Perceptual-cognitive Training Improves Cross-cultural Communication in a Cadet Population

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SOARTECH
Modeling human reasoning.
Enhancing human performance.

Need

- GIFT *conditions* capture learner performance
  - Specific to one training system
  - Requires technical expertise to create
  - Captures individual observations, not relations between them
- Developing *patterns* to let instructors easily relate conditions

- GIFT *tailoring* in response to learner performance
  - Should deliver precise interventions based on what way the learner was wrong
  - Should inform future tailoring in other training systems
- Developing *misconceptions* for domain-specific & domain-general tailoring
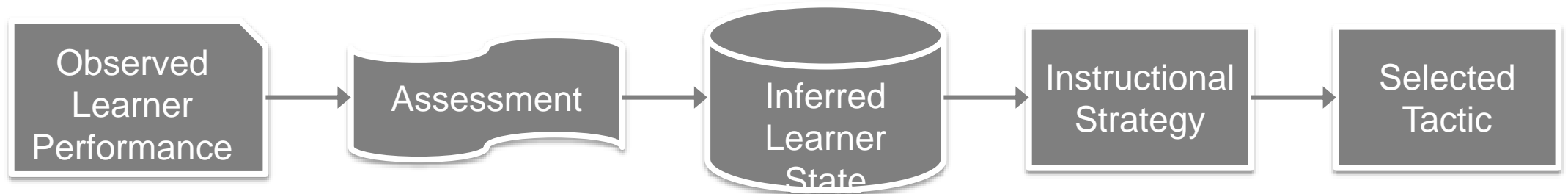
Value

- **What specific functionality will GIFT gain?**
  - Recognize patterns – across learner-system interactions.
  - Infer misconceptions – to support domain-general tailoring.

- **What will be higher quality?**
  - Immediate tailored feedback during a GIFT course
  - Feedback, interventions, comparisons to others, or simply progress reports

- **What will be easier for end users?**
  - Overlaid over an existing GIFT course, not requiring a rewrite
  - Instructors choose and apply reusable adaptive feedback without engineer support

