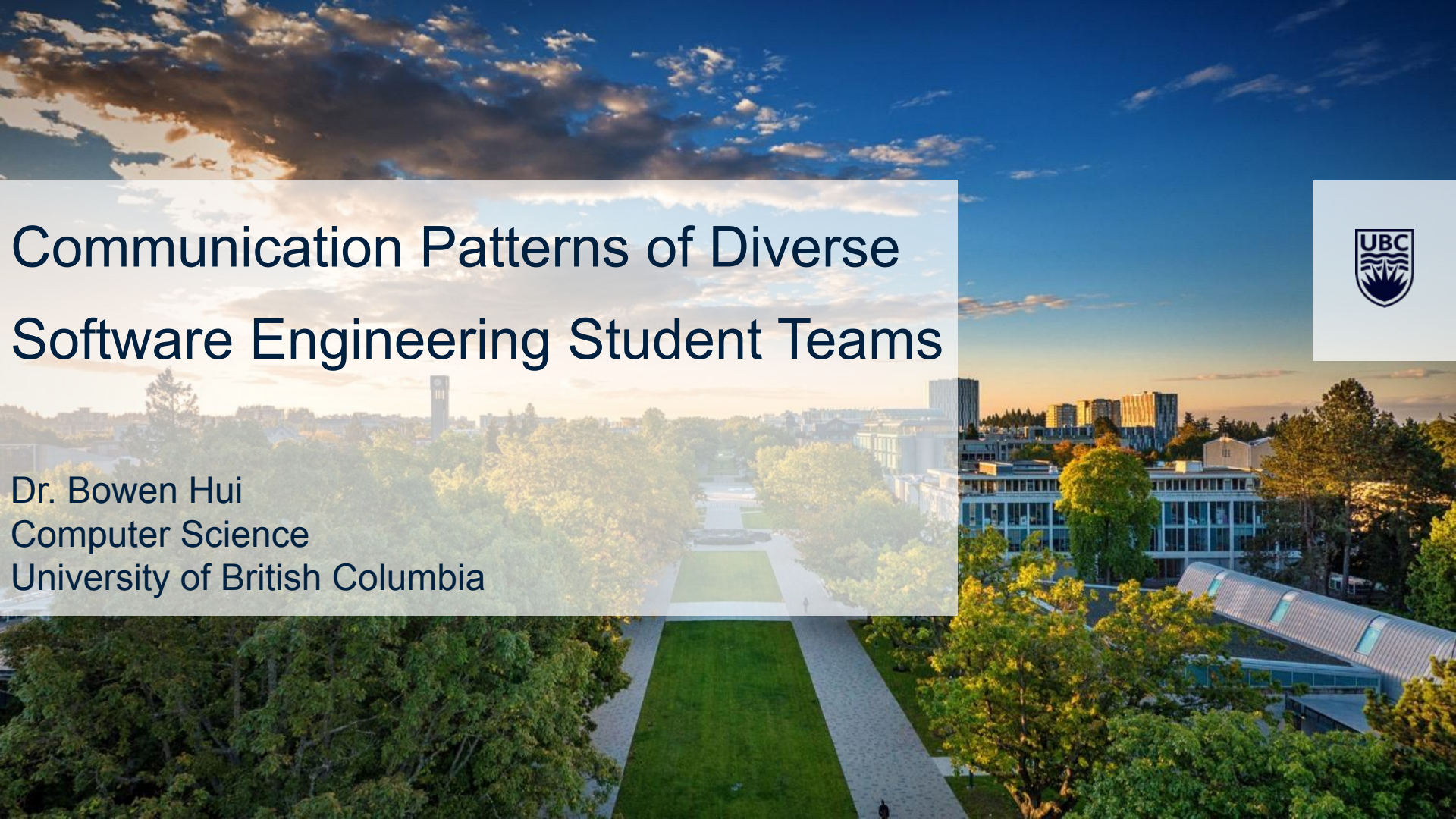
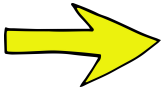


Communication Patterns of Diverse Software Engineering Student Teams

Dr. Bowen Hui
Computer Science
University of British Columbia

Technology-Enhanced Personalized Learning



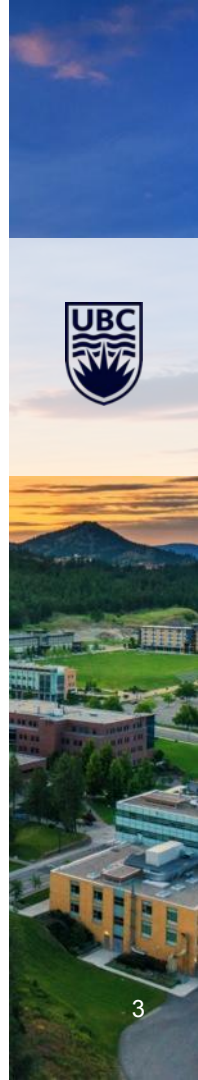
Technology to maximize learning outcomes for ***individuals***

Technology to maximize learning outcomes in ***teams***

Why Teams?

