Adapting Difficulty Levels in Personalized Robot-Child Tutoring Interactions

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MOTIVATION

Individual students learn best at different paces. Questions that are too easy for a student may cause boredom, while questions that are too difficult may lead to confusion. Both often cause students to disengage.

Personalizing a tutoring interaction includes presenting sequences of questions based on their difficulty and breaks to fit the individual needs of a student.

We will use a social robot to **personalize the pace** of a tutoring interaction with a child. We will measure both **learning gains and engagement**.

ROBOT TUTOR

ADAPTIVE MODEL

DOMAIN

How do we balance more difficult questions with easier questions in robot tutoring? What pace works best for each individual student?

Given a specific student's history, should the next question the robot provides be harder, easier, or of the same difficulty? Perhaps the student needs a break?

APPROACH

For $t = 1, \ldots, T$:

1. Given **context** $x_t \in \mathbf{X}$
2. Choose 1 of K **actions**: $a_t \in \{1, \ldots, K\}$
3. Receive **reward** $r_t(x_t, a_t) \in [0,1]$

Given context, learn action with greatest reward over time.

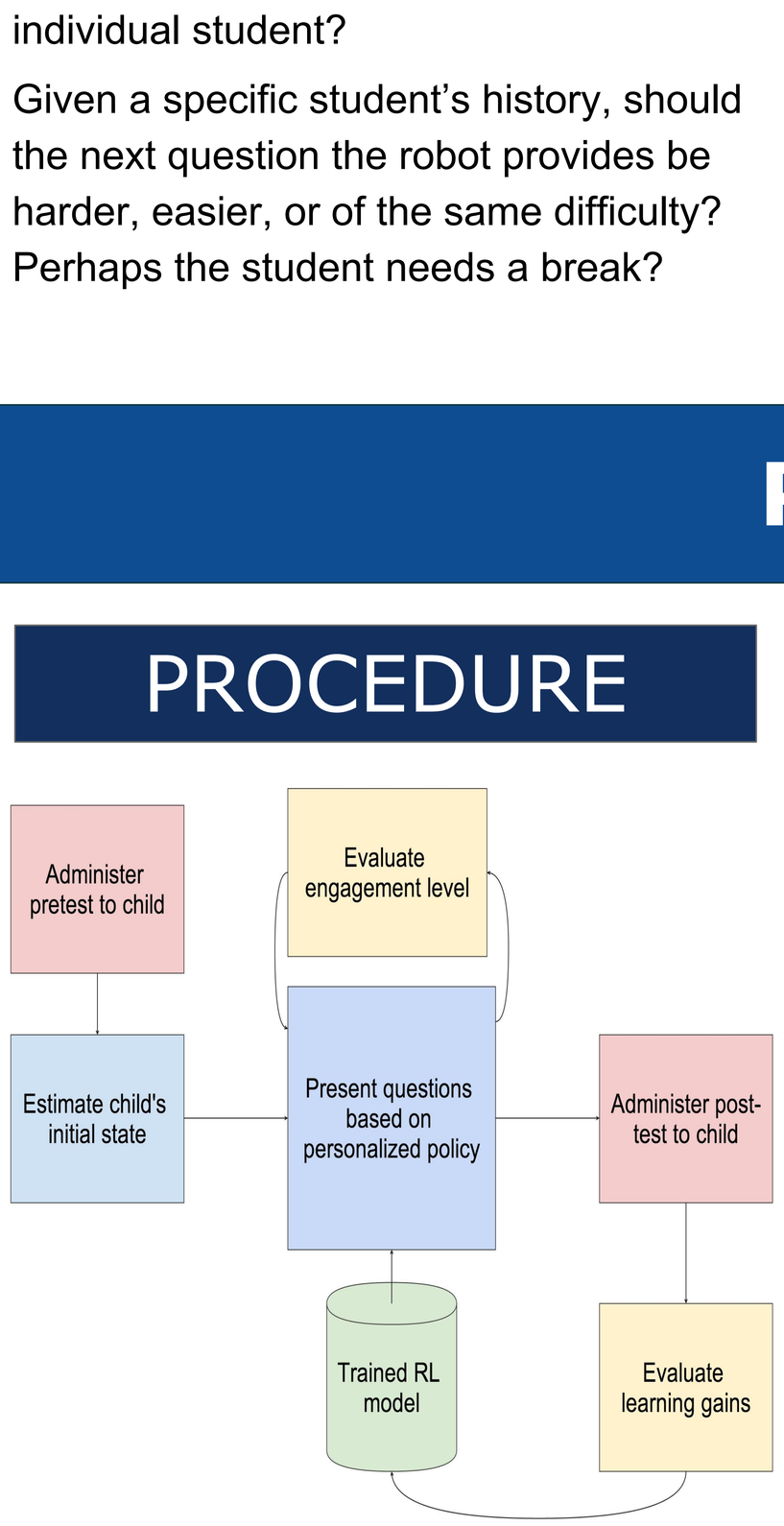
Context: x_t = [% questions answered correctly, # consec. correct, difficulty current question,...]

Actions: $a_t \in \{$***harder*** *question*, ***easier*** *question*, ***similar*** *question*, or *fun activity*$\}$

Reward: $r_t(x_t, a_t) > 0$ when current answer correct or *engaged* = true

PROPOSED STUDY

PROCEDURE



CONDITIONS

1. Control group: **Random** ordering of questions based on difficulty levels and breaks
2. Group receiving **adaptive pace** based on reward encompassing learning gains and measurement of engagement

OPEN QUESTIONS

- Development of classifier to detect engagement level in real time
- Use of immediate vs. delayed reward signals
- Trade off between increasing learning gains and sustaining engagement

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