- **What will be better for GIFT developers?**
  - Native processing within GIFT
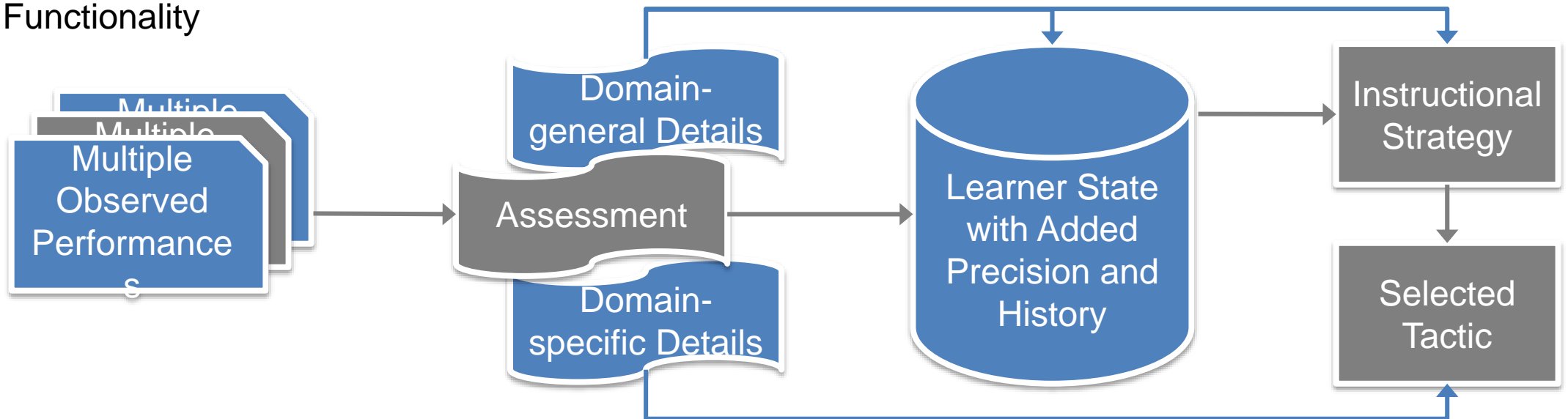