Domain-Specific Assessment: What foundational concepts and reasoning skills are community college students learning?

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Council for the Study of Community Colleges

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Context for Domain-Specific Assessment

- A national debate about measuring student learning in higher education
  - *Academically Adrift*, Arum & Roska, 2011
  - *Measuring Stick* series, The Chronicle of Higher Education, 2010
  - *Measuring Up on College-level Learning*, Miller & Ewell, 2005
  - *A Culture of Evidence*, Dwyer, Millet, & Payne, 2006
  - Voluntary Framework for Accountability, AACC, 2010-2011
  - Accreditation agency pressure for measuring student learning outcomes (SLOs)

General elements of the debate

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Assessment: Accountability

Rising college costs/high debt load

Few good jobs at the end

What are students getting for their money and time?

Instruction with high costs and high risk of failure

How can college achieve more success for more students?

Solution: Get more strategic

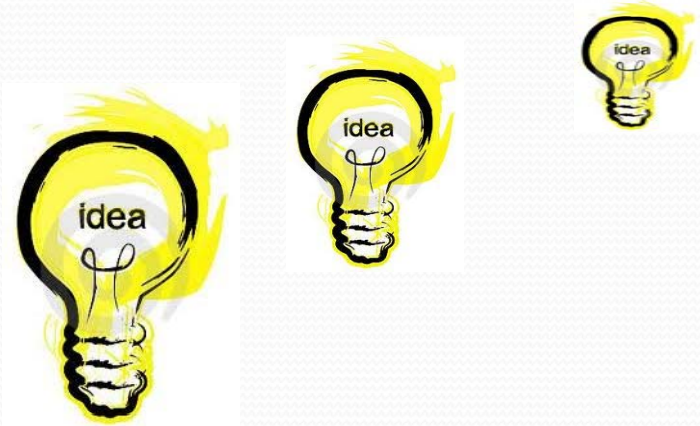
- About the design and delivery of student services, courses, curricula, and instruction
- Designing pathways and classroom approaches that ensure greater success for all students in all CC tracks

Our focus:
General education success track

- GE community college instructors face the challenge of covering a wide swath of content
- Some still consider “gate keeping” or “weeding out” their primary job
- Students respond by:
  - Not pursuing these majors, not doing well in courses
  - Not retaining knowledge for everyday application in life
  - Not succeeding!
- GE courses affect transfers, CTE students

Strategy: Better assessment in general education to support success

- Assessment that measures:
- Understanding of foundational "big ideas" in domains



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- Reasoning practices valued in these domains

What's our goal for big ideas in general education?

- To have students master key content so they can:
  - L*ook at the world differently*
  - *Apply domain-specific ideas in everyday lives*
- It's not being an expert in a domain, but it's "thinking like an expert."

THINK LIKE
AN EXPERT

What are big ideas?

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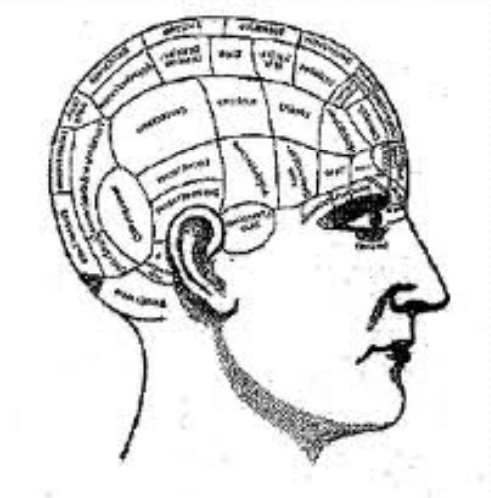
- Non-intuitive concepts and reasoning processes
- Developed over many generations of humanity
- Cannot be figured out through common sense or standard logic
- Not a memorized collection of facts and procedures, but a schematically organized cognitive system for thinking differently

Background

- An assessment based on:
  - Cognitive Science:
    - How do people learn?
    - Importance of domain-specific knowledge/skill for building reasoning skills



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Background

- An assessment based on:
  - Cognitive Science:
    - How do people learn?
    - Importance of domain-specific knowledge/skill for building reasoning skills
  - Evidence-Centered Design:
    - Method for developing assessments measuring "hard to measure" knowledge/skills

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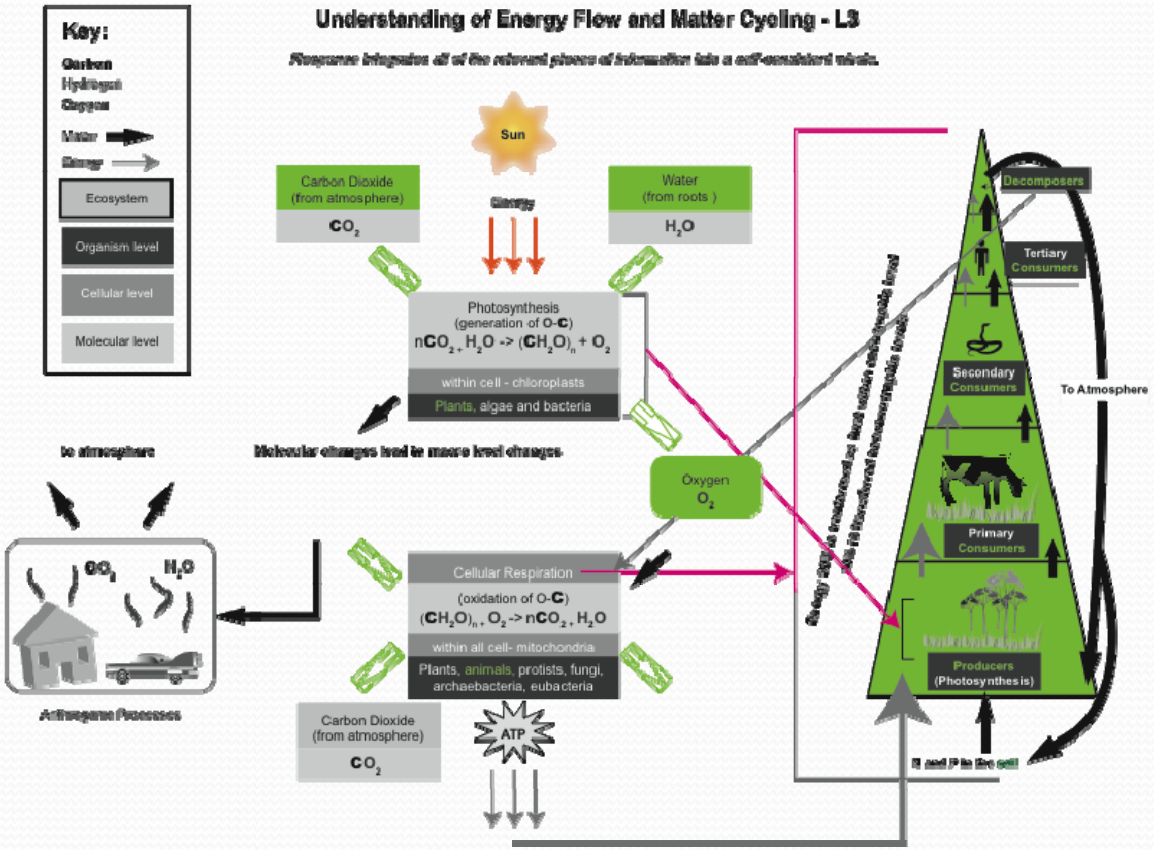
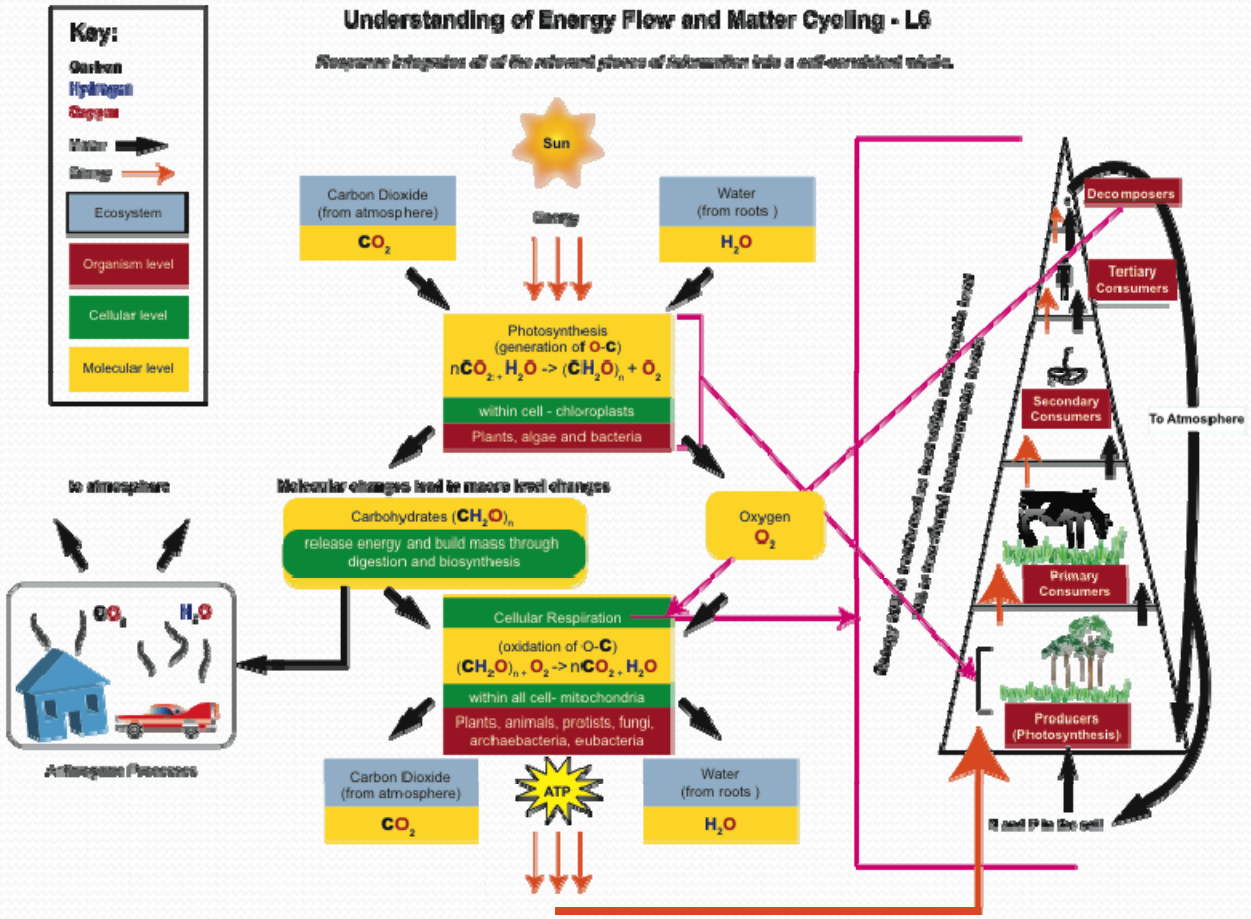
Model 1. Biology

