just said that wouldn't protect Sony.

129. MR. KROFT: I don't believe it would, and that's why I say I'm not sure --

130. QUESTION: Does it protect Xerox?

131. MR. KROFT: That's why I just said I'm not sure if it does.

132. QUESTION: But your view of the law is that as long as Xerox knows that there's some illegal copying going on, Xerox is a contributory infringer?

133. MR. KROFT: To be consistent, Your Honor, I'd have to say yes.

134. QUESTION: A rather extreme position.
Attack proposed test with *reductio ad absurdum* hypo

1. Propose test t s.t. applying t to cfs yields outcome x; give reason(s)

2. Attack t: pose *r.a.a* hypo h s.t. applying t to h yields x, and give reasons why that should *not* be so for a suitable test.

3. Abandon test t
   - Modify test t to t' s.t. applying t' to cfs yields x and applying t' to h does not yield x.

Save t: attack “should *not* be so” by analogizing (cfs, h)

MR. KROFT: If there was only one show on the air that were copyrighted and which could not be copied without objection, if the Petitioners sold this device with knowledge that it would be used to copy that show, ... the Petitioners would be liable.

QUESTION: But your view of the law is that as long as Xerox knows that there's some illegal copying going on, Xerox is a contributory infringer?

MR. KROFT: To be consistent, Your Honor, I'd have to say yes.

QUESTION: A rather extreme position.
Propose test t s.t. applying t to cfs yields outcome x; give reason(s).

1

Attack t: pose *disanalogous* hypo h s.t. applying t to h yields x, and give reasons why that should *not* be so for a suitable test.

2

Abandon test t

Modify test t to t' s.t. applying t' to cfs yields x and applying t' to h does not yield x.

3

Save t: Attack “why a suitable test should *not* be so” by analogizing (cfs, h)

Modify test t to t’ s.t. applying t' to cfs yields x and applying t' to h also yields x.

4

Save t: Attack “why a suitable test should” by distinguishing (cfs, h)

5

Abandon test t

Modify test t to t' s.t. applying t' to cfs yields x and applying t' to h does not yield x.

Model attacking proposed test with (dis-)analogous hypo
Lakatos-style hypothetical reasoning

1. Propose conjecture \( t \) s.t. \( t \) is true of cfs’s; give reason(s)

2. \( t \equiv \) for all polyhedra \( V - E + F = 2 \)
   Number of (vertices – edges + faces)

3. Induction; Exists proof: (1) remove one face of polyhedron and stretch flat on blackboard….

4. Attack \( t \): pose hypo \( h \) s.t. \( t \) is not true of \( h \) but \textit{should} be for various reasons.
   Cylinder:
   \[ V - E + F = 0 - 2 + 3 = 1 \]

5. Abandon conjecture \( t \)
   Modify \( t \) to \( t' \) s.t. \( t' \) is true of cfs’s and \( t' \) is true of \( h \).
   Save \( t \): attack “\textit{should be}” by distinguishing (cfs, \( h \))

Limit \( t \) to any polyhedra which, by removing one face, can be stretched flat on a blackboard and the resulting network be connected \( V - E + F = 2 \).
Why is hypothetical reasoning important?

• Systematic methodology for creative, exploratory reasoning
• Makes assumptions explicit
• Explores linkages among facts, theory, evaluation criteria
• Tools for exploring concepts’ meanings and for making rules relevantly more and less general
• Real world methodology, sometimes predictive of real outcomes
What’s hard in learning hypothetical reasoning skills?

• Getting good examples (e.g., Sup. Ct. oral arguments)

• Understanding the oral argument examples?
  – Oblique dialogues assume familiarity with case background.
  – Hard to see/explain interpretive relations in the argument texts:
    1) Identify and formulate proposed tests
    2) Explain how a hypothetical relates to a test and why
    3) Explain how an advocate responds to a hypothetical and why
    4) Evaluate response to hypothetical vis a vis the test

• Making interpretive arguments?
  – Hard to invent factual hypo for purpose of testing proposed test.
    • Hard to integrate facts, reasons why suitable test should reach certain outcome, criteria for making and evaluating arguments and selecting appropriate responses.

• Would an explicit model help students understand? Perform?
  – Does identifying/explaining components and relations help or hinder?
  – Do visual (or other) representations help or hinder?
Three research goals

1. How well do law students understand the interpretive role of hypothetical reasoning in Sup. Ct. oral arguments?

2. Can tech-supported collaborative instruction help them learn to reason with hypotheticals?

3. Can the process of reasoning with hypotheticals be modeled computationally and facilitate instruction?
3. Can computational model help?

