Towards a complex systems perspective on the temporal patterns of dialogic collaborative problem solving

ICCS 2020
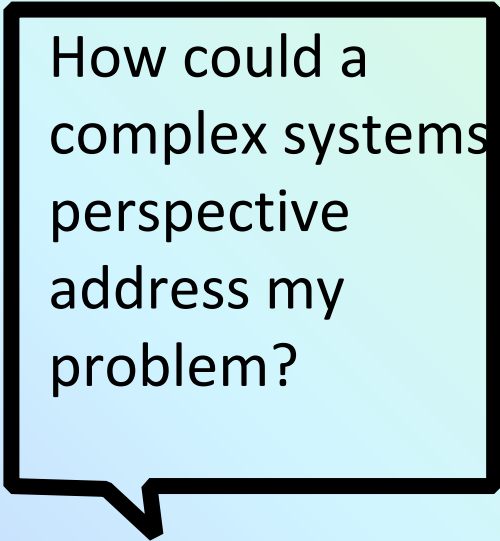Liru Hu
July 28, 2020

Hello!

I am Liru HU

A PhD student from the Faculty of Education, University of Hong Kong

How does peer talk affect performance and learning in collaborative problem solving

Both bachelor and master degrees in Educational Technology

How could a complex systems perspective address my problem?

❏ **Project background**

❏ **Attractors in social interaction**

❏ **Participation inequity**

❏ **Emergent ideas**

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…two or more agents attempt to solve a problem by sharing *the understanding and effort required to come to a solution and* pooling *their knowledge, skills and efforts to reach that solution.* (OECD, 2013, p.6)
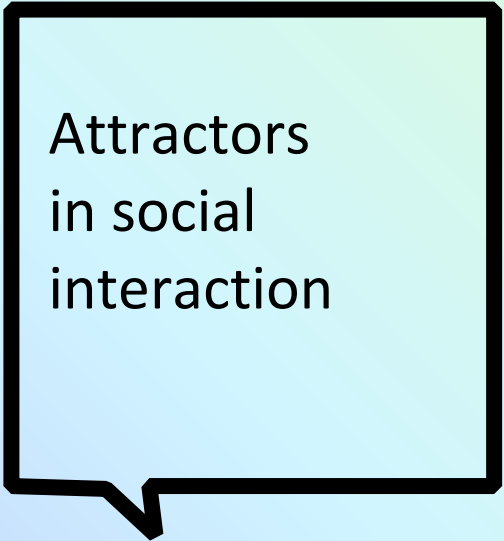
Dialogic CPS:

How to talk to solve a problem together?

Identify substantial temporal features of peer talk that can distinguish high and low performing groups

How could a complex systems perspective help understand the evolution of a dialogic collaborative problem solving process?

Develop an intervention program **to improve dialogic CPS performance**

Attractors in social interaction

An *attractor* is "the value, or set of values, that a system settles toward over time" (Boeing, 2016, p. 4).

Three types of attractors
- Fixed-point
- Limit cycle
- Strange : Fractal structure

(Grebogi, Ott, & Yorke, 1987).

Human interactions are structured by:

- Past interaction experiences or shared knowledge;
- Basic rules of human communication, such as turn taking (Sacks et al., 1974);
- The external target of problem solving;