Beginning understanding of energy flow and matter cycling



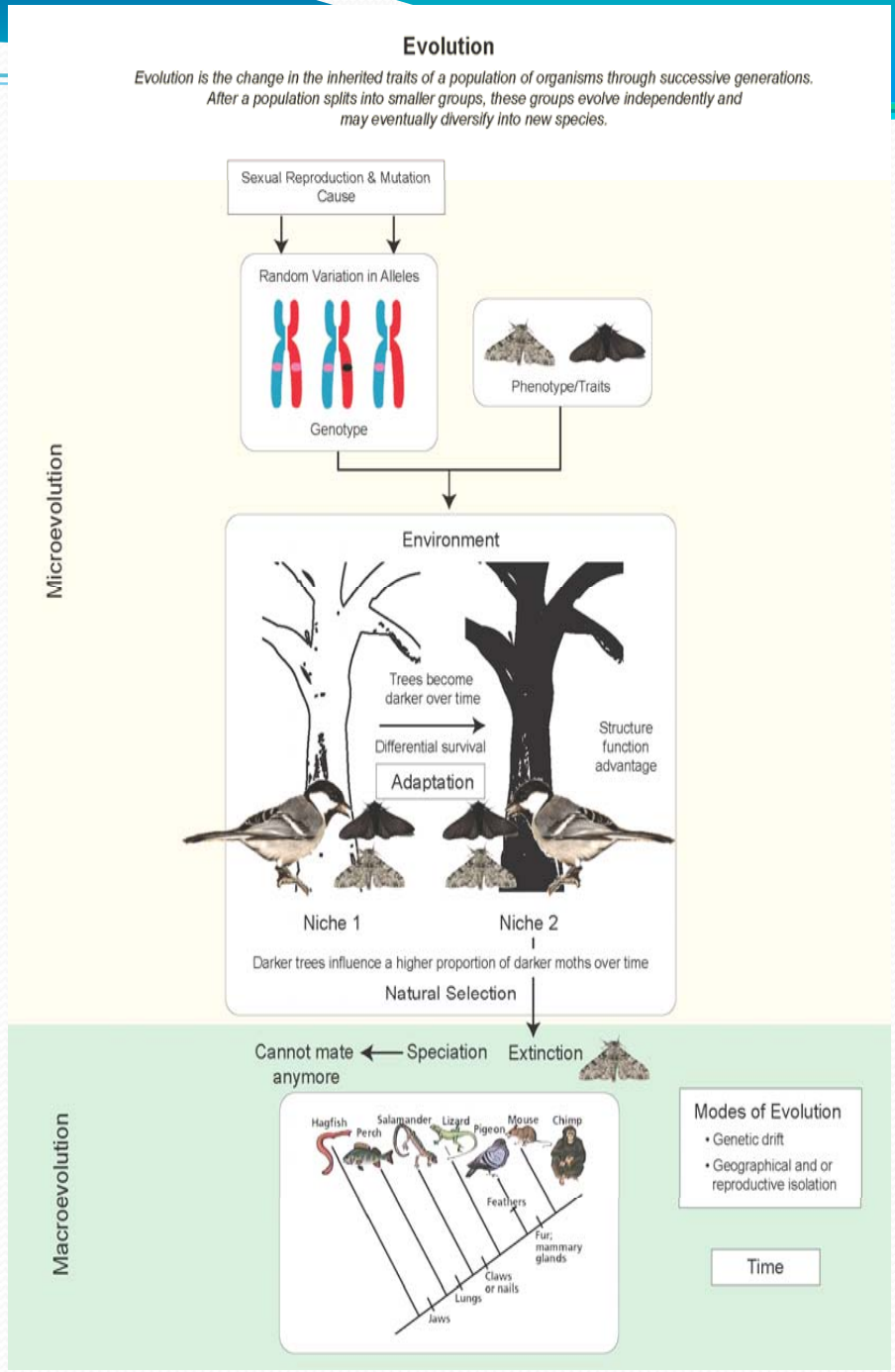
Model 1. Biology

Advanced understanding of energy flow and matter cycling



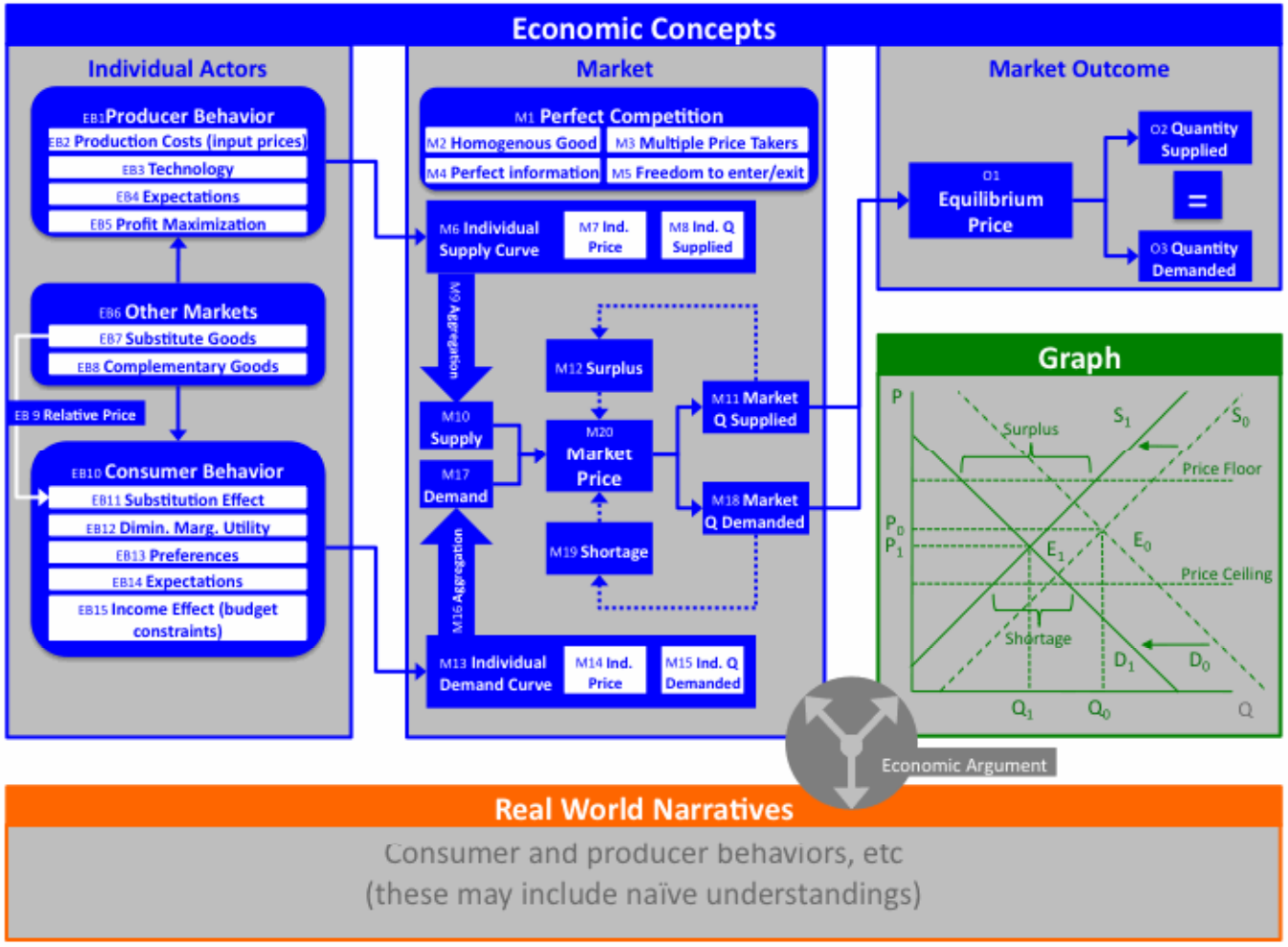
Model 2: Biology

Advanced understanding of evolution



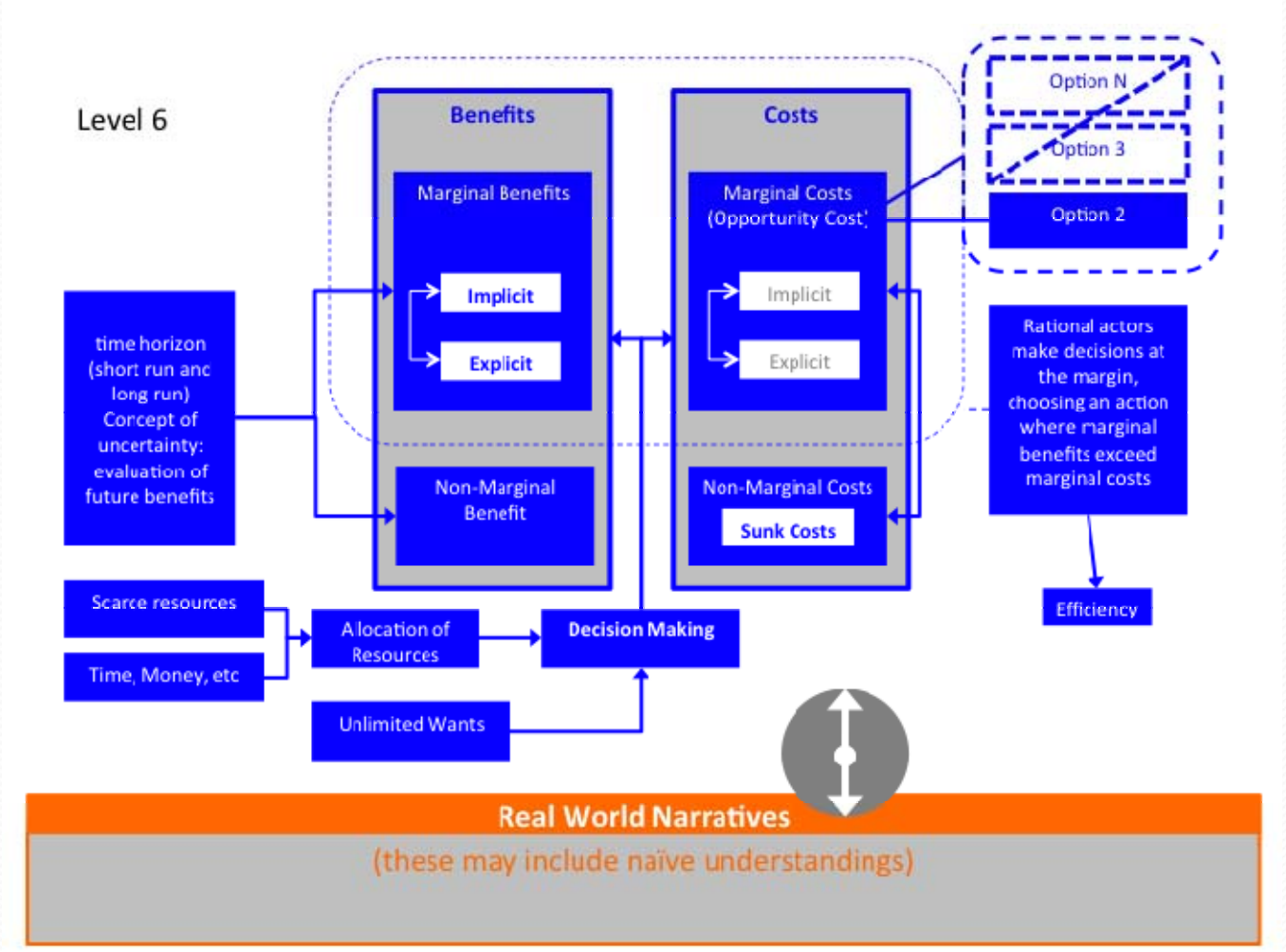
Model 3: Economics

Advanced understanding of the supply & demand model



Model 4: Economics

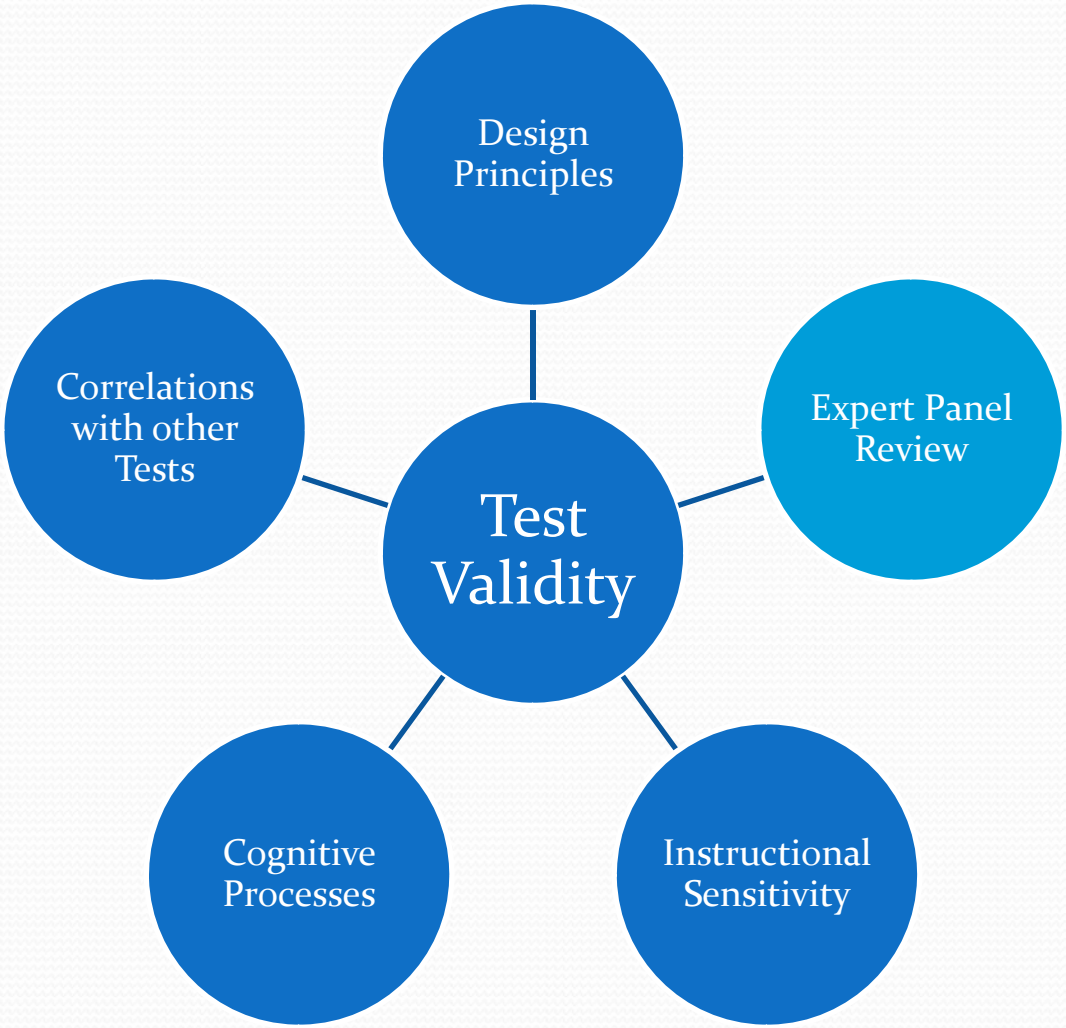
Advanced understanding of opportunity cost and decision making



Our work: Designing and validating prototype assessment

- U.S. Department of Education, Institute for Education Sciences (IES) grant
  - This presentation focuses evidence from our first validation study
    - Content validity
  - Design process is discussed in another draft research paper
    - AERA this afternoon

Types of Validity Evidence Gathered



Expert panel validity study participants, purpose

- Experts (4 biology, 4 economics) rated the questions of three contrasting examinations:
  - SRI's prototype domain-specific assessment
  - A college biology or economics content knowledge test
  - A college critical reasoning test
- Purpose:
  - Compare similarities and differences among tests
  - Characterize the knowledge measured by specific items in the tests

Expert panel validity study booklets, conditions

- 2 1-day rating sessions
- Rating booklets with:
  - Either 41 DSA biology test items OR 47 DSA economics test items (Test A)
  - 67 biology test items OR 30 economics test items (Test B)
  - 40 critical reasoning test items (Test C)
- Blocked presentation, alternating different test segments, different ordering per expert
- Experts blind to test/assessment developer

Expert judgments sought

- Experts rated each prompt on following:

Expert judgments sought

- Experts rated each prompt on following:
  - **What types of knowledge** would students use to answer this assessment task?