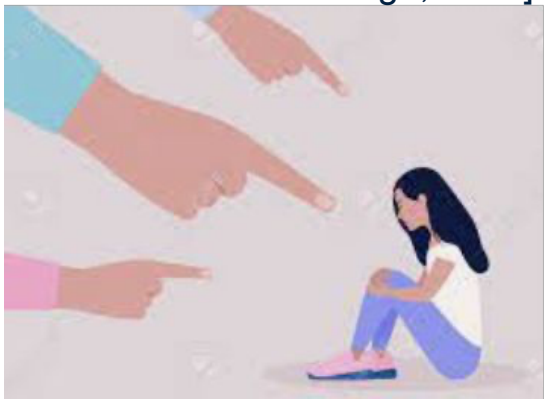
- Collaborative problem solving leads to better outcomes
  - Builds on each other's knowledge
  - Increases productivity
  - Encourages personal growth
  - Promotes innovation
  - Develop long-term relationships

- Attention on teamwork in educational and workplace settings
  - A core 21st Century skill



Diversity in Teams

- Many educators agree that team diversity is important
- Conflicting results that diversity has on team outcomes and how diversity is defined [Horwitz & Horwitz, 2007]
- ***Gender-diverse*** and ***race-diverse*** teams often result in more conflict where minoritized members are:
  - Confronted with microaggressions [Ong et al. 2011]
  - Perceived as less skillful than peers in homogeneous teams [Pelled, 1996; Baugh, 1997]
  - Treated with bias
    - not heard, not given leadership roles, pressured to change behaviors [Grindstaff & Mascarenhas, 2019]
- Problems are exacerbated when minorities are ***tokenized*** [Kanter 1977; Spangler et al. 1978; Thompson & Sekaquaptewa 2002]



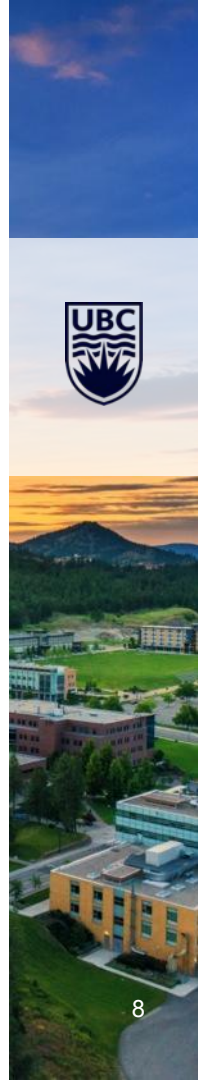
Your Reflections

- Your past experiences or observations of student teams
  - What kind of imbalances were/are there?

Your Reflections

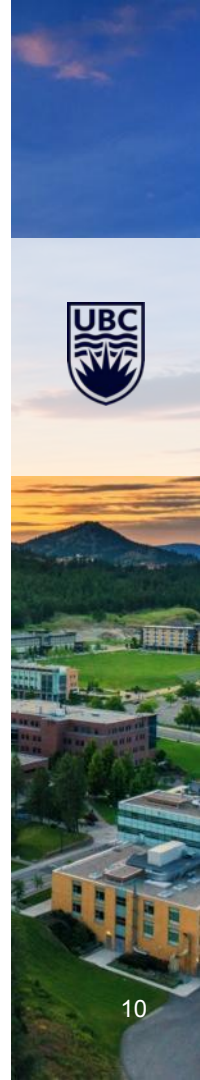
- Your past experiences or observations of student teams
  - What kind of imbalances were/are there?