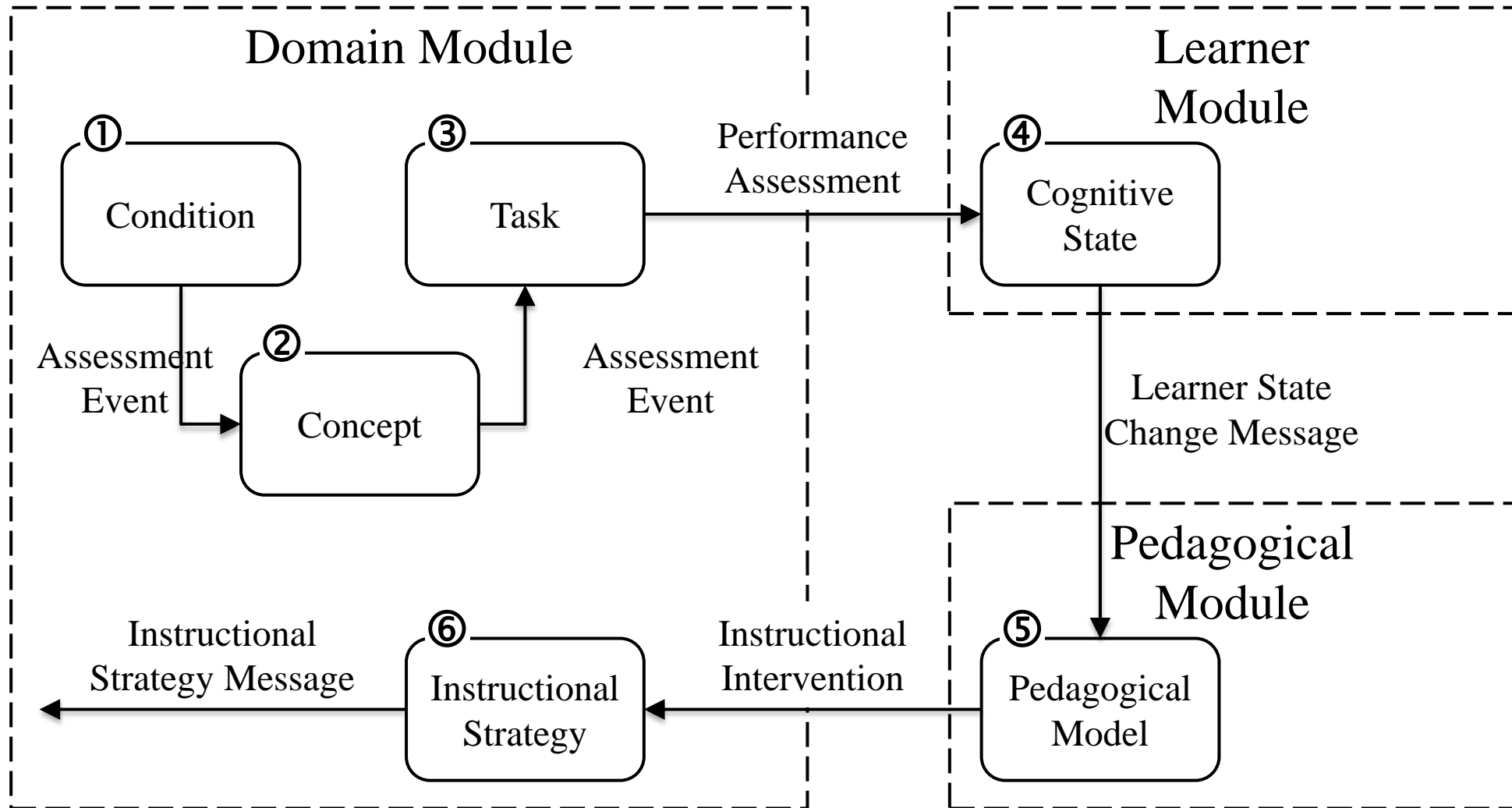 - Compatible with GIFT Cloud
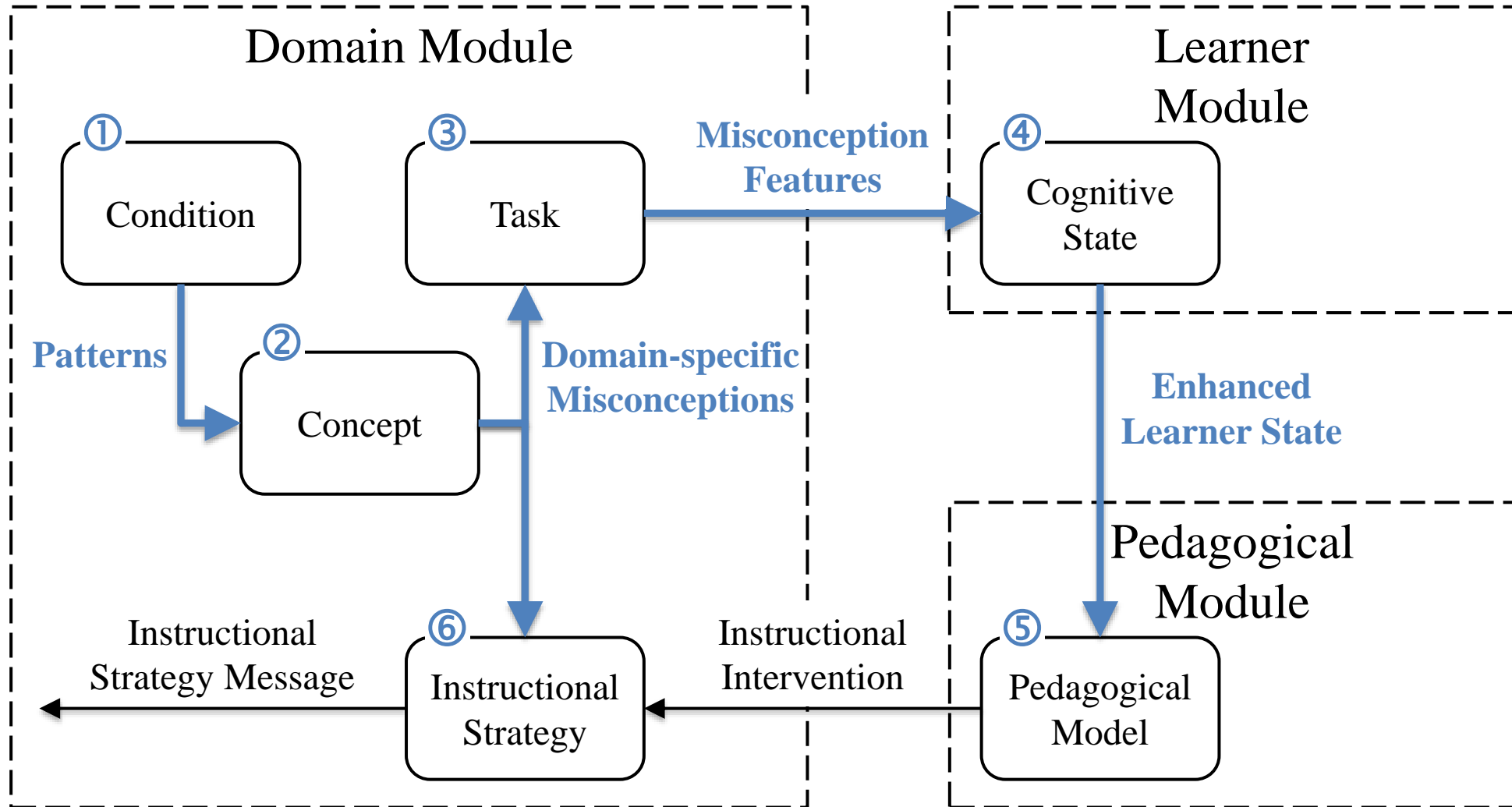
Approach