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  - **What types of knowledge** would students use to answer this assessment task?
  - **What types of reasoning** would students need to answer this assessment task?

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  - **What types of knowledge** would students use to answer this assessment task?
  - **What types of reasoning** would students need to answer this assessment task?
  - **When do students learn** the knowledge/reasoning approach in the post-secondary curriculum sequence?

Expert judgments sought

- Experts rated each prompt on following:
  - **What types of knowledge** would students use to answer this assessment task?
  - **What types of reasoning** would students need to answer this assessment task?
  - **When do students learn** the knowledge/reasoning approach in the post-secondary curriculum sequence?
  - **How important** is the knowledge/reasoning approach measured by each item?

Expert panel rates items on knowledge, reasoning types

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- *Quality of Domain Reasoning:*
  - Biology: Argumentation; Data interpretation; Field/Lab procedures; Computation; Data representation creation;
  - Economics: Use of narrative; graphs; models; argumentation

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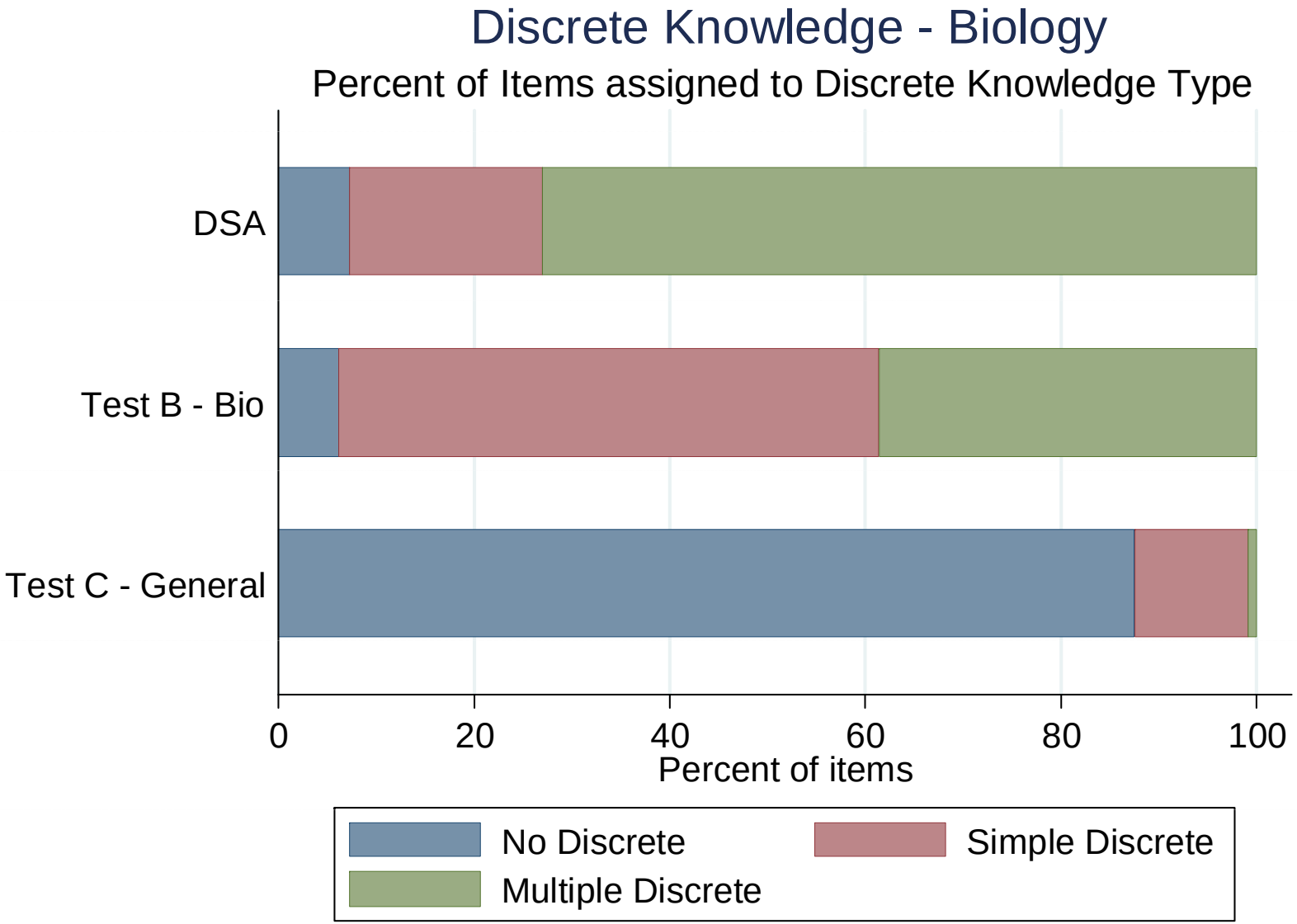
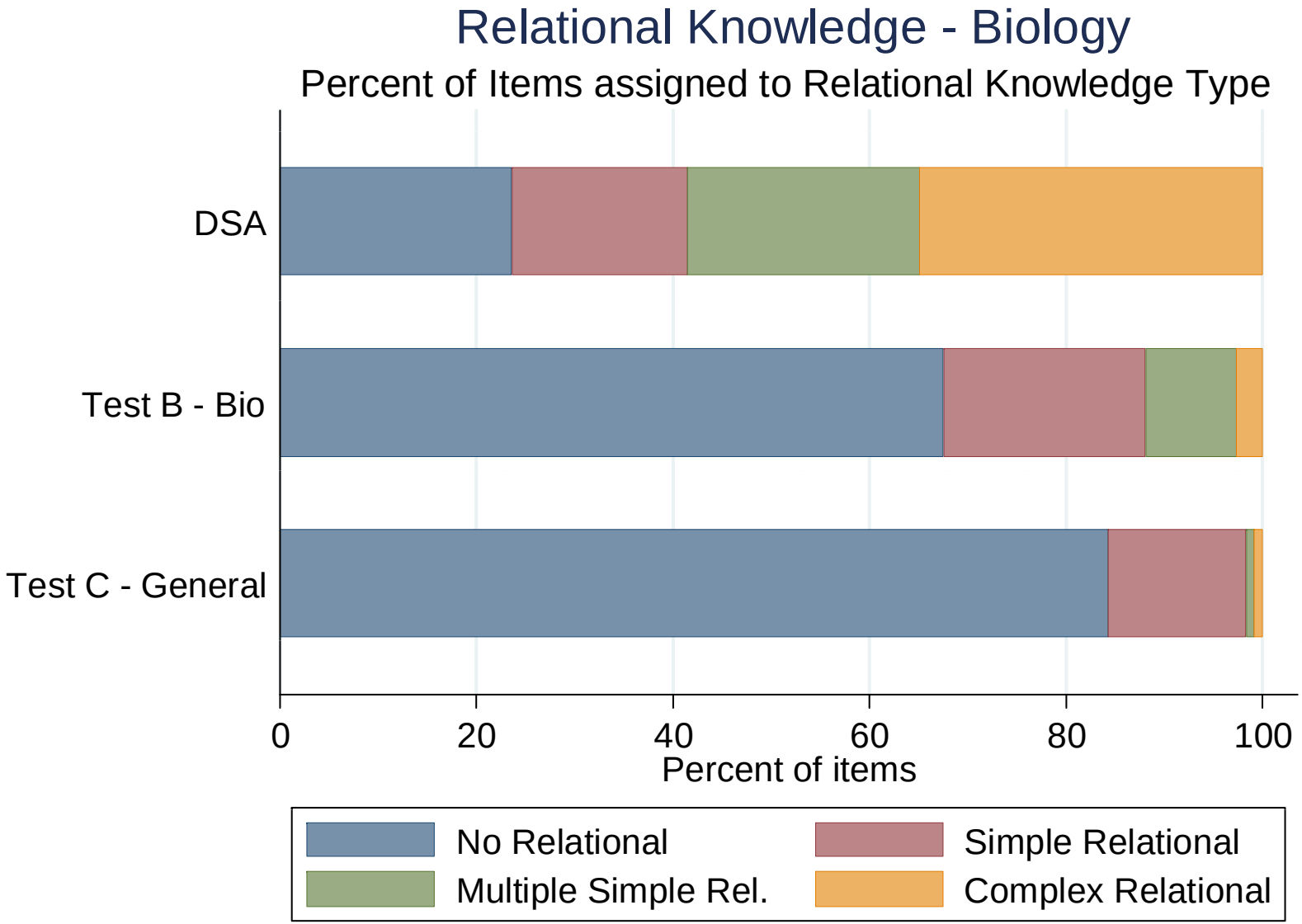
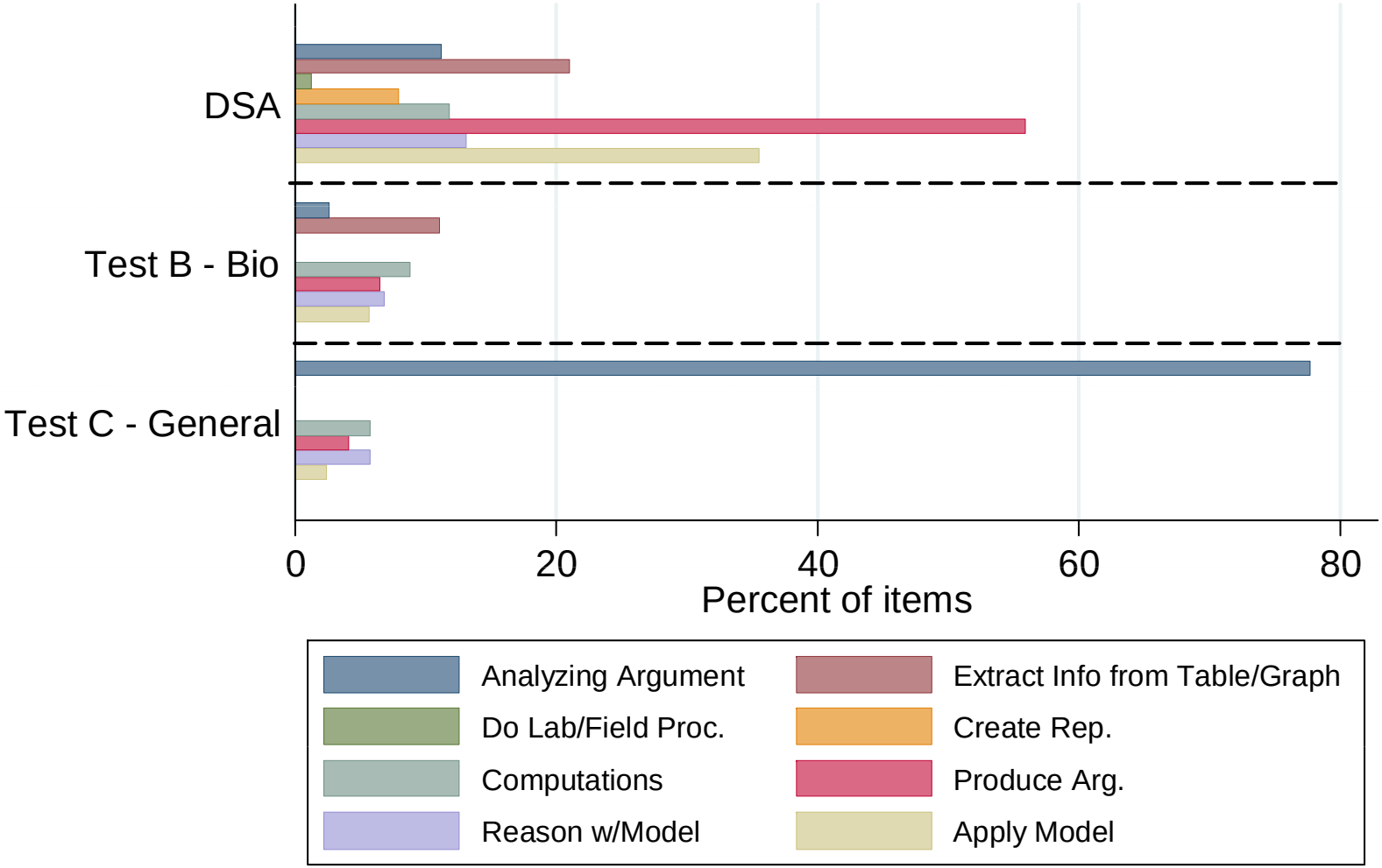
- *Progression of Domain Knowledge Types:*
  - Simple and complex discrete knowledge (e.g, facts, terms);
  - Simple and complex relational knowledge (e.g., a couple ideas in relation);
  - Strategic reasoning (e.g., knowing when and how to apply knowledge to a situation).