- Literature reports on:
  - Gender-based role division
  - Task assignment bias
  - Dominance and comfort in group interactions
  - Social loafing



Recent Findings [Sæter et al., 2024]

- Paper: The Role of Team Composition in Agile Software Development Education: A Gendered Perspective
- Divided 240 students into teams of 6
- Controlled for number of women
- Collected self-reported data
- Patterns:
  - "tendency for gatekeeping at a technical level by the boys"
  - Boys expect girls to do design tasks
  - 5W/1M: "a friendly and chatty tone while programming"
  - 0W/6M: least focus on design, most on programming
  - Lowest Teamwork Quality scores at 2W/4M, 3W/3M
  - Seeking technical advice and approval from men



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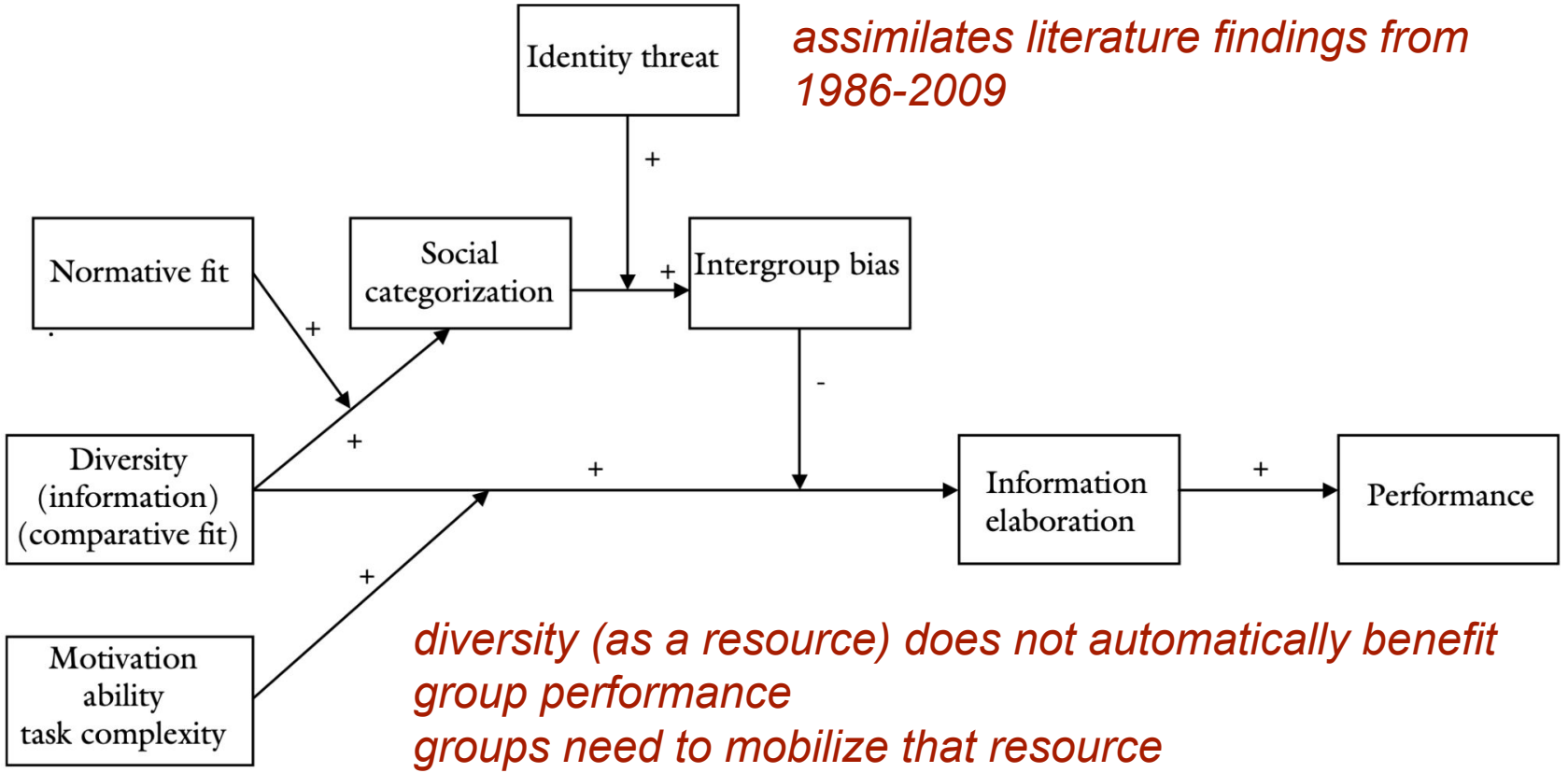
- Paper: The Role of Team Composition in Agile Software Development Education: A Gendered Perspective
- Divided 240 students into teams of 6
- Controlled for number of women
- Collected self-reported data
- Findings:
  - Tokenism effects persist beyond 1
  - Gender parity ≠ equality
  - Equitable treatment begins to surface when ***majority*** are women