People automatically imitate others and align their behaviour with that of their peers during social interactions (Lieberman, 2007; Littleton & Mercer, 2013) or uptake capable others' strategies (van de Pol, Mercer, & Volman, 2019; Wertsch and Stone, 1999). .
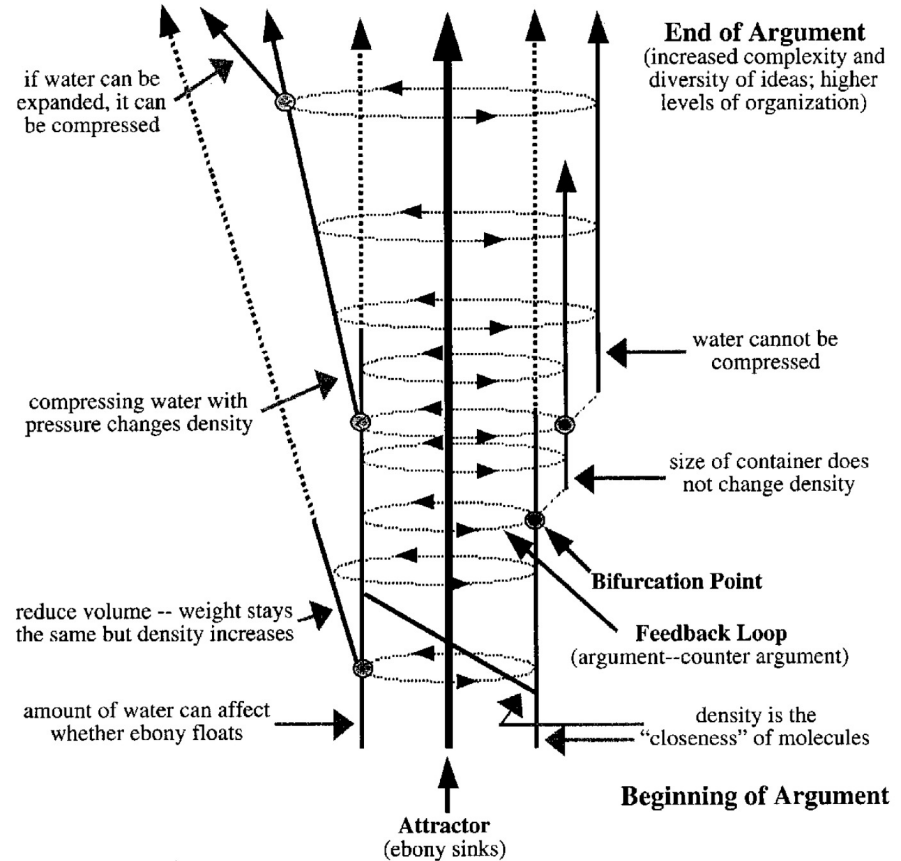
Mirror neurons allow people to spontaneously gain experiential insights into each other's minds and empathically imitate others (Gallese, Keysers, & Rizzolatti, 2004; Iacoboni, 2009).
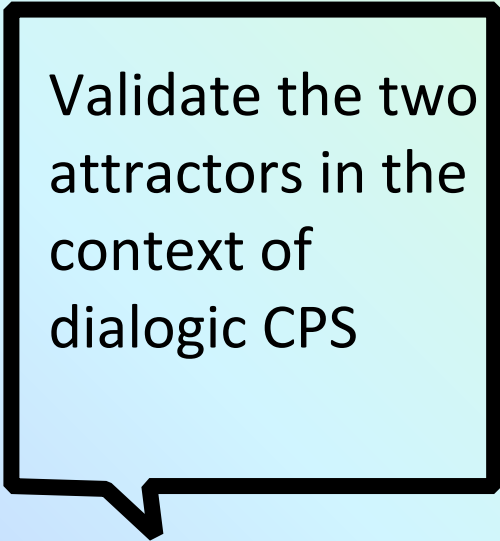
A possible Fixed-point attractor: Participation inequity
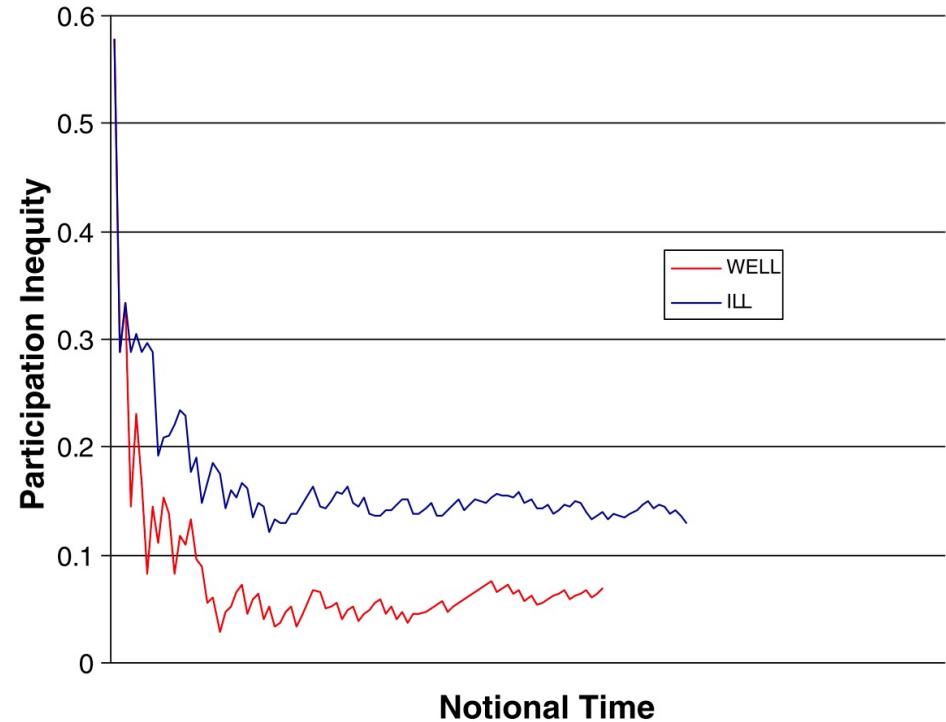
Participation inequity was operationalized as the standard deviation of individual participation proportions.