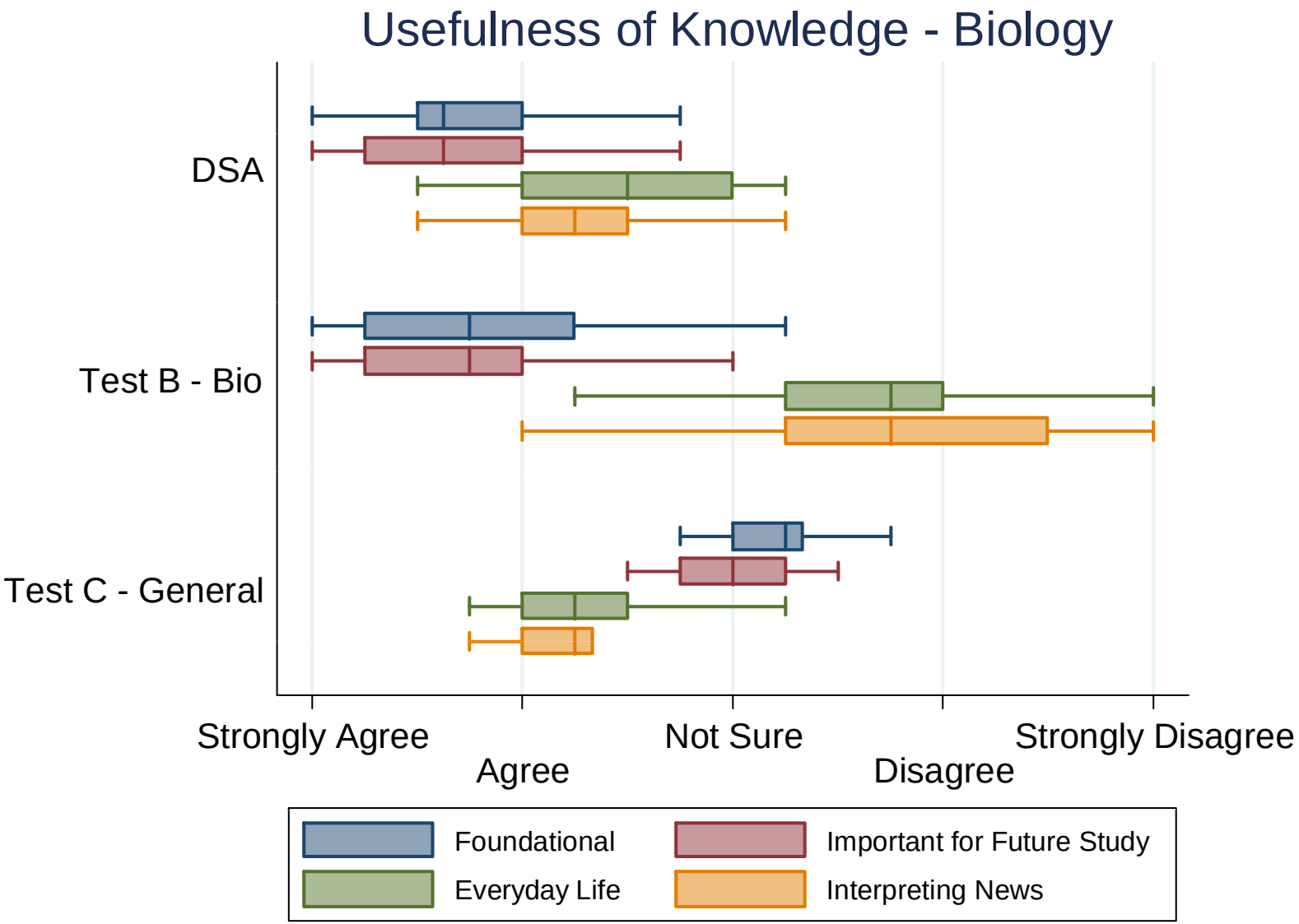

Discrete Knowledge - Biology
Percent of Items assigned to Discrete Knowledge Type
DSA
Test B - Bio
Test C - General
0
20
40
60
80
100
Percent of items
No Discrete
Simple Discrete
Multiple Discrete

