Learning Programming from Tutorials and Code Puzzles: Children's Perceptions of Value

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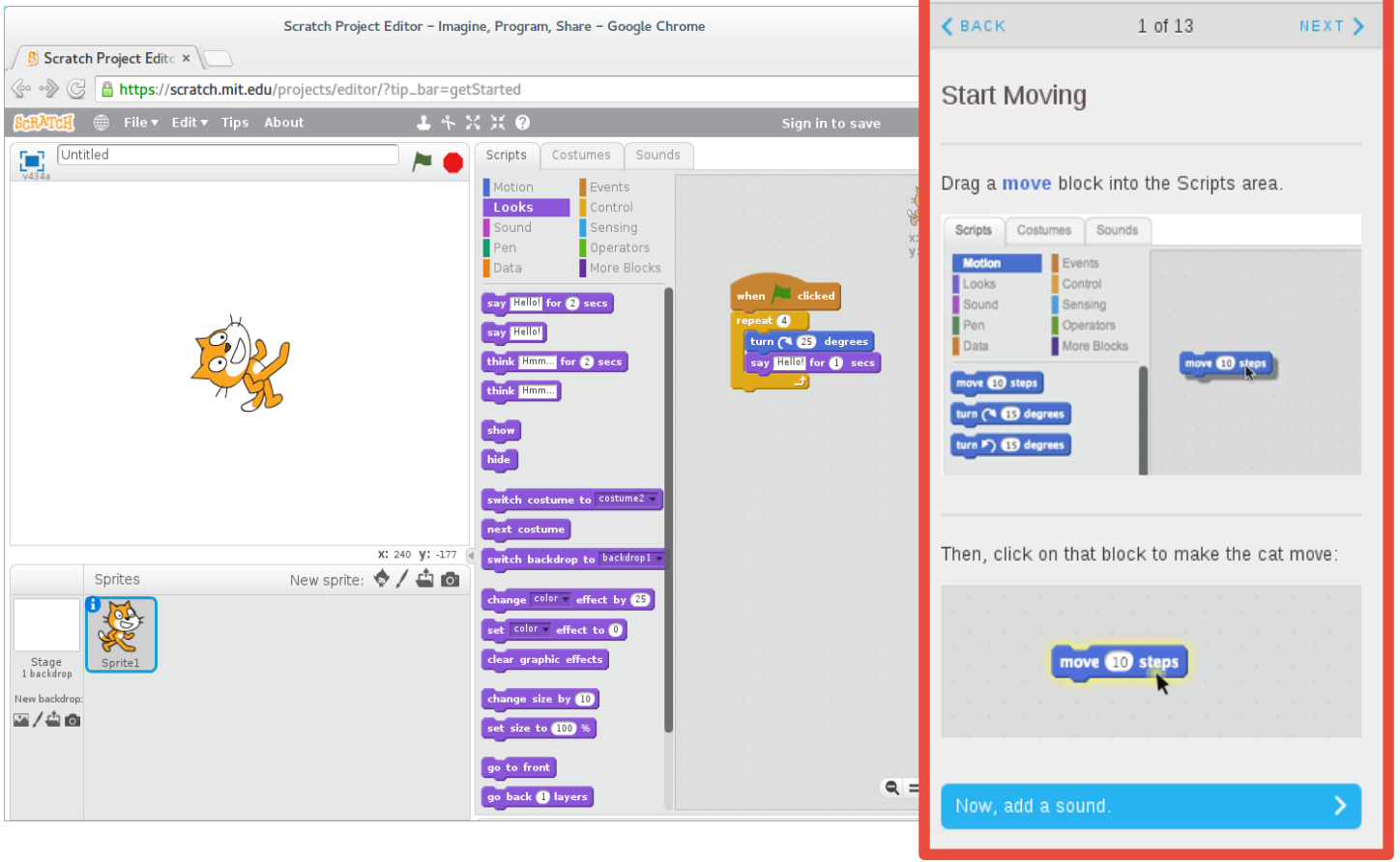
Meet Clara & Friend

Independent Learning Support in Novice Programming Environments

Independent Learning Support – Tutorials



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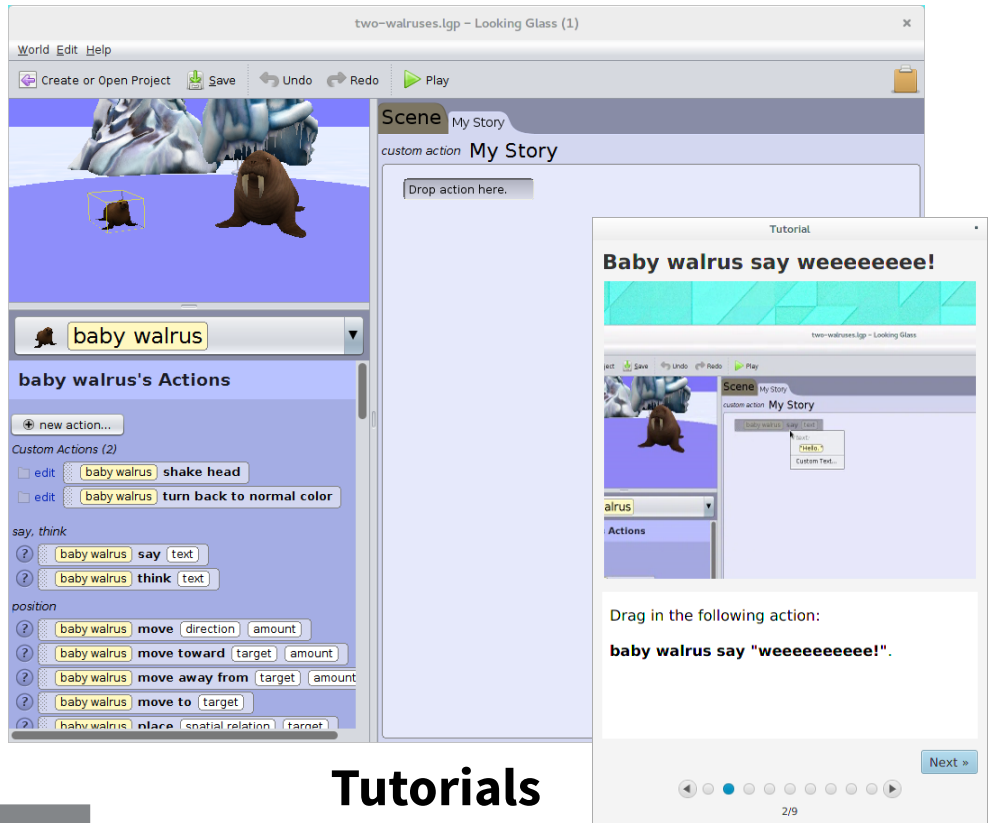
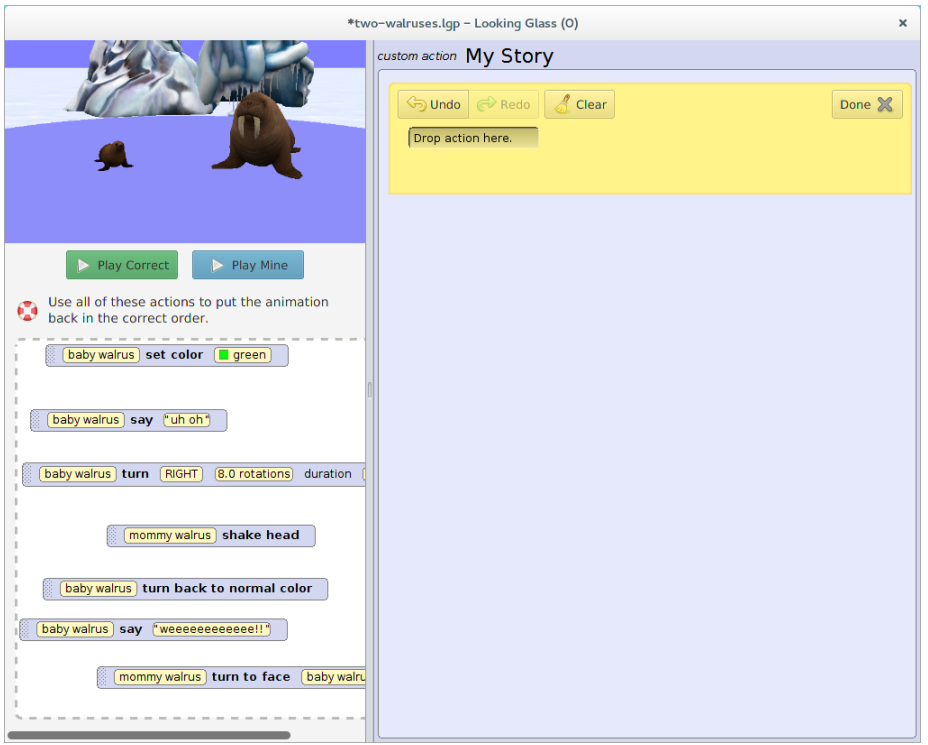
Independent Learning Support – Code Puzzles

Independent Learning Support: Tutorials vs. Code Puzzles



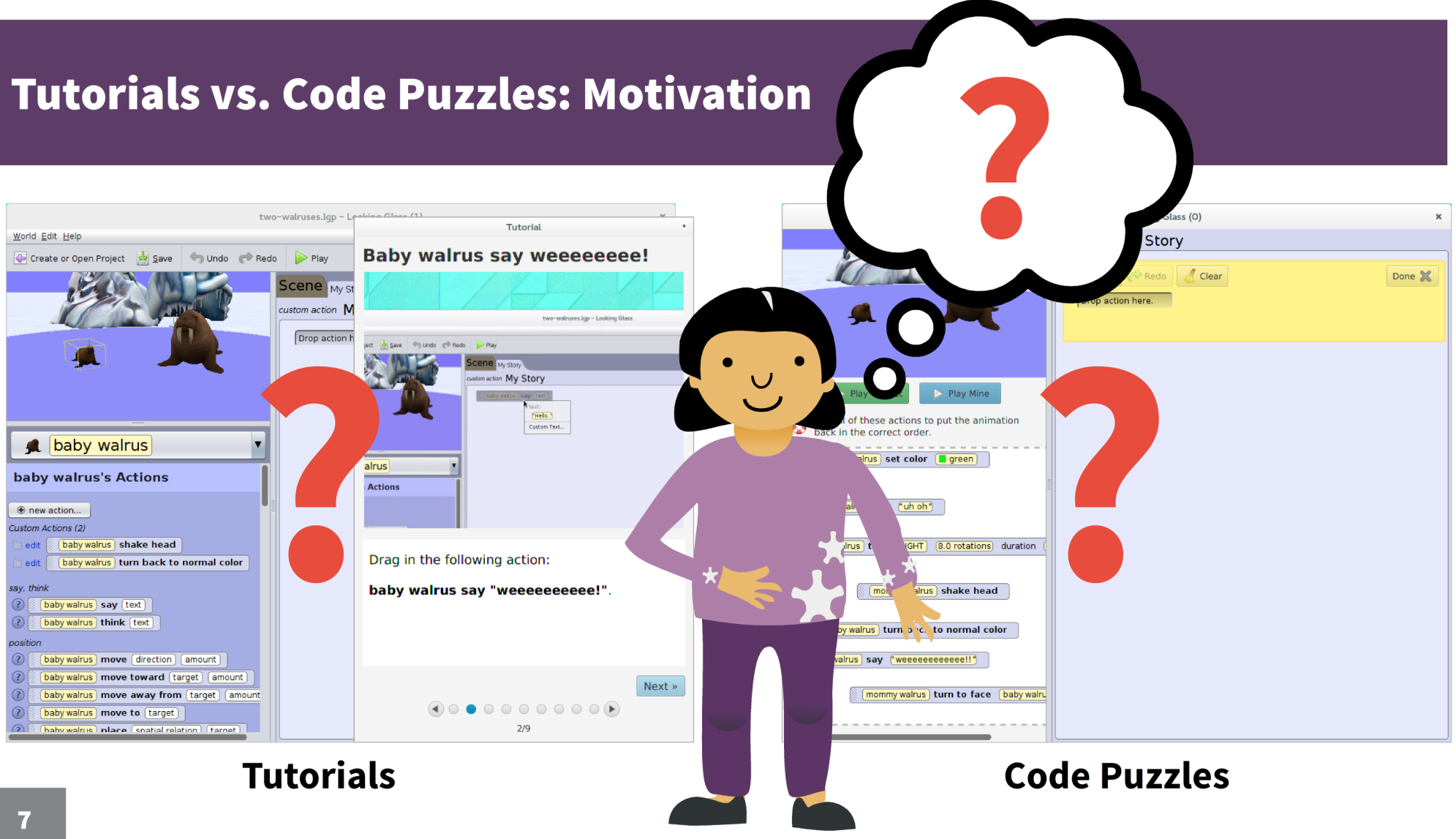
Tutorials



Code Puzzles

K. J. Harms, N. Rowlett, and C. Kelleher, “Enabling independent learning of programming concepts through programming completion puzzles”

Tutorials vs. Code Puzzles: Motivation



Tutorials **Code Puzzles**

K. J. Harms, N. Rowlett, and C. Kelleher, “Enabling independent learning of programming concepts through programming completion puzzles”

Research Questions

What decisions do users make?

Are code puzzles more motivating than tutorials?

What are users perceptions of value for each instructional format?

- Motivation?
- Learning?

Exploratory Study

30 participants (10 to 15 years)

14 female, 16 male

Average age: 11.2 years

6 Instructional Tasks

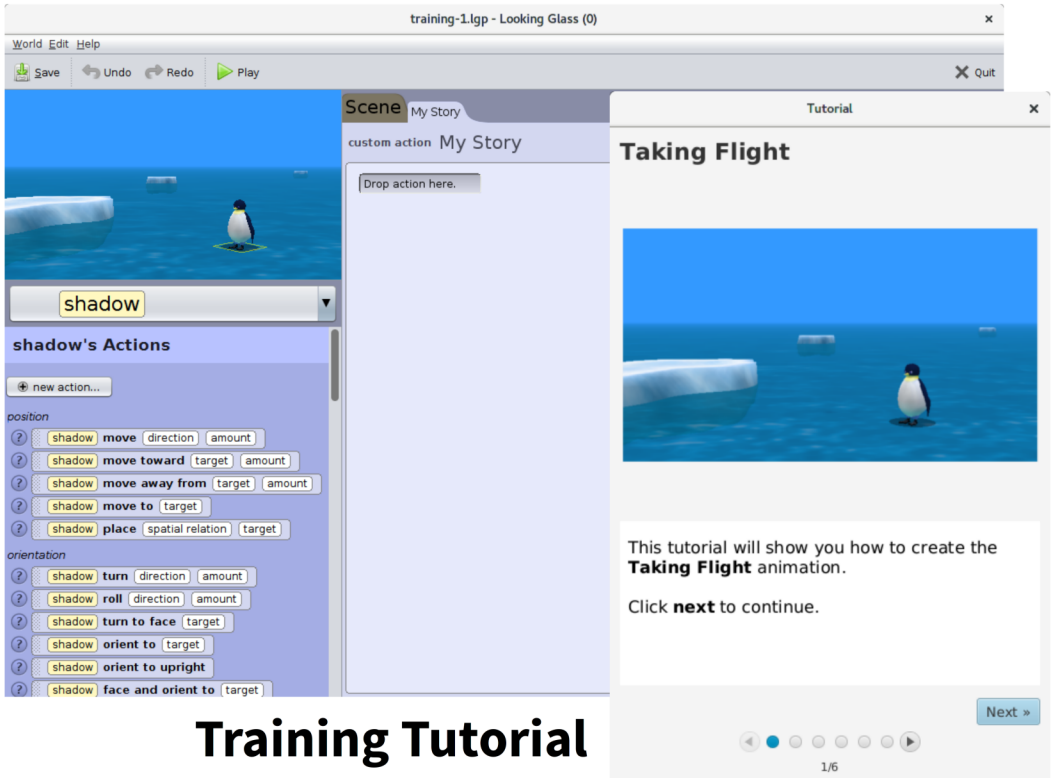
For each pick an instructional format:

tutorial

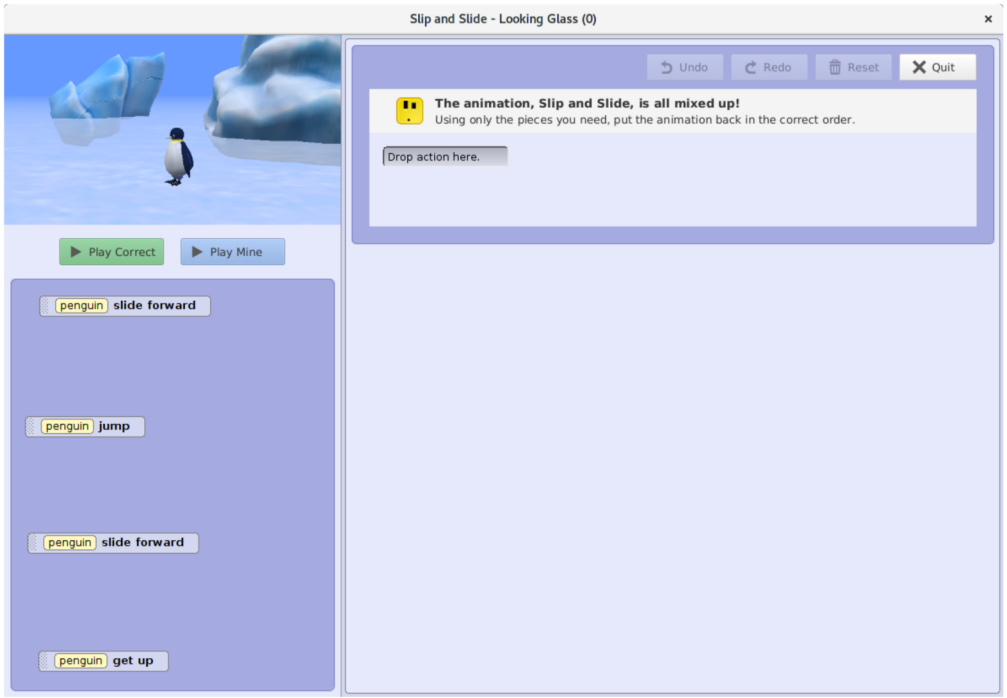
code puzzle

LookinG Glass

Training

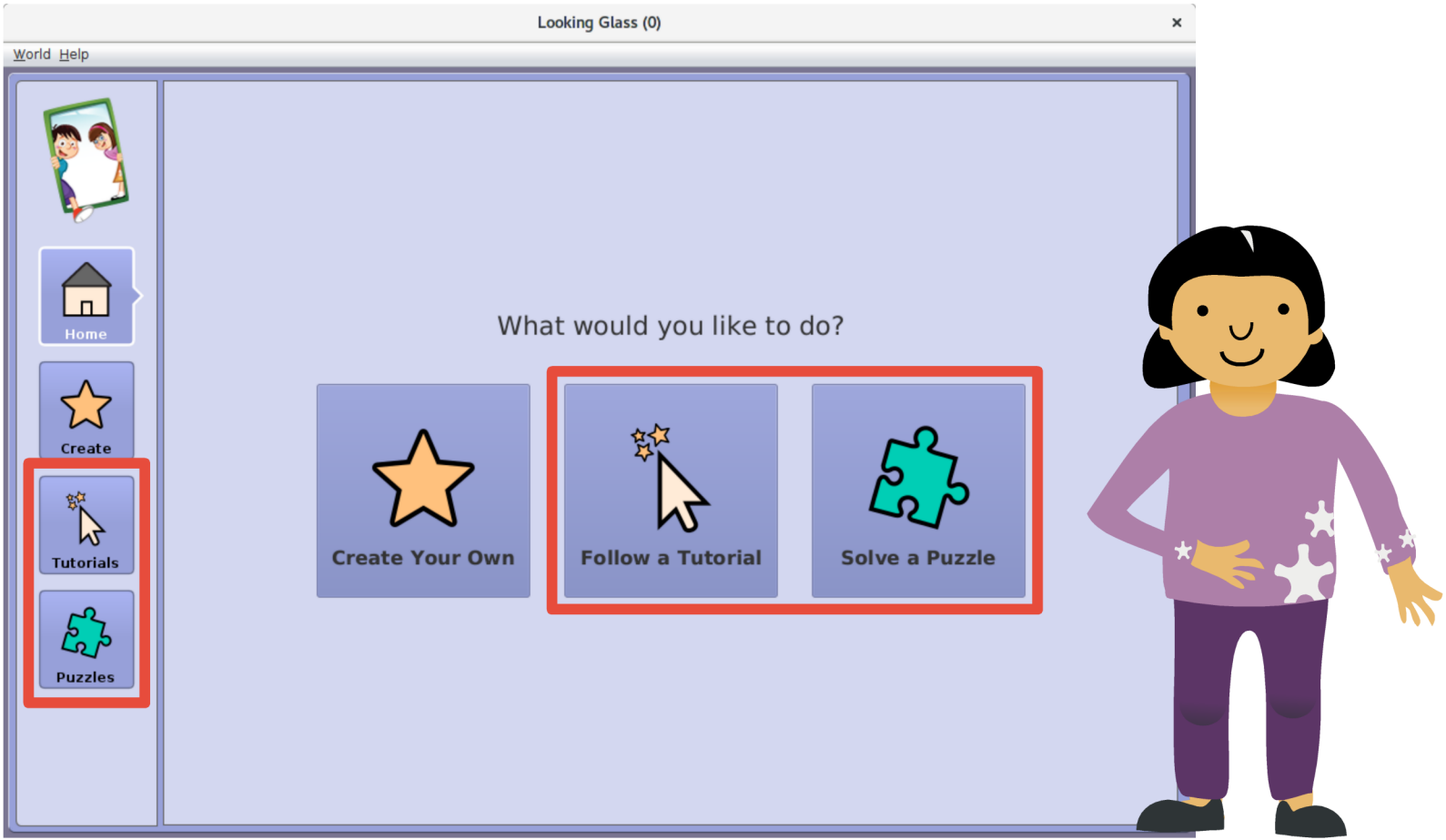


Training Tutorial

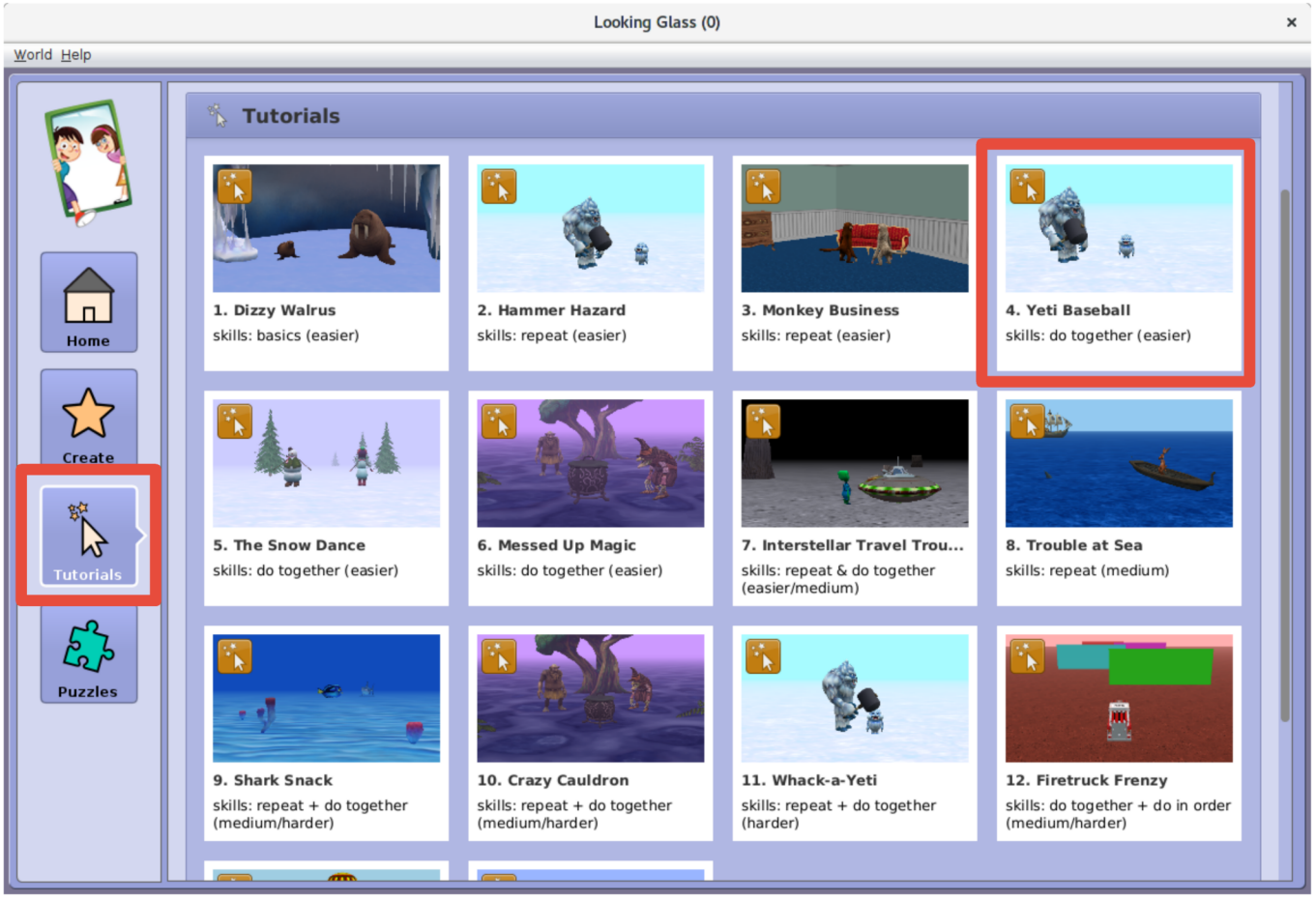


Training Puzzle

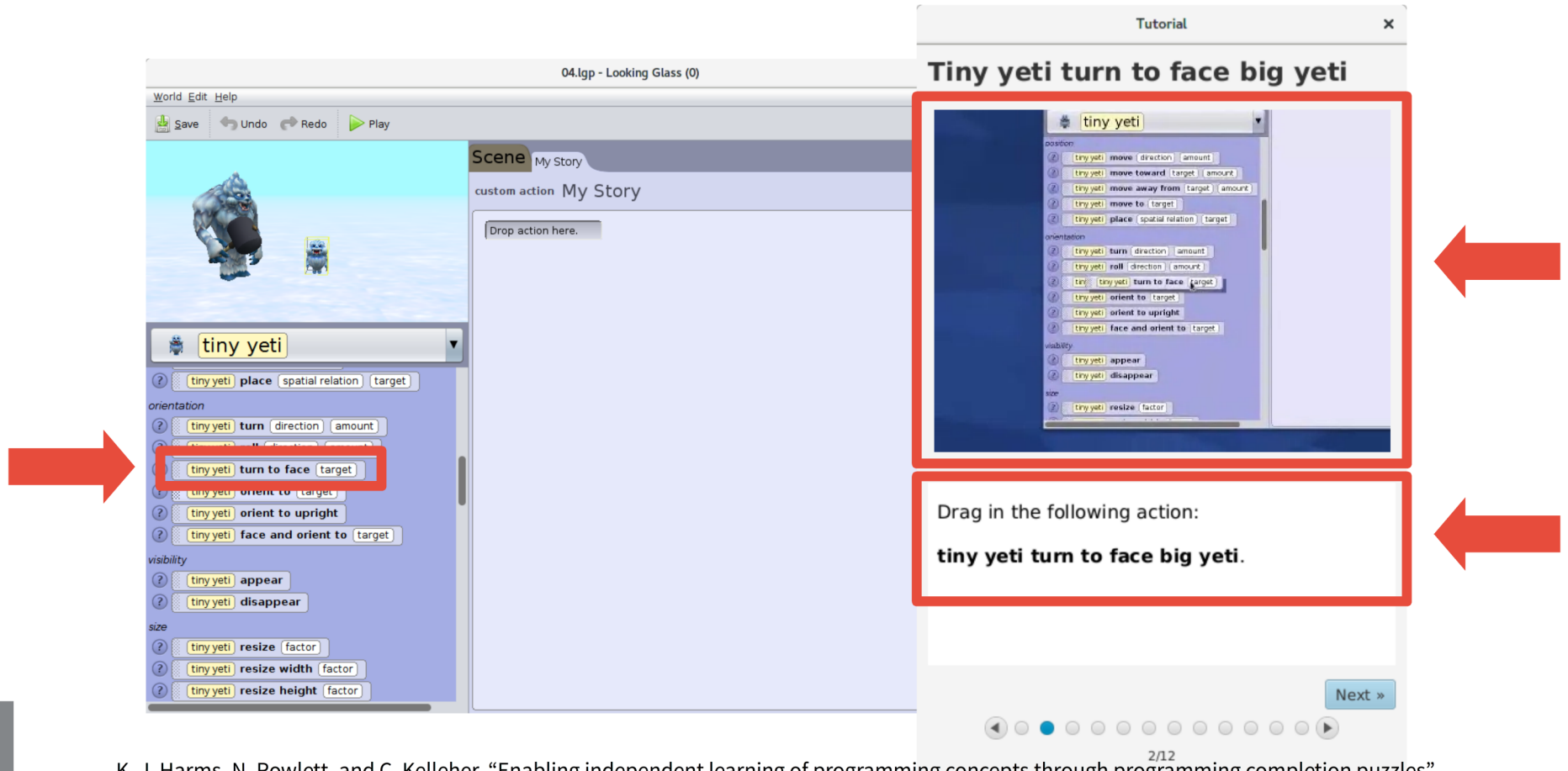
Choose Instructional Format: Tutorial or Puzzle



Instructional Tasks: Tutorials

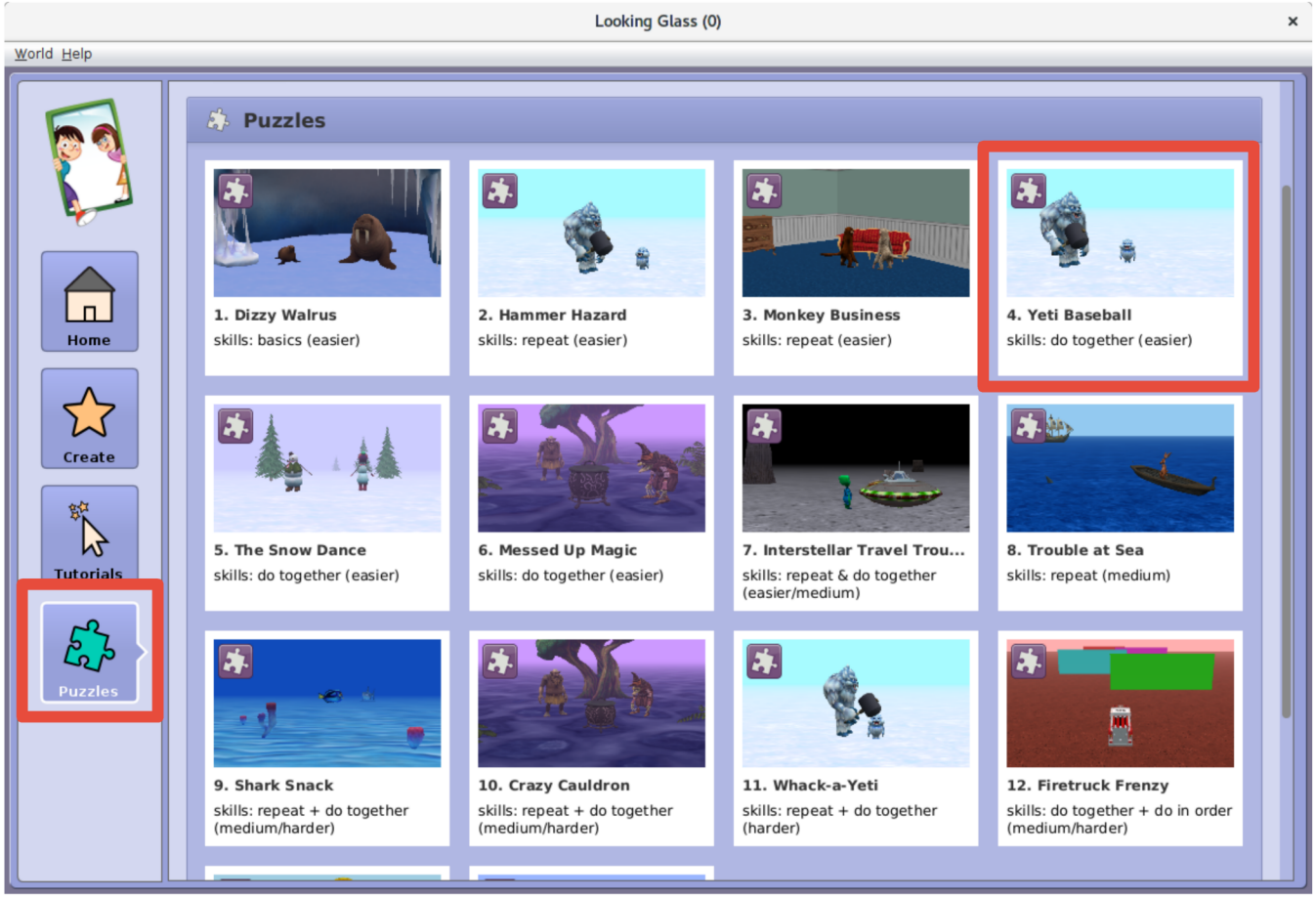


Instructional Format: Tutorial

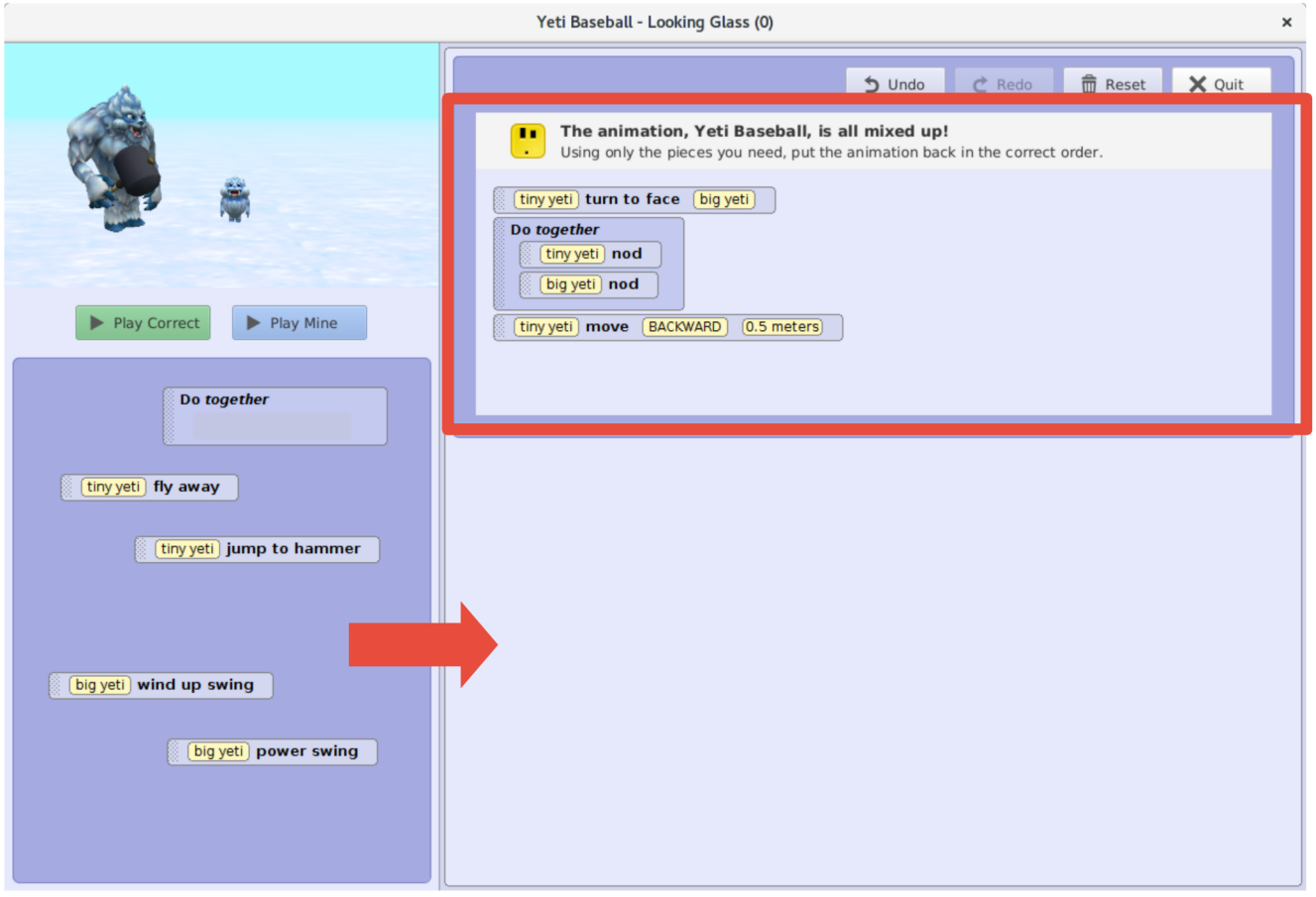


K. J. Harms, N. Rowlett, and C. Kelleher, “Enabling independent learning of programming concepts through programming completion puzzles”

Instructional Tasks: Puzzles



Instructional Format: Puzzle



K. J. Harms, N. Rowlett, and C. Kelleher, “Enabling independent learning of programming concepts through programming completion puzzles”

Semi-Structured Interviews

Pre-Study Interview

"How would you rate your current programming or coding expertise? why?"

...

Post-Task Interviews (6)

"Was the experience of completing the tutorial/puzzle valuable to you in any way? why?"

"Did you learn anything new or did you acquire any new skills while doing the tutorial/puzzle?"

...

Post-Study Interview

"When is it better to to use tutorials/puzzles on your own? why?"

...

Exploratory Study: Data Summary

Instructional Tasks (167)

- 62 tutorials
- 105 puzzles

Responses

- 3,915 interview question responses
- Average 40.2 minutes per participant

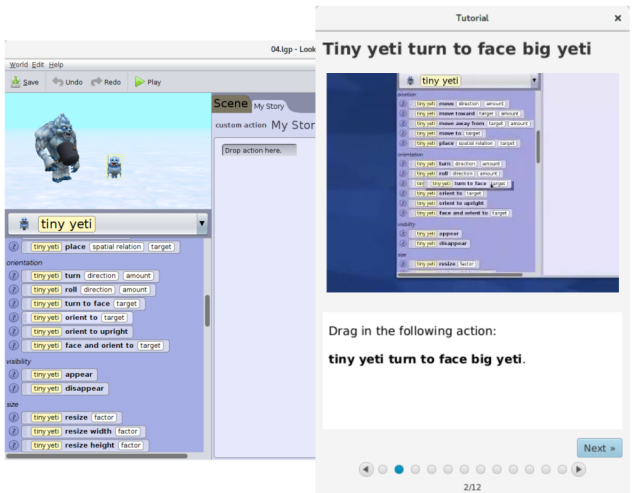