- Can it engage students in hypothetical reasoning?
- AI models of Lakatos-style reasoning in machine learning:
  - card game plans (Hearts) (Hayes-Roth, R. 1983)
  - number theory concepts: HR (Pease, Colton, et al. 2002)
  - engaged students in making case-based legal arguments analogizing and distinguishing cases, but not posing hypos to assess tests.
- HYPO: posed hypothetical variations of problem situation to strengthen/weaken argument (Ashley, 1988)
  - Used heuristics to pose hypos by modifying cases along dimensions.
  - Some response types modeled, but not in dialogical context in which hypos put pressure on proposed tests and their concepts.
HYPO heuristics for posing hypotheticals

Define dimensions: stereotypical fact patterns that tend to strengthen or weaken claim in a case.

H1: Make a near miss dimension apply
H2: Strengthen or weaken a case along applicable dimension
H3: Move a case along a related dimension
H4: Make a case extreme along a dimension
H5: Make a case into a near-win given a target

Define which hypothetical modifications are meaningful:
- Argument context (and Claim Lattice) helped choose hypothetical modifications.
- Goal to show how plaintiff’s position in current fact situation (cfs) can be strengthened/weakened in light of near-by cases.
HYPO model of SONY hypotheticals

Define dimensions:

- **possible-noninfringing-use:**
  - percentage of copied programs not copyrighted
- **known-infringing-uses:**
  - percentage of copyrighted programs def. knew were copied

**Hypos1-3:** 10% of programs copied are not copyrighted; 50%; 99.9%

- weaken seed case (cfs) for plaintiff along possible-noninfringing-use dimension:

- Heuristics:
  - H2 (weaken along applicable dimension)
  - H4 (make extreme along dimension)

**Hypo4:** only .1% of copyrighted programs copied were infringing, but defendant *knew* they were being copied.

- strengthen Hypo 3 for plaintiff along known-infringing-uses dimension:

- Heuristics:
  - H1 (make near miss dimension apply)
  - H3 (move case along related (i.e., conflicting) dimension)
Method for Interpretive Legal Domain

Rule 1. Examine past cases and decision rules and propose a test.
   – See if a past rule applied to the cfs arguably leads to a favorable decision.
   – If so, use that rule as proposed test for deciding the cfs and give reasons.
   – If not, construct a proposed test that when applied to the cfs leads to a favorable decision and is consistent with the results of some important past cases, and give reasons.

Rule 2. Inspect argument in light of past cases/rules that arguably lead to the opposite conclusion and pose counterexample.
   – Find past-case- or construct hypothetical counterexample to the proposed test, such that the counterexample is:
   – [analogous to] [disanalogous from] the cfs (i.e., a suitable test when applied to the counterexample should yield [the same][a different] result) and yet the proposed test when applied to the counterexample leads to [a different][the same] result, and give reasons.

Rule 3. Respond to the counterexample as follows:
   – Save the proposed test by disputing that a suitable rule applied to the counterexample should yield [the same] [a different] result (i.e., show that the supposedly analogous counterexample is really [disanalogous] [analogous]). Or
   – Modify the proposed test so that it is behaves like a suitable rule or does not apply to the counterexample (i.e., [remove][add] a condition (or [expand][limit] a concept definition such that the modified rule applies to the counterexample and yields the same result, applies to the counterexample and yields a different result or no longer applies to the counterexample, as appropriate.) Or
   – Abandon the proposed test.
Computational model for simpler domain

- Players: advocate and interrogator
- Cases and outcomes: <7♣, A♥, 6♠>, <3♠, 5♦, 10♦> **Goal**: <5♣, 8♣, 4♦>
- Proposed tests: If (suit(C2) ≠ ♥) → ♦
- Reasons for critiquing tests:
  - Policies capturing trade-offs among principles like
  - Rule’s complexity, coverage, generality, complement coverage, etc.
- Hypotheticals:
  - Interrogator selects cases to critique proposed test given interrogator’s policy
  - Hypo: < 9♥, 3♥, 8♦> → If (val(C2) ≤ 8) → ♦ given preference for values over suits
- Defining new concepts for proposed tests:
  - FaceCard = \{Cx | val(Cx ≥ 10}\}
  - SharpVals = \{4,7,K,A\}
  - SharpCards = \{Cx | val(Cx ∈ SharpVals)\}
Conclusions

• Hypothetical reasoning is a systematic cognitive methodology for creative, exploratory reasoning. It makes assumptions explicit, explores concepts’ meanings and the linkages among facts, theories, and evaluation criteria.

• Supreme Court oral arguments are unique examples of hypothetical reasoning at work. How can they best be used as pedagogical examples?

• Three on-going projects to assess:
  1. How well do law students understand the interpretive role of hypothetical reasoning in Sup. Ct. oral arguments? Can we objectively assess improvements?
  2. Whether tech-supported collaborative instruction can help them learn to reason with hypotheticals?
  3. Whether the process of reasoning with hypotheticals can be modeled computationally and facilitate instruction?
1. Experiment

**Task:** Study transcripts of Sup. Ct. oral arguments (two 3-hour sessions.)

**Participants:** 17 students in pre-law summer program

**Hypothesis:** Detailed self-explanation prompts can scaffold students’ understanding of oral argument transcripts.

**Experimental condition:** Specific prompts ask student to track if/how the attorneys change their proposed tests in response to Justices’ questioning.