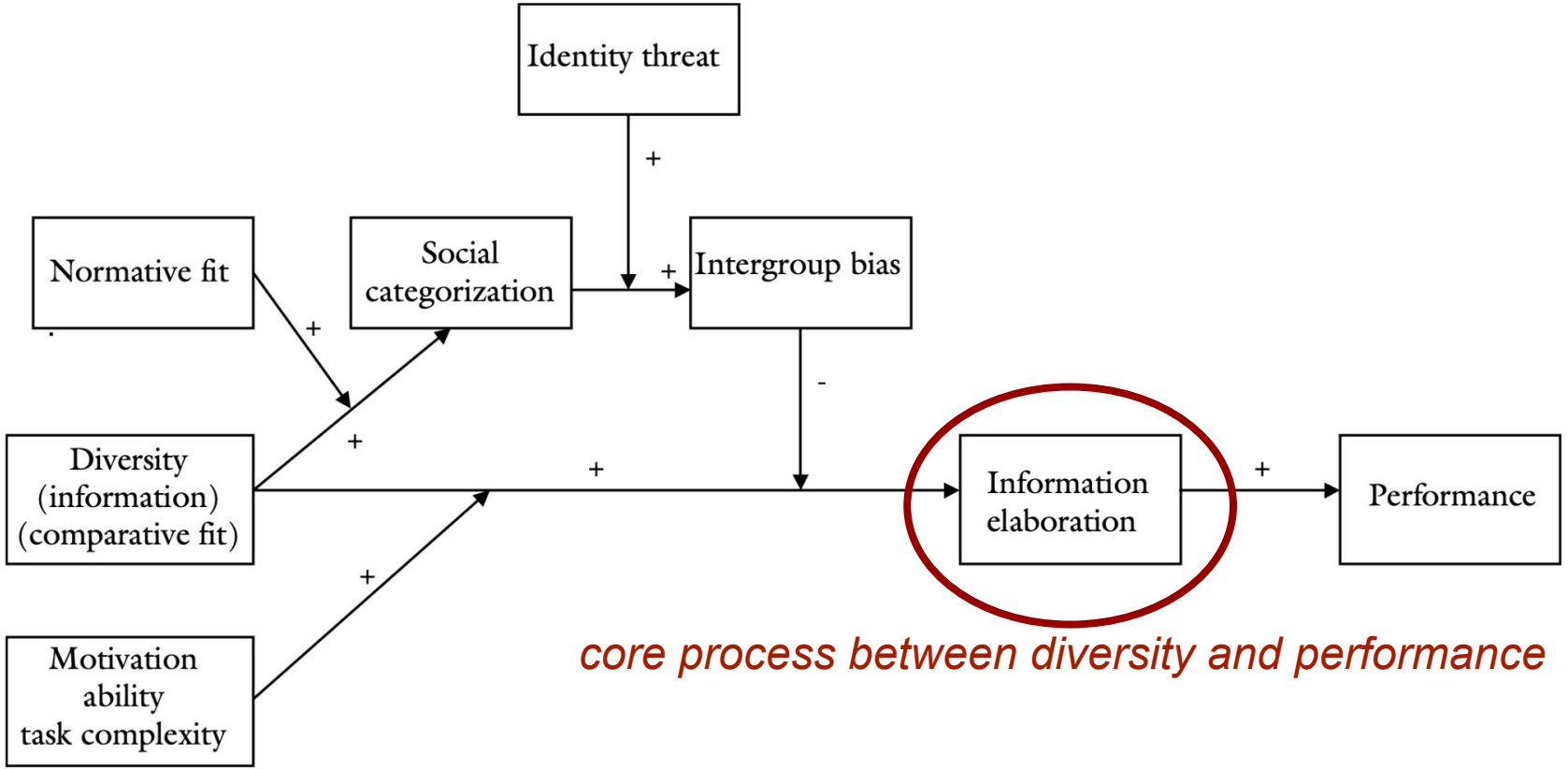
Categorization Elaboration Model [van Knippenberg & van Ginkel, 2010]