(Kapur & Kinzer, 2007; Kapur, Voiklis, & Kinzer, 2005; Kapur et al., 2008; Voiklis, Kapur, Kinzer, & Black, 2006)

A possible strange attractor: Object of discussion

(Stahl, 2010, 2014; Umaschi, 2001)

Validate the two attractors in the context of dialogic CPS

Participants

164 fourth-grade primary school students (58% male; 42% female) from five classes in two schools in mainland China.

Procedure

Participants grouped of four, balanced in terms of gender and prior mathematics grades.

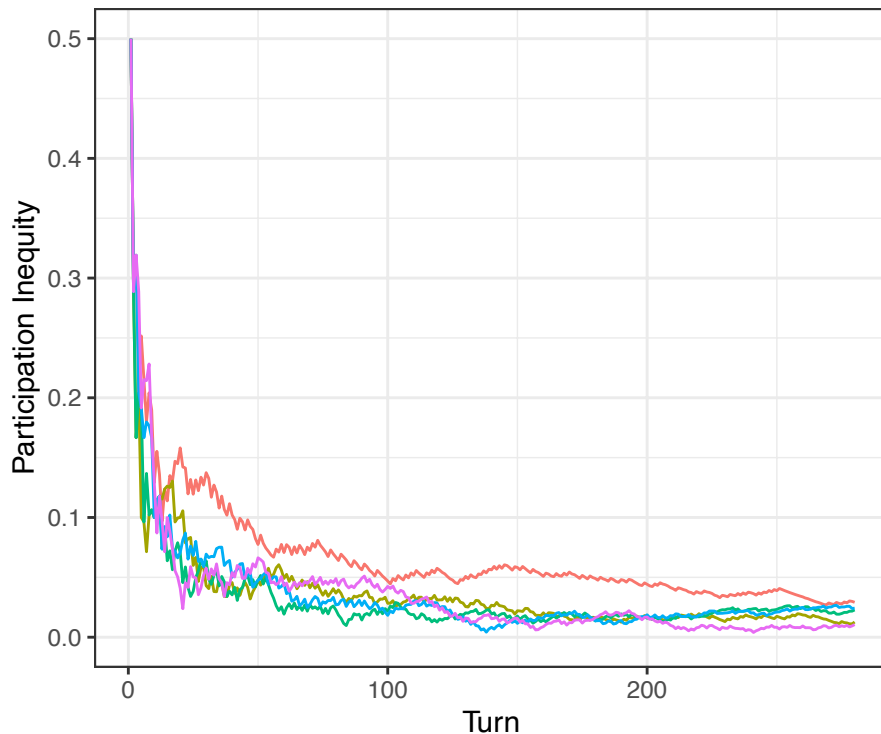Each group was given 30 minutes to collaboratively solve three structured open-response mathematical problems.