**Control condition:** Generic prompts (“Explain”) in the same place as the specific prompts.

**Post-test argument skills assessment:** argumentation questions (e.g., generate hypotheticals) about similar problem (near transfer) and novel problem (far transfer) (3 hrs).
Assessment form excerpts

■ **SONY, 4a:** How well did the student pose and explain a hypothetical that would violate some version of a test for determining whether SONY was contributorily liable for copyright infringement customers committed with VCRs supplied by SONY?

1 = Not well at all  5 = Very well

■ **SONY, 4a:** Briefly state the test which, the student implies, the hypothetical would violate:

■ **SONY, 4a:** Check any that apply: The student’s hypothetical was:

- Abstract and conclusory
- Concise with no irrelevant details
- Factually specific
- Irrelevant to the argument
- Nonsensical
- Not mentioned in the transcript
- Not really there
- Not well focused
- Relevant to the argument
- Very creative
- Very similar to one in the transcript
- Well focused
2. Collaborative Mark-up Tools
# Toward a computational model...

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<thead>
<tr>
<th>Advocate:</th>
<th>Rule:</th>
<th>Concept</th>
<th>Arg:</th>
</tr>
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<tbody>
<tr>
<td>Goal: $&lt;5\spadesuit,8\spadesuit,4\diamondsuit&gt;$</td>
<td>If $(\text{suit}(C2) \neq \heartsuit) \rightarrow \star$</td>
<td>Defs:</td>
<td>Rule uses general criterion \textit{suit}; simple, complete coverage</td>
</tr>
<tr>
<td>Cases: $&lt;7\spadesuit, A\heartsuit,6\spadesuit&gt;,$ $&lt;3\spadesuit,5\diamondsuit,10\diamondsuit&gt;$</td>
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<tr>
<th>Interrogator:</th>
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<th>Response:</th>
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<tbody>
<tr>
<td>Hypo: $&lt;9\heartsuit, 3\heartsuit, 8\diamondsuit&gt;$</td>
<td></td>
<td>Not about case but complement</td>
<td></td>
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<tr>
<td>Hand: $9\heartsuit, 3\heartsuit, J\heartsuit, 6\spadesuit,8\diamondsuit,$…</td>
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<td>Goal: $&lt;5\spadesuit,8\spadesuit,4\diamondsuit&gt;$</td>
<td>If $(7 &lt; \text{sum}(C1,C2) &lt; 14) \rightarrow \star$</td>
<td>Defs:</td>
<td>Rule simple, complete coverage, about case, focus on essential concepts (but new, less general criterion)</td>
</tr>
<tr>
<td>Cases: $&lt;3\spadesuit, K\spadesuit, 2\diamondsuit&gt;,$ $&lt;5\heartsuit, 2\heartsuit, 6\spadesuit&gt;,$ $&lt;9\heartsuit, 3\heartsuit, 8\diamondsuit&gt;,$ $&lt;7\spadesuit, A\heartsuit,6\spadesuit&gt;,$ $&lt;3\spadesuit,5\diamondsuit,10\diamondsuit&gt;$</td>
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### Toward a computational model... (cont.)

| Advocate:          | Rule: If ((FaceCase(C) and diff(C1, C2) < 3) or (FaceCase(C) and (diff(C1, C2) > 1) and (7 < sum(C1,C2) < 14))) → ♦ | Concept Defs: sum(Cx,Cy) = (val(Cx) + (val(Cy))
|                   | Diff(Cx, Cy) = |val(Cx) – val(Cy))| |
|                   | FaceCard = {Cx | val(Cx ≥ 10} | |
|                   | FaceCase = {{<Cx,Cy,Cz} | |
|                   | FaceCard(Cx) or |
|                   | FaceCard(Cy)} | |
|                   | Arg: Revise FaceCard to cont. existing rule; good coverage. |

| Advocate:          | Rule: If ((((C1 ∈ SharpCards) and (C2 ∈ SharpCards)) and (suit(C1)≠suit(C2))) or ((C1 ∈ FaceCards) and (C2 ∈ FaceCards))) → ♦ | Concept Defs: |
|                   | SharpVals = {4,7,K,A} | |
|                   | SharpCards = {Cx | val(Cx ∈ SharpVals} | |
|                   | Arg: High coverage, ... |

| Interrogator:      | Hypo: < 2♠, 7♣, 4♥> | Response: Uses span, rejects monster |
|                   | Hand: K♦, 2♠, J♥, ... |

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