assimilates literature findings from 1986-2009

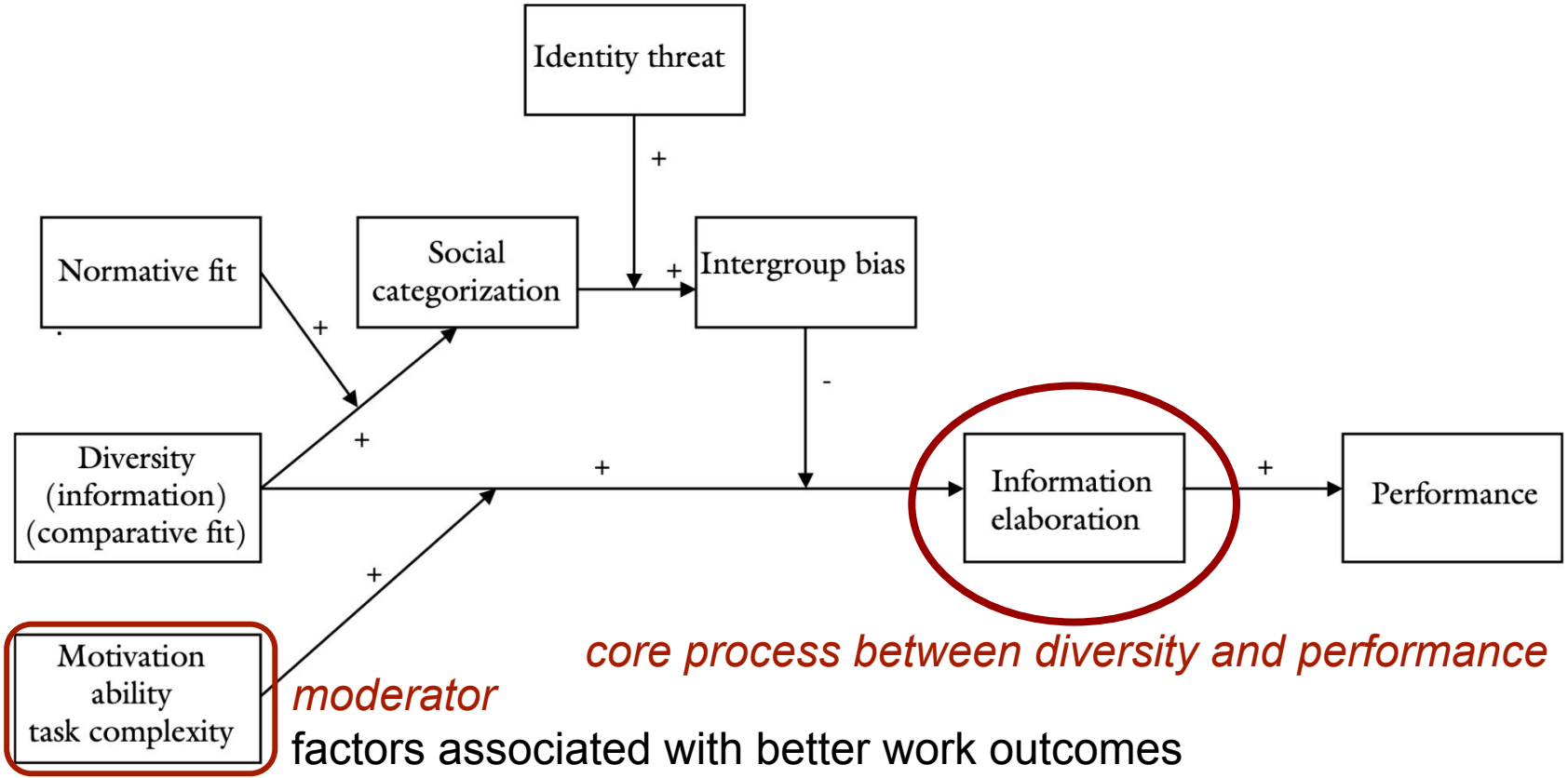
diversity (as a resource) does not automatically benefit group performance
groups need to mobilize that resource

Categorization Elaboration Model [van Knippenberg & van Ginkel, 2010]



core process between diversity and performance

Categorization Elaboration Model [van Knippenberg & van Ginkel, 2010]