Group discussions were audio taped. A survey on demographics information, prior math grades, self-concept, math learning enjoyment, friendship etc.

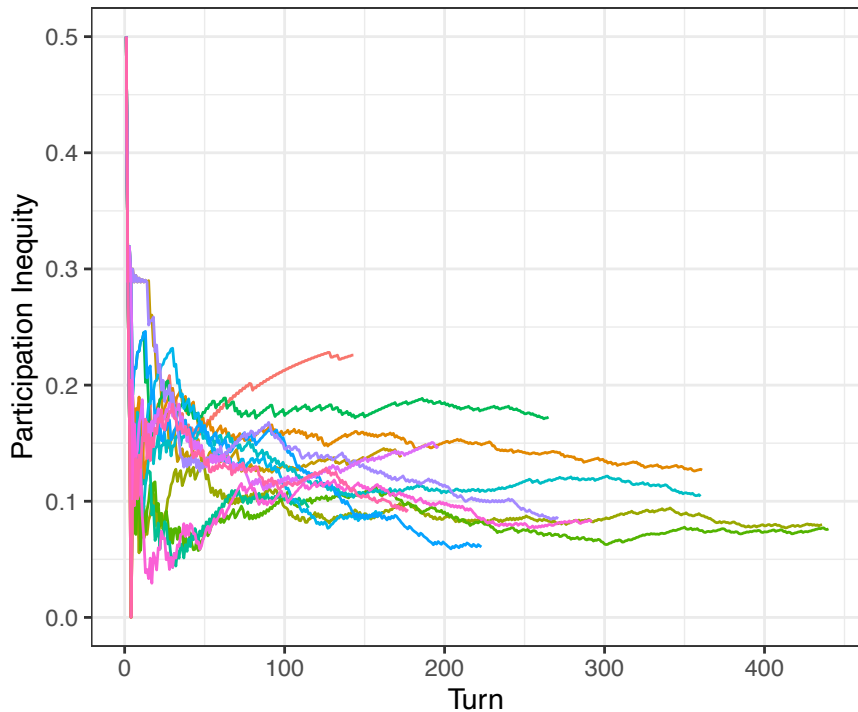# Participation