Current Functional Description

Observed Learner Performance → Assessment → Inferred Learner State → Instructional Strategy → Selected Tactic

New Functionality

Multiple Observed Performances → Assessment (Domain-general Details, Domain-specific Details) → Learner State with Added Precision and History → Instructional Strategy → Selected Tactic

New Patterns   New Misconceptions

4

High-level data flow: GIFT SOA

High-level data flow: Additions

Patterns

- Focus on patterns of learner actions
  - Rather than, e.g., spatial patterns

- Basis in formal temporal logic / interval logic
  - Commonly used for reasoning about plans / software synchronization / timing guarantees
  - Focus on instructor and instructional use with a subset of higher-level operators

- Experimental patterns
  - Hesitation: change any answer two or more times before submitting
  - Hurrying: submit any answer within five seconds of a choice presentation
  - Improving: exhibit correct behavior twice with no intervening mistake
    This pattern enabled a positive intervention, rather than silence, when learners did well

Misconceptions

- Domain-specific detail on a "Below Expectations" estimate in learner module
  - Underlying reasons for incorrect behavior enable authoring more adaptive feedback

- Domain-general markup supports adaptive response in pedagogical module
  - Urgency
  - Importance

- Experimental misconceptions
  - Cautious: the learner is overly deferential or sacrifices a key goal
  - Authoritarian: the learner is overly concerned with being respected or obeyed
  - Mission-focused: the learner achieves a near-term mission at a high cost to relationships
 - Rules-focused: the learner follows rules too inflexibly

Experimental design

- N = 74 West Point Cadets used a subset of five training scenarios
  - Scenarios focused on seeing, interpreting, and acting on cues (e.g. body language) in Army cross-cultural communication settings (contact with civilians during missions)

- Pre-test and post-test (identical) measured near and far transfer of material
  - Situational judgment tests (SJTs) focused on skill application and required value tradeoffs
  - Cognitive load questionnaires and technology acceptance survey analyzed separately

- Scenario subset learning objectives:
  - Initiate and engage in encounters that support the mission and build rapport
  - Practice perspective-taking to make sense of encounter
  - De-escalate conflicts and repair relationships
  - Balance tact and tactics to achieve long-term goals in a safe manner.
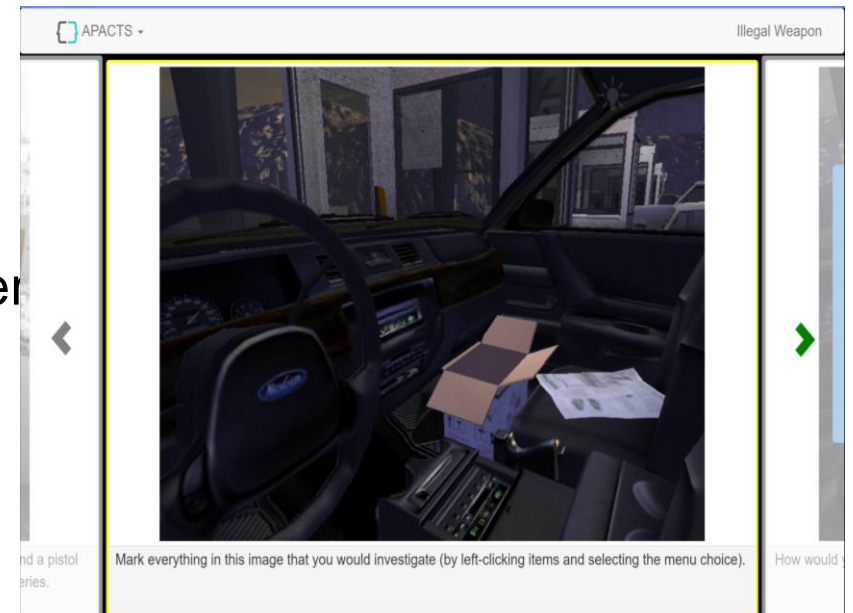
Results – patterns