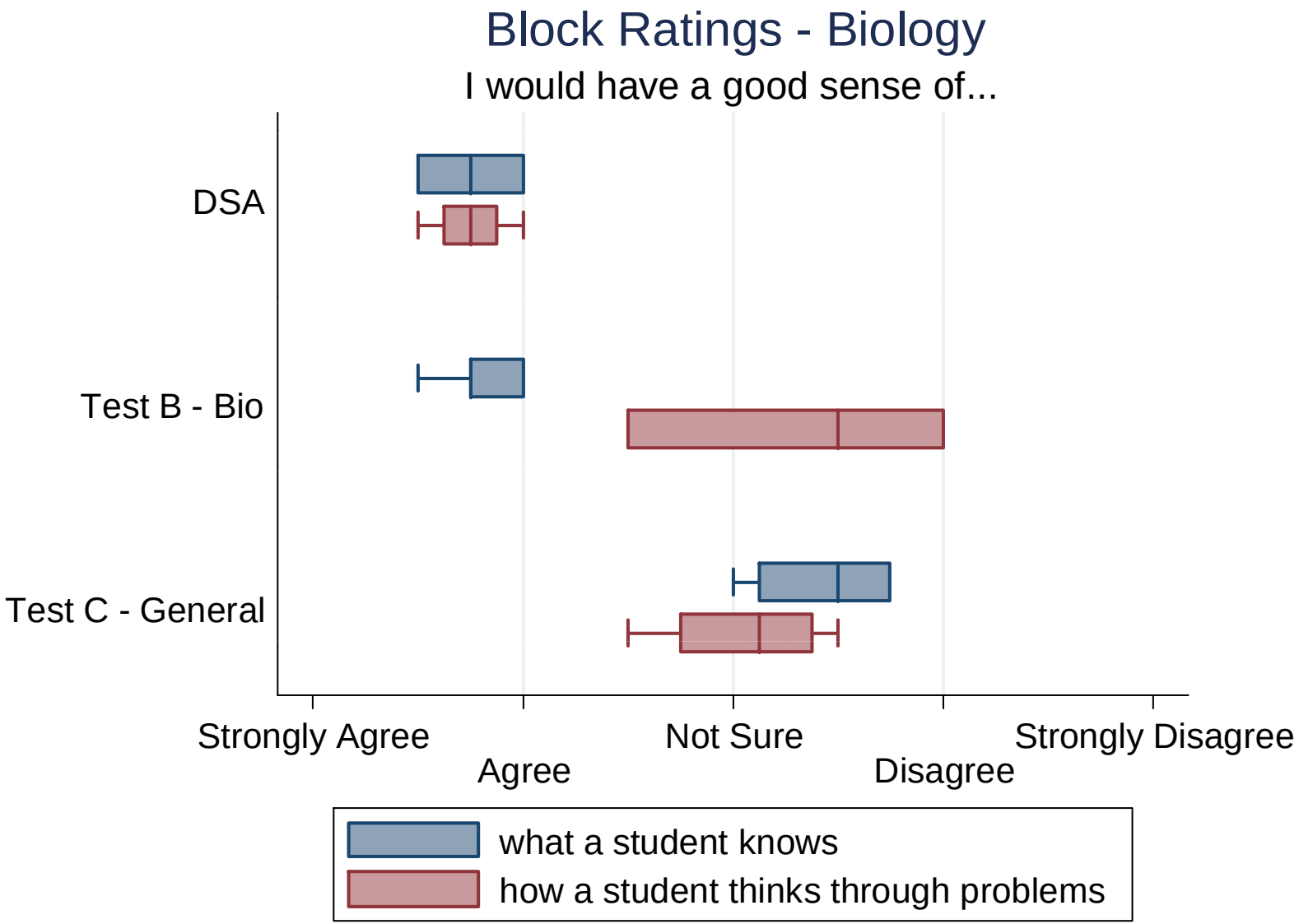

Relational Knowledge - Biology
Percent of Items assigned to Relational Knowledge Type
DSA
Test B - Bio
Test C - General
0
20
40
60
80
100
Percent of items
No Relational
Simple Relational
Multiple Simple Rel.
Complex Relational

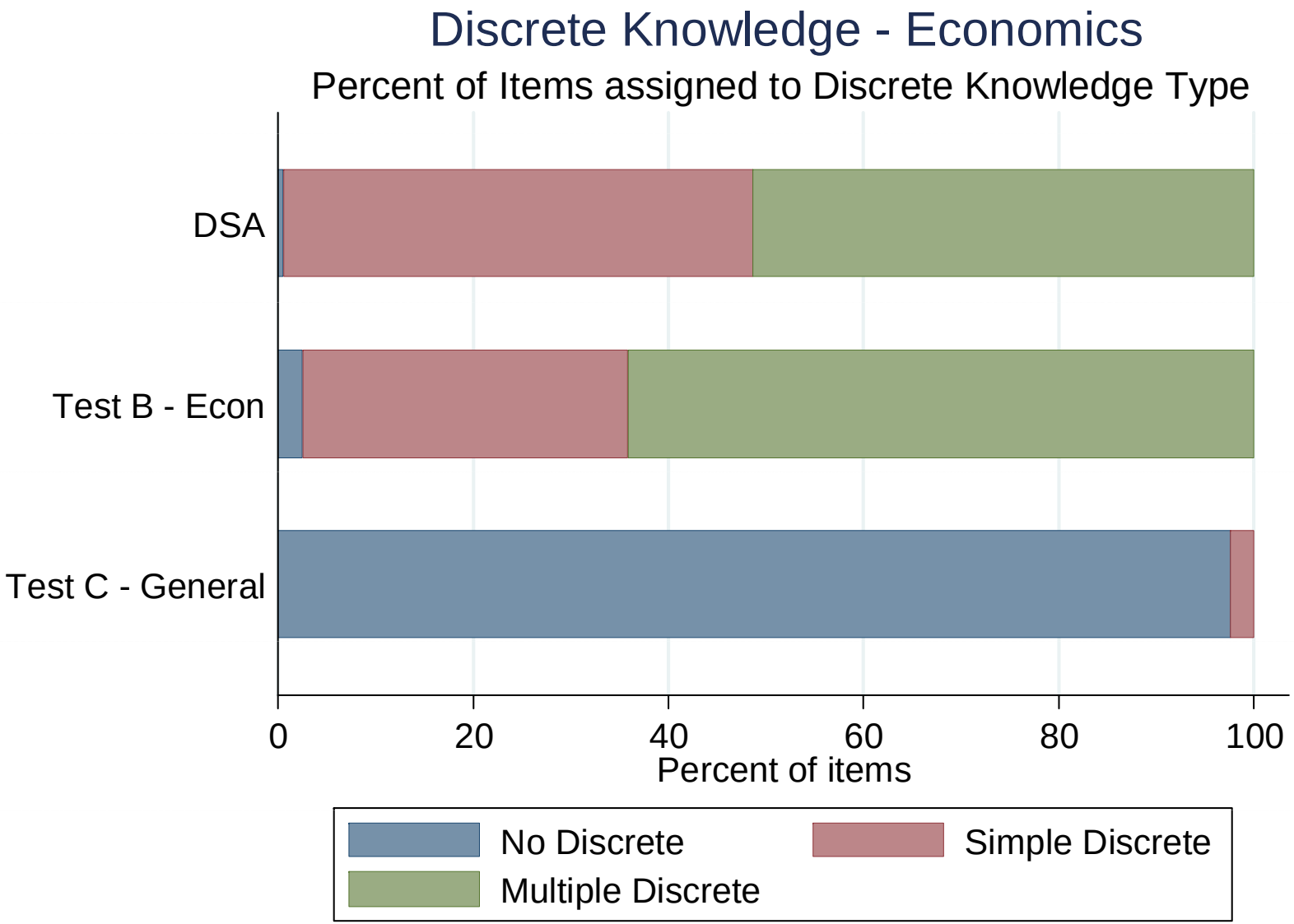
Reasoning Ratings - Biology

Percent of Items tagged with Reasoning Type




Usefulness of Knowledge - Biology
DSA
Test B - Bio
Test C - General
Strongly Agree
Agree
Not Sure
Disagree
Strongly Disagree
Foundational
Important for Future Study
Everyday Life
Interpreting News


Block Ratings - Biology
I would have a good sense of...
DSA
Test B - Bio
Test C - General
Strongly Agree
Agree
Not Sure
Disagree
Strongly Disagree
what a student knows
how a student thinks through problems