inequity

A All groups (n = 41)
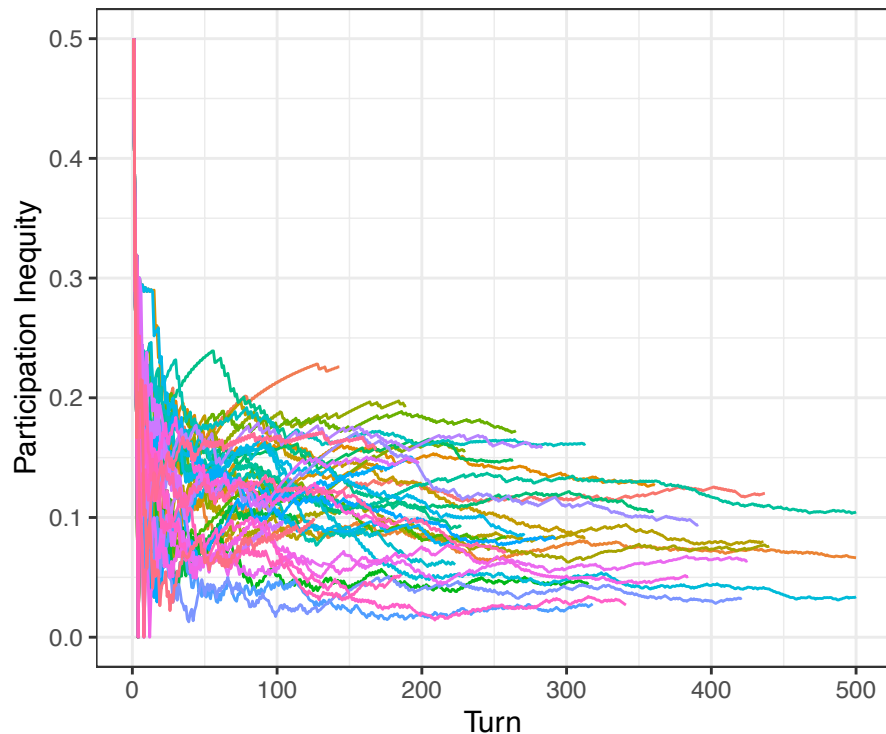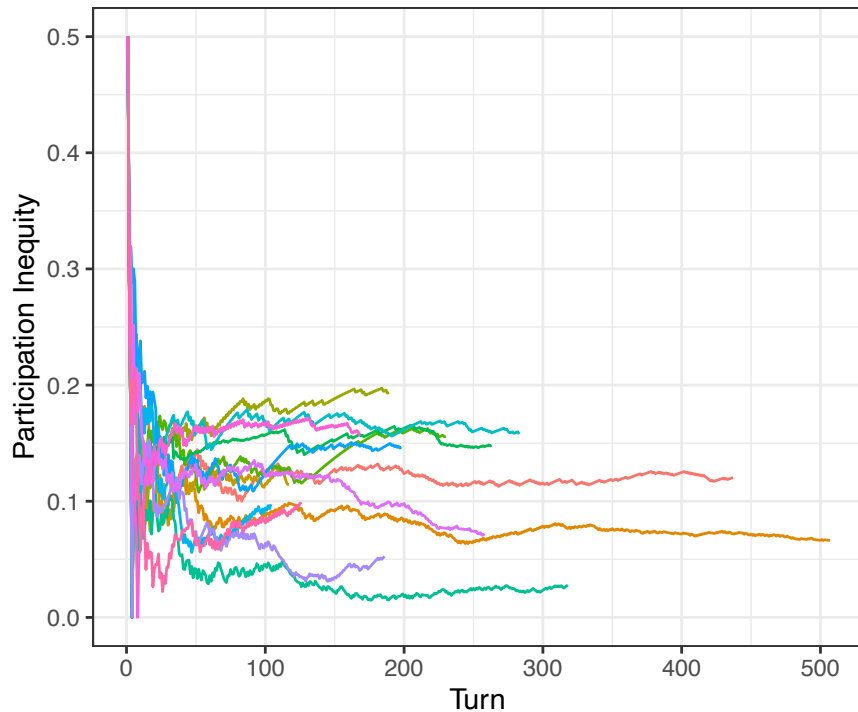
B Reference groups (randomly generated, n = 5)