- Discovered new patterns, associated with later learning outcomes
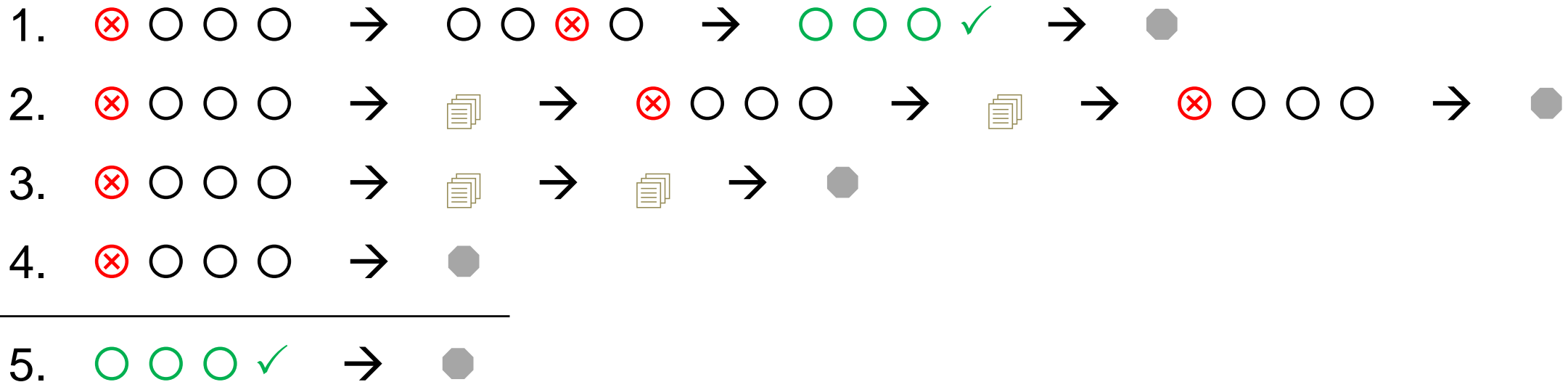

- Patterns can help instructors detect ineffective training in near real time
  - Instructors can then author new adaptive patterns that improve training without engineers
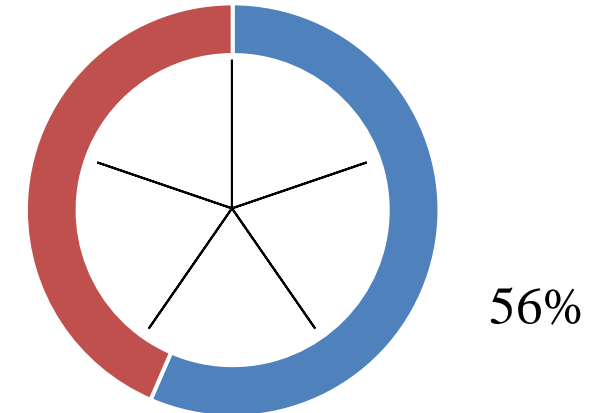
Results – misconceptions