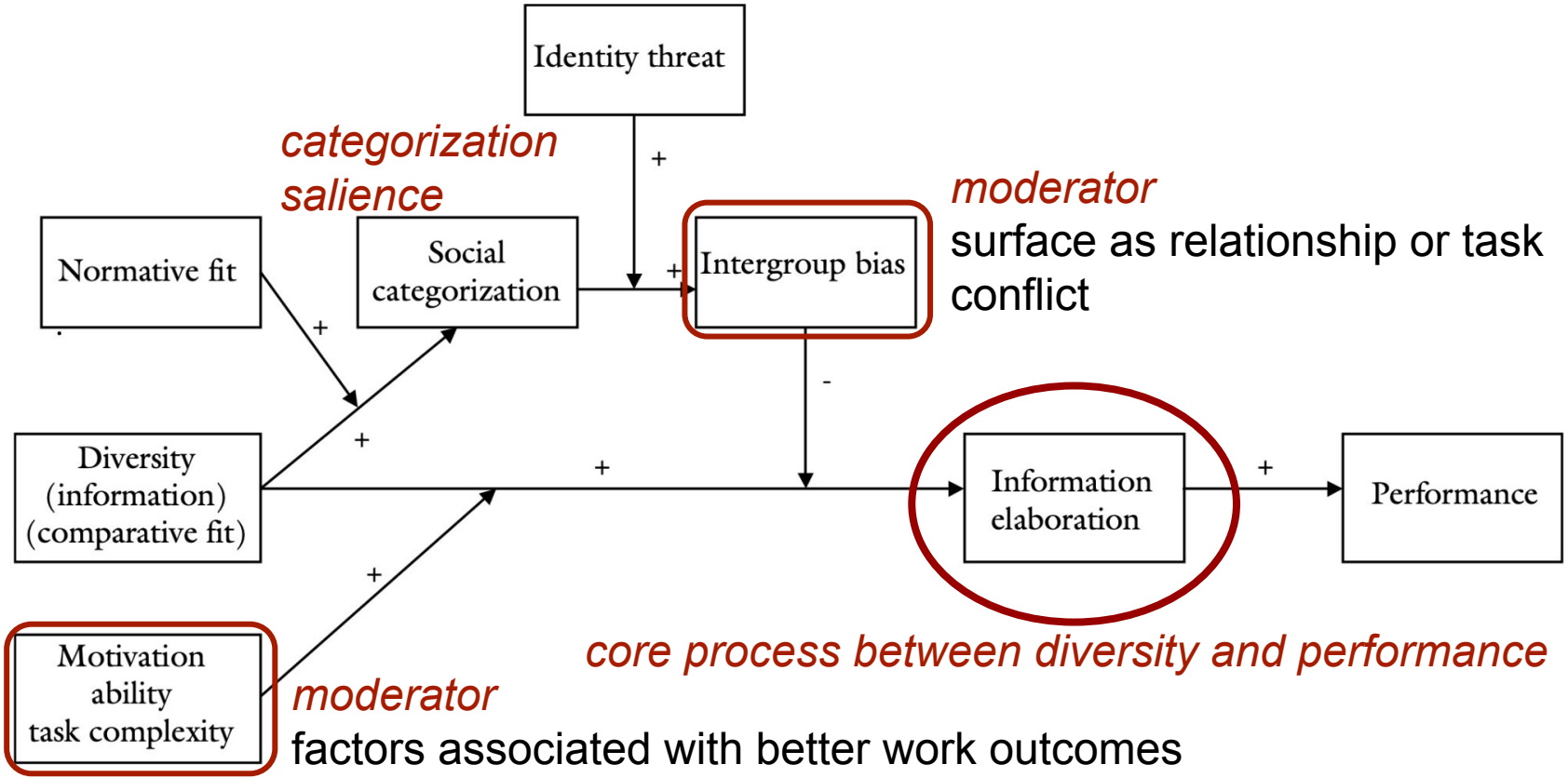


core process between diversity and performance

moderator

factors associated with better work outcomes

Categorization Elaboration Model [van Knippenberg & van Ginkel, 2010]

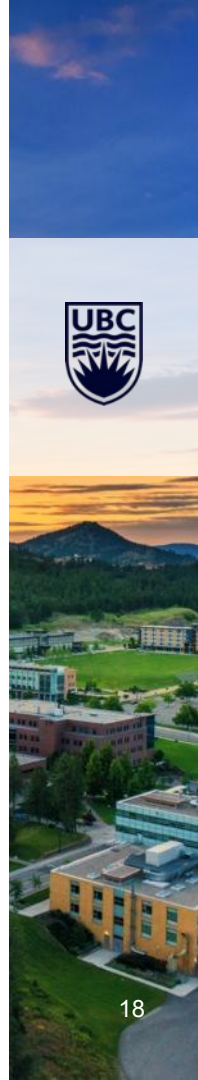


Software Engineering Team Collaboration

- Team members work on a programming project (e.g., hosted on GitHub)