Dynamics of participation inequity for all involved groups (A) and randomly generated reference groups (B).
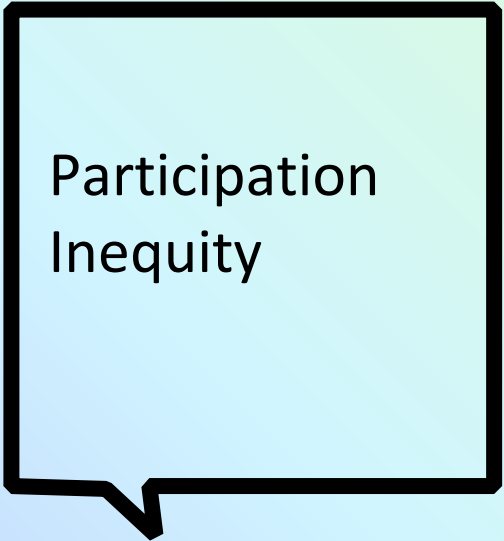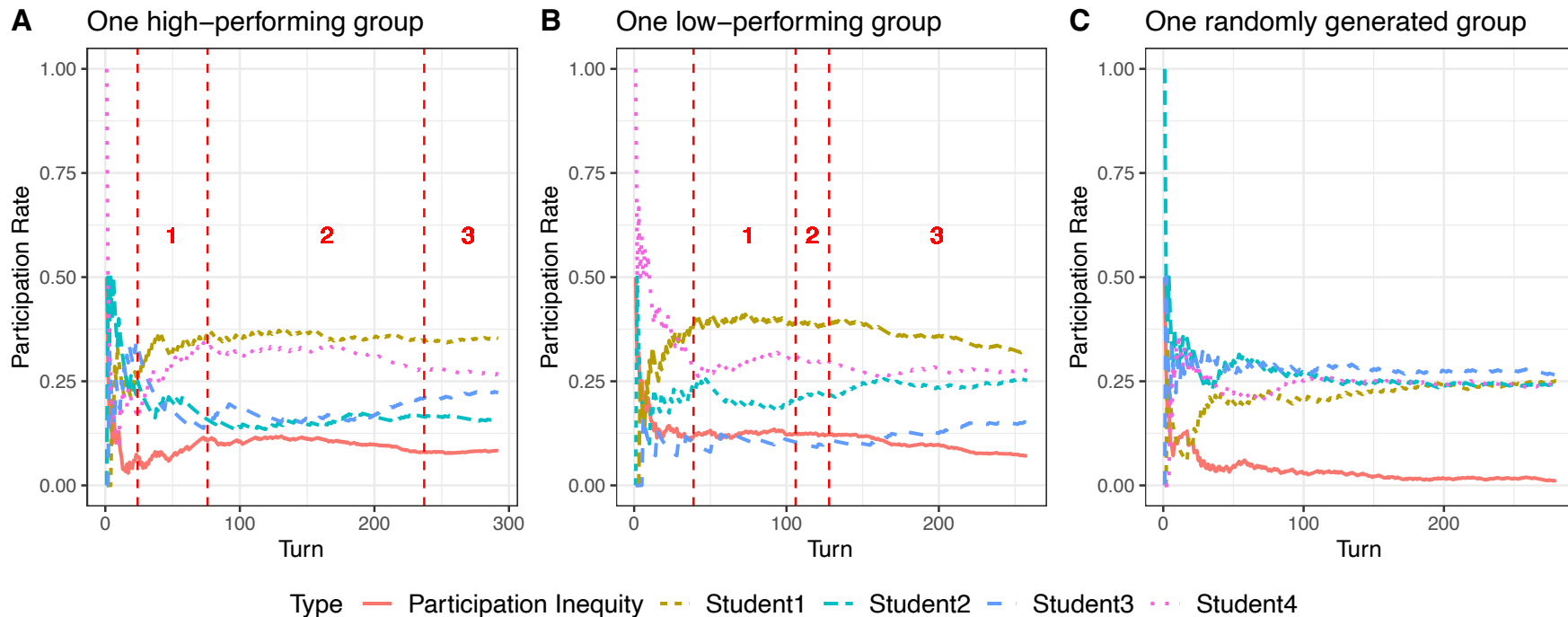
Participation inequity

Dynamics of participation inequity for high-performing groups(A) and low-performing groups (B).

Participation inequity

Dynamics of individual participation rates for one high-performing group (A), one low-performing group (B) and one randomly generated group (C). The areas numbered 1, 2 and 3 denote three problems.

## Participation Inequity

Consistent with previous findings:

- There is an early stabilization phenomenon of participation inequity in dialogic CPS.

What I added on:

- The group-level stabilization pattern emerged at the individual level.
- The participants' participation in dialogic CPS seemed to be a process of revealing and/or building their social identities and roles in a specific group.

