Using Lag Sequential Analysis to Determine Significant Behavior Transitions While Debugging

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Research Questions

1. How do behavior frequencies vary according to debugging process and debugging task difficulty?
2. What behavior transitions occur more and less frequently than chance, and why?

Method

Sample The setting of this research is an undergraduate course designed for children's play and playful learning in early childhood education (ECE) at a large university in the northeastern United States. 19 preservice teachers consented to participate. Of these, three pairs were purposefully chosen for this study (see table below; all are pseudonyms). None of the participants self-reported prior robot programming experience, though one self-reported intermediate prior programming knowledge.

Teams	Participants	Age	Race/ ethnicity	Academic standing	Prior field experience	Programming Knowledge
Team 1	Anne (F)	20	Asian	Junior	Preschool	no knowledge
	Judith (F)	20	White	Junior	PreK & 4th Grade	intermediate knowledge
Team 2	Rhonda (F)	20	White	Junior	Preschool	no knowledge
	Pauline (F)	21	White	Junior	Preschool	no knowledge
Team 3	Regina (F)	19	White	Sophomore	Preschool	low knowledge
	Jorge (M)	22	Hispanic/ Latino	Senior	5th-8th grade	low knowledge

Note. F=female and M=male.

Robotics Unit Each pair completed five debugging tasks in total. The debugging tasks were categorized as having low-, medium-, and high-level complexity based on these criteria: *computer science (CS) concept, mathematics concept, adding a group of blocks, predictability level, solution path,* and *familiarity*.

Data Sources Participants' debugging activities in Ozoblockly and use of scaffolding tool were screen-recorded by a screen capturing tool. An online tool for scaffolding with expert modeling was used by participants during each debugging task. Everything that participants wrote in response to the scaffolding prompts was saved. Participants individually responded to reflection questions related to debugging challenges and responses, positive and negative aspects of working with Ozobots, how Ozobots can be used in children's play, and how they would support such instruction.

Analyses

Two codes independently coded the lagged transcripts using the following five behavioral codes: exploring, understanding, or playing with the code (B1), exploring, understanding, or playing with the Ozobot (B2), exploring, understanding, or using scaffolding prompts (B3), sharing confusion or inconsistency between ideas (B4), and information/help seeking (B5).

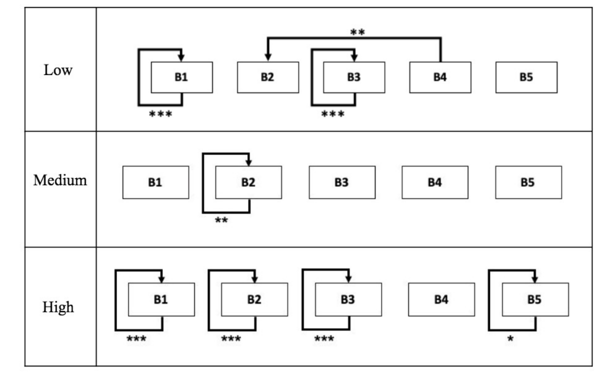
We conducted lag sequential analysis (Bakeman & Gottman, 1997) for behavioral codes with the LagSequential R package (Draper & O'Connor, 2019) and sentiment analysis using the sentimentr R package (Reinker, 2019).

Results

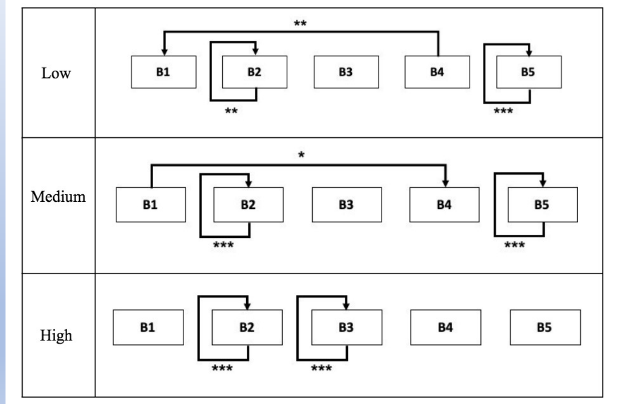
Sentiment Analysis: From rule discovery to rule refinement, there is a general increasing trend in sentiment score. Seven out of the nine tasks had increasing sentiment scores from QA5 to QC1, indicating students felt more positive about their refined rules or managed to write down the rules in a more positive tone. One pair had a decreasing sentiment score and the other had a non-changing neutral sentiment score.

Lag Sequential Analysis: Please see the three tables below.

Anne & Judith - Significant behavior transitions occurring more than expected by chance



Rhonda & Pauline - Significant behavior transitions occurring more than expected by chance



Regina & Jorge - Significant behavior transitions occurring more than expected by chance