- Good accuracy comparing against pre-test and post-test
  - Manual analysis of Scenario 1 and matched test item
  - Future work will automate analysis and check against all items
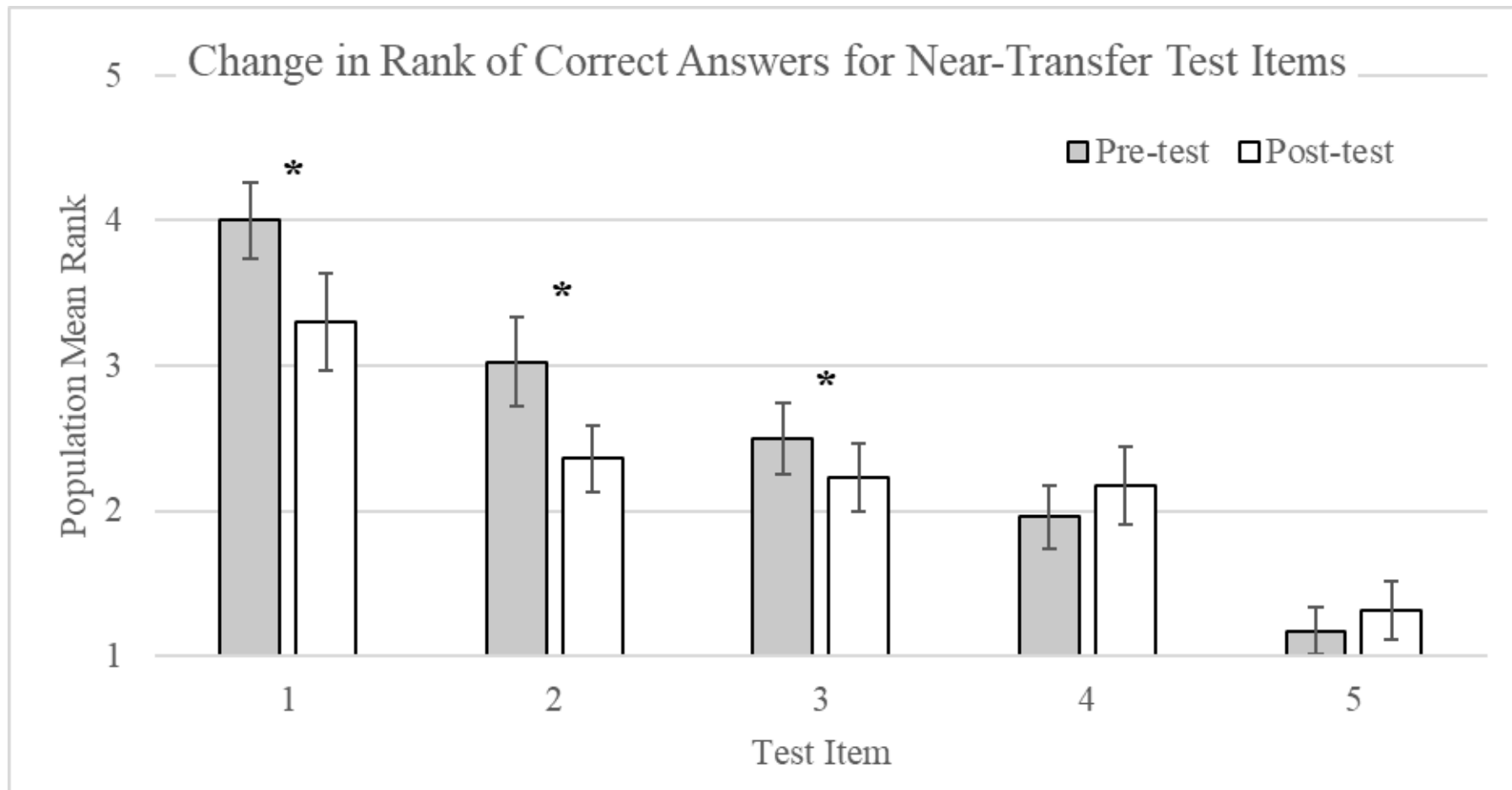
Pre-test → First Misconception Detected
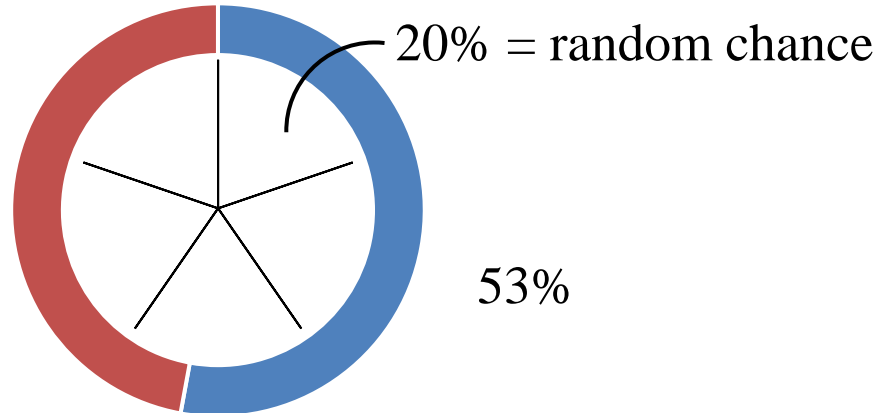
Last Misconception Detected → Post-Test

20% = random chance

53%

56%

- Discovered possible domain-general misconceptions
  - Frustration / disengagement, wheel spinning, curiosity / willingness to explore

Results – impact on learning

- Significant improvement (decrease = improvement) on 1-3, ceiling effect on 5

Future research directions

- Complete data analysis
  - Behavior patterns and associations with learning outcomes
  - Correlation of patterns displayed or interventions presented with final outcomes
  - Automate analysis and possibly reuse for machine learning of patterns

- Increase generality of the approach
  - Reuse same types of patterns in a second training domain
  - Domain-general misconceptions or inputs about learner states and traits

- Release for public use
  - Supports future end-user tool to easily author adaptive feedback

Questions

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