Discrete Knowledge - Economics
Percent of Items assigned to Discrete Knowledge Type
DSA
Test B - Econ
Test C - General
0
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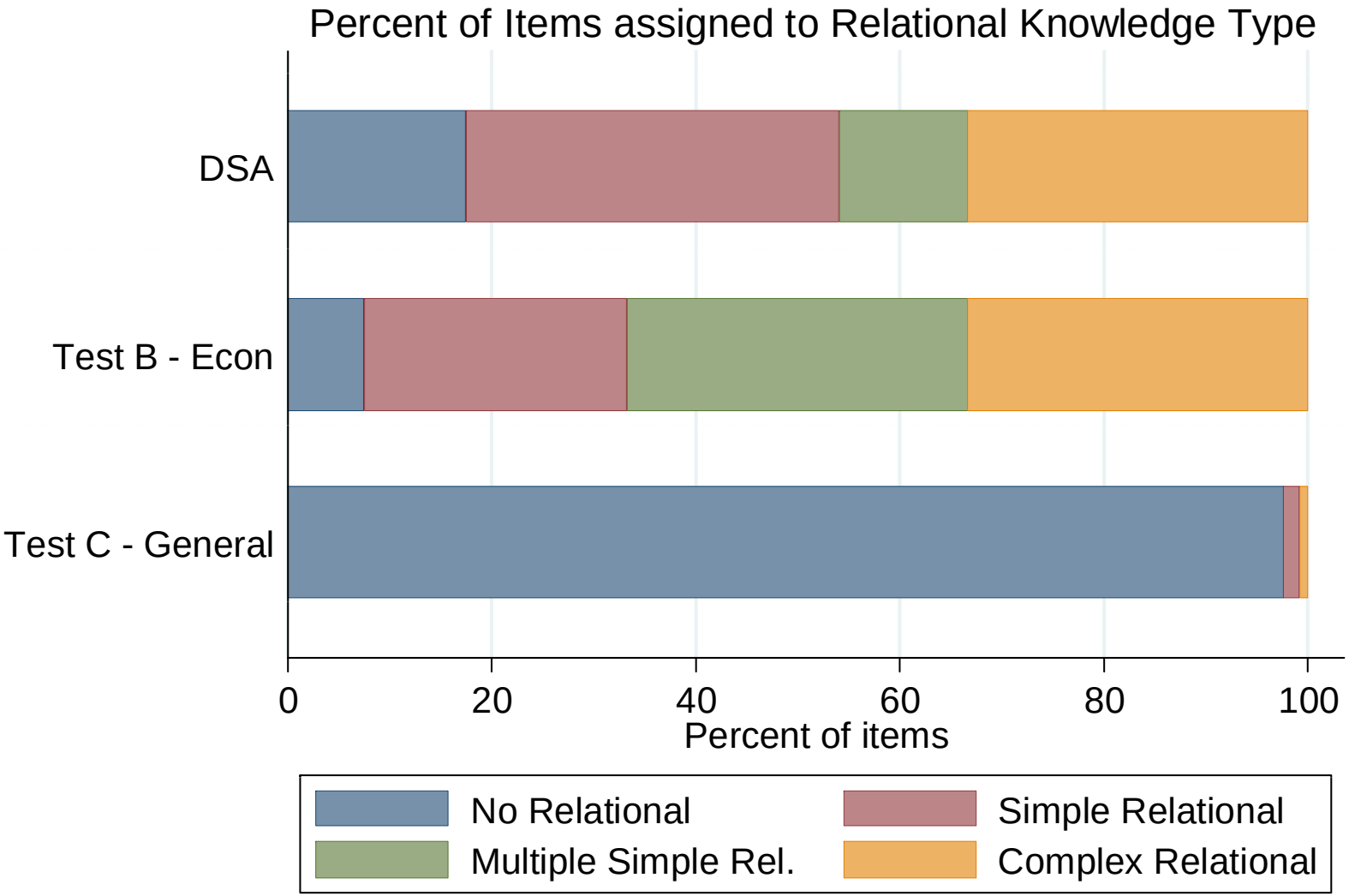
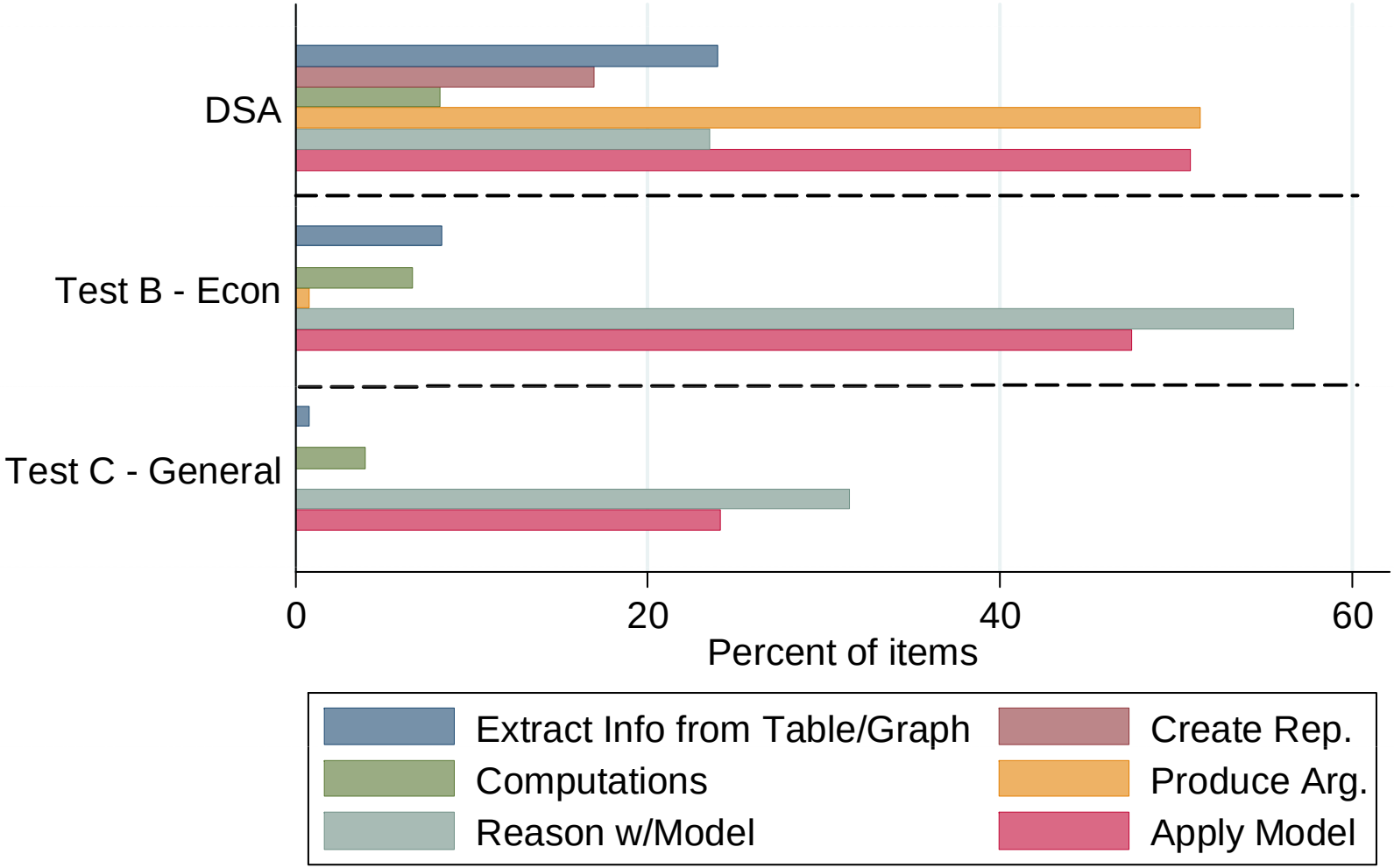
40
60
80
100
Percent of items
No Discrete
Simple Discrete
Multiple Discrete

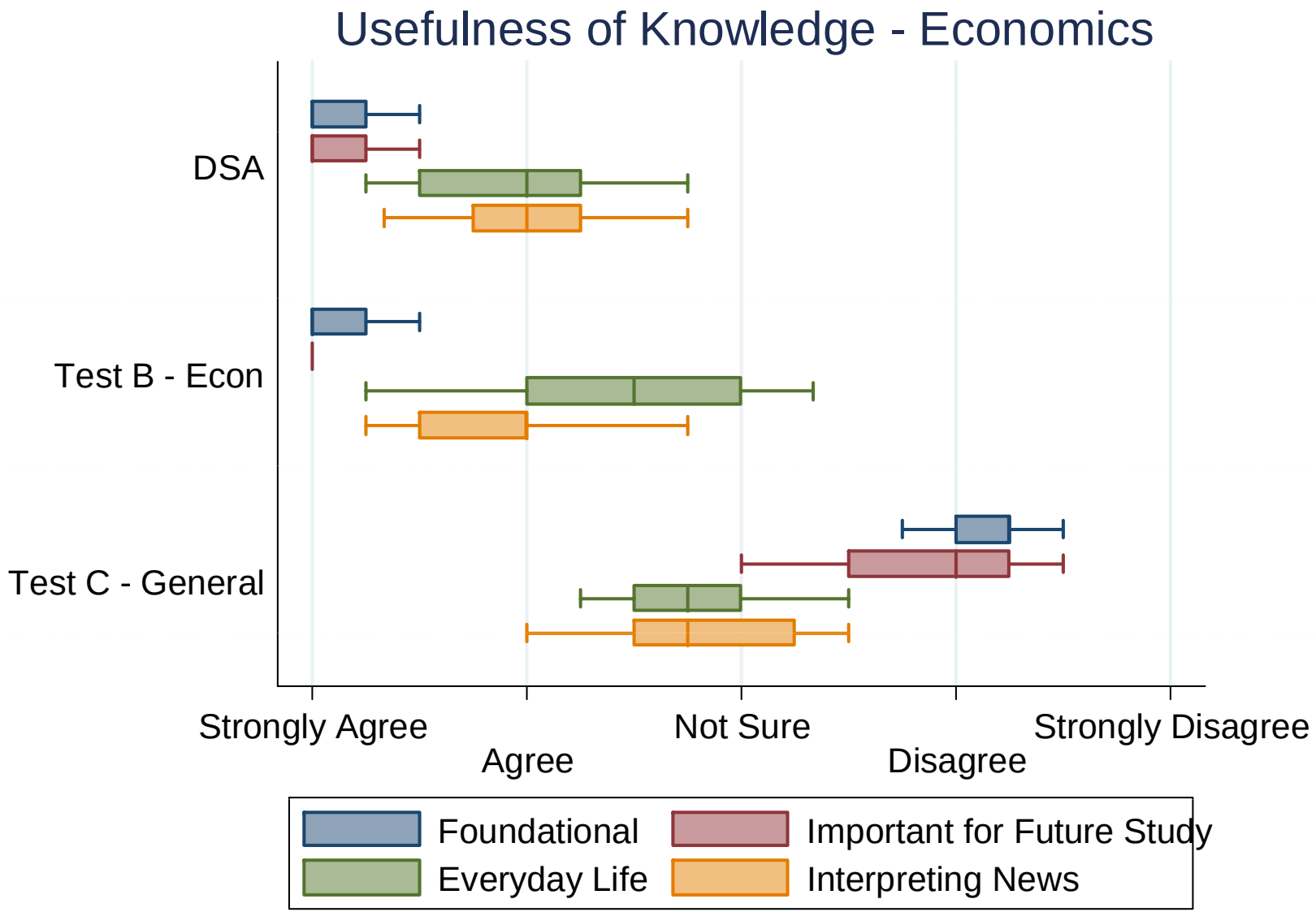
Relational Knowledge - Economics



Reasoning Ratings - Economics

Percent of Items tagged with Reasoning Type

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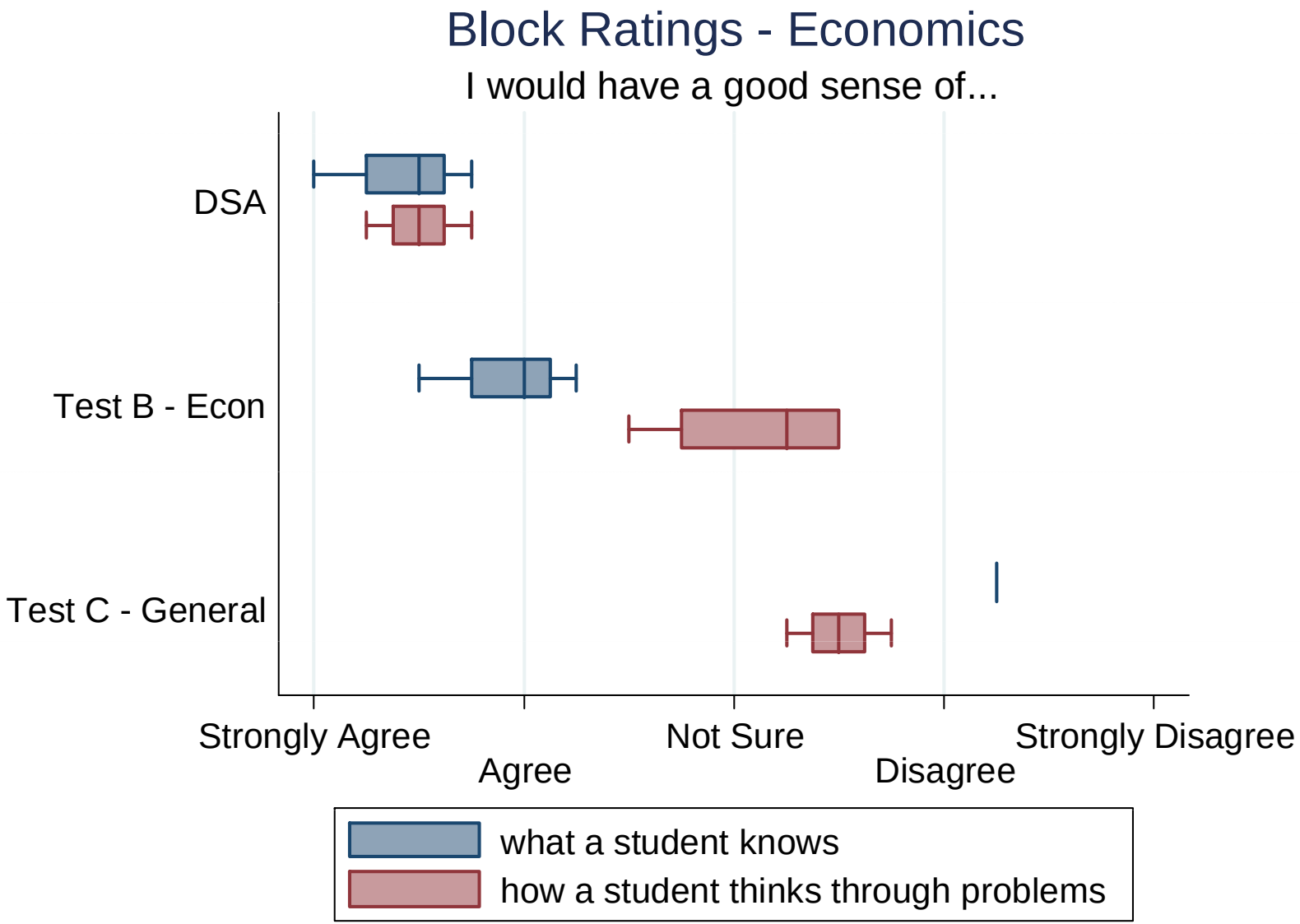
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Agree
Not Sure
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what a student knows
how a student thinks through problems

Discussion

- Initial expert review of the assessment questions indicates:
  - Good content validity for biology and economics
  - The items measure:
    - Skills to apply domain-knowledge to everyday problems
    - Reveal student reasoning in the domain

Discussion

- These assessments—and the assessment development process—provide a principled path for:
  - **Program Planning:**
    - What kind of value is a program offering to students, both majors and non-majors
    - Tracking how well students are learning the core knowledge and skills for future study
    - *AND everyday application in life*

Discussion

- These assessments—and the assessment development process—provide a principled path for:
  - **Program Planning:**
    - What kind of value is a program offering to students, both majors and non-majors
    - Tracking how well students are learning the core knowledge and skills for future study
    - *AND everyday application in life*
  - **Classroom Diagnostics:**
    - Include in regular assessment to see what critical content and reasoning skills student are missing
    - Use results to target instruction and focus remediation

What contexts exist for applying this knowledge in everyday life?

Biology

- *Know how evolution affects:*
  - *Issues around environmental quality – natural selection cannot operate fast enough on populations of large organisms to protect them from many human-caused ecosystem changes*
  - *Issues around* personal *and public health – natural selection can operate very fast on populations of micro-organisms – antibiotic resistance problems*

What contexts exist for applying this knowledge in everyday life?

Biology

- *Know how the carbon cycle affects:*
  - *Issues around environmental quality – carbon being absorbed and emitted in a cycle all the time; human carbon combustive processes can overload the system*
  - *Issues around personal and public health – your health depends on cellular respiration, which depends on oxygen and which produces energy for all cellular processes*

What contexts exist for applying this knowledge in everyday life?

Economics

- *Know how economic principles can improve your reasoning around:*
  - *Issues of personal decision making: You need to consider the costs of forgone options*
  - *Issues around cost of services and goods you buy: You need to understand prices are not set by individual greed, but by larger systems involving the supply chain*

What contexts exist for applying this knowledge in everyday life?

Economics

- *Know how economic principles can improve your reasoning around:*
  - *Issues of government policy: You need to consider the impacts that government decisions can have on a market by changing the incentive structure for buyers and sellers*

Keep in touch!

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