Emergence of Ideas
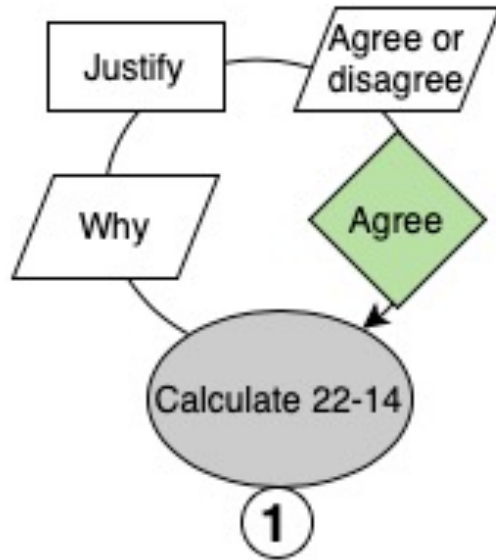
Three types of talk move

- **Reasoning:** Justify, Elaborate, Add on
- **Evaluate:** Agree, Disagree
- **Invitation:** Do you agree/disagree? Why? Can you say more?

Emergence of Ideas
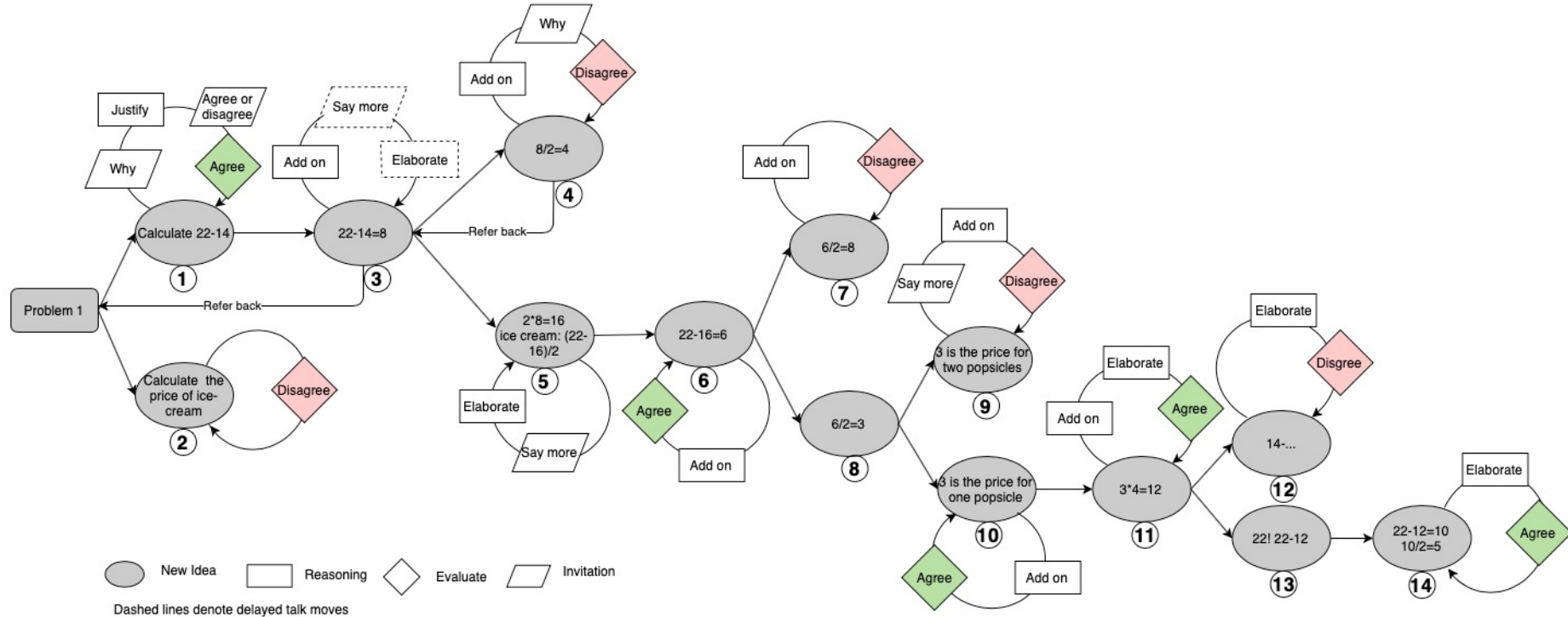

The structure of emergent ideas in the **high-performing group.** Talk moves of agree and disagree were coloured. Each idea was numbered according to the time it emerged.
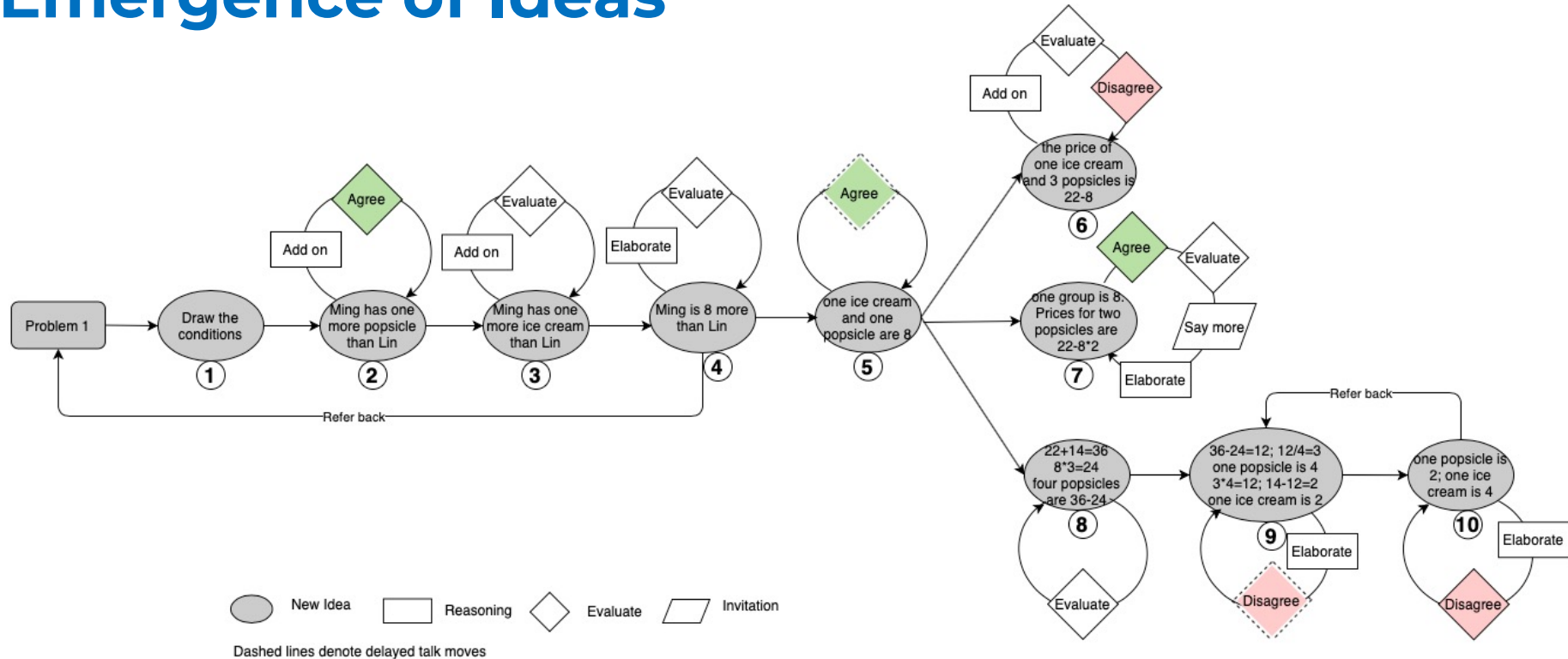
Emergence of Ideas

The structure of emergent ideas in the **low-performing group.** Talk moves of agree and disagree were coloured. Each idea was numbered according to the time it emerged.

Emergent Ideas

Consistent with previous findings:

- Talk moves of the evaluation type, in particular "agree" and "disagree", helped control the bifurcations of emergent ideas.

What I added on:

- The regulative power of "evaluation" talk moves differs between high-performing and low-performing groups.

- Invitational talk moves help induce reasoning, while reasoning talk moves help produce new ideas.

- The three types of talk moves together induce different regulative processes and push ahead the collaboration processes.

Thanks!

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