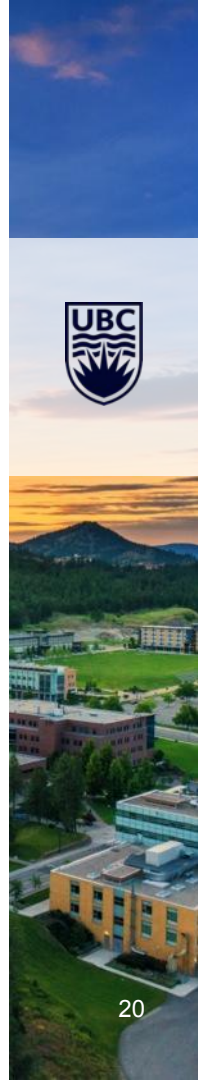
- Development cycle:
  - Members simultaneously pull the master version
  - Members work independently on additional features locally
  - Members ask for ***code reviews*** from others
  - If approved, new code is pushed and merged to create a new master version

- Literature reveals issues with gender-diverse professional teams, but limited studies on student teams and other diversity factors
  [Rodríguez-Pérez et al., 2021; Graßl et al., 2023]



Dataset

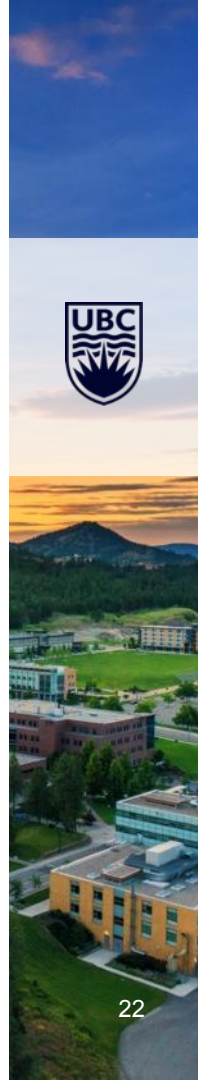
- Code reviews manifest as asynchronous messages between team members
- Collected this data from 105 students split into 22 teams
  - 86 males, 15 females, 1 non-binary, 3 no answer
  - 63 racial minorities and 42 European descent
  - 11 racialized gender minorities
- A team is ***diverse for a learner characteristic*** if at least 2 members differ
  - 12 gender-diverse teams vs. 10 all-male teams
  - 16 racially diverse teams vs. 6 racially homogeneous teams (5 were all racial minorities, 1 all European descent)
  - 8 teams had 1+ racialized gender minorities vs. 14 teams without intersectional members



Content Analysis

- Two coders on 29.79% of the data
  - 7,610 comments segmented by sentence
  - One round of inductive familiarization, followed by two rounds of deductive categorization [Braun & Clark, 2021]
  - Established intercoder reliability ($\alpha = 0.8564$)

- Codebook on next slide
  - Utilizing an action/process coding form of categorical labeling, and a non-exclusive approach to assigning labels [Saldana, 2009]
  - **12,587 comments** segmented by phrases that switched labels



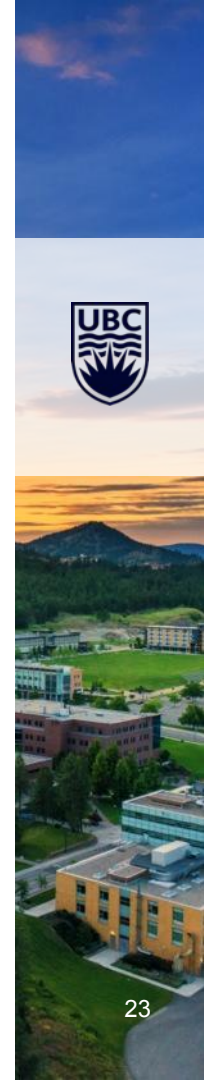
Codebook

Task Oriented

Relationship Building

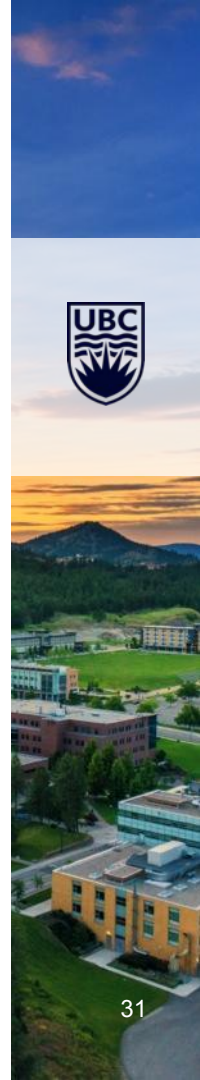
Facilitates Elaboration

	Code	Meaning and Examples
Task	**Approving**	= to approve something e.g. “The code all works and looks good to me”, “Approved.”, "LGTM"
Task	**Updating**	= providing programming context or a status update or stating a planned task (i.e. something that is *done*, a task left out intentionally) e.g. “All the individual logs added”, “Ready to merge!”
Task *(Reln)*	**Criticizing**	= pointing out something is wrong without additional helpful suggestions e.g. “This doesn’t work”, “This package is outdated”
Task	**Directing**	= giving specific instructions, suggestions with code e.g. “Please add the user stories”, “Remove this”, “Let’s …”
Task *(Reln)*	**Suggesting**	= providing specific direction on how to change something. Soft version of directing. e.g. “How about this?”, "Perhaps …"
Reln	**Complimenting**	= saying something is good or well done e.g. “Great logs”, “Nice work”, “The UI looks fantastic”, "Great work Mac!"
Reln	**Encouraging**	= saying something supportive, boosts team morale e.g. “You’ve got this buddy!”, "It was great working with you all"
Reln	**Thanking**	= saying thanks with or without reference to the object e.g. “Thanks!”, “I appreciate all the work you’ve done”
Elab *(Reln)*	**Apologizing**	= recognizing a mistake e.g.”oops my bad”, “sorry about that”
Elab *(Reln)*	**Agreeing**	= saying something in agreement e.g. “sounds good!”, “Ok makes sense”, “Sure”
Elab	**Disagreeing**	= saying something in opposition e.g. “I disagree. It should be SERIAL”, “Hmm, or not.”
Elab	**Explaining**	= explaining why something is done, knowledge explanation e.g. “as I understand it, the builtin package replaces it”
Elab	**Asking**	= requests for explanation or clarification, asking for an opinion e.g. “newline?”, “Could you help explain what this is?”, "Let me know what you think"



Epistemic Network Analysis (ENA) [Shaffer, 2017]

- Uses quantitative techniques to analyze qualitative data
  - Identifies and quantifies connections among units in coded data
  - Visualizes their relationships in dynamic networks
  - Compare statistical differences between networks
- Our context:
  - Units are the coded labels (Approving, Criticizing, Encouraging,...) and teams (but no analysis here)
  - Comparing differences in communicative behaviors
  - Context within work artifact (not full picture)



SVD2
(13.2%)

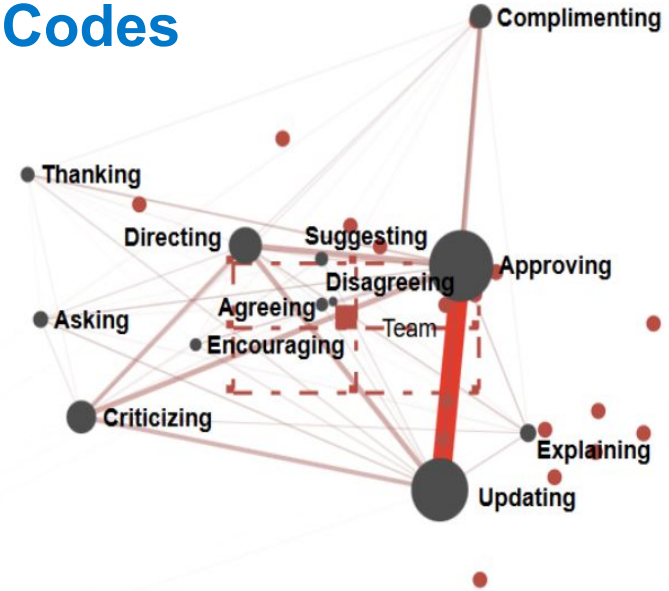
Overall ENA Graph: All Teams, All Codes

Black dots are codes
- Larger ~ more occurrences

Red dots are teams
- Square is the average team

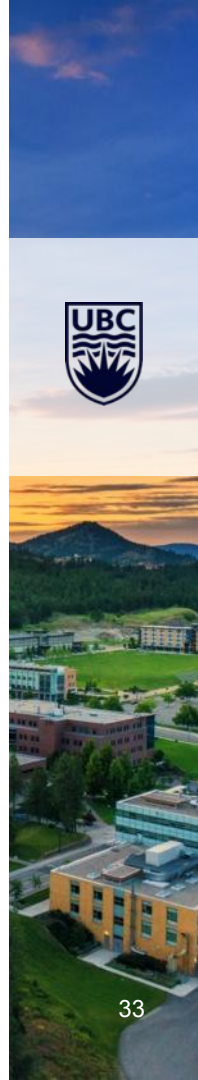
Lines represent code co-occurrence
- Thickness ~ higher frequency

Dashed box is confidence interval



Apologizing

Detailed Results (Removed)



How do we encourage equitable participation?


UBC
THE UNIVERSITY OF BRITISH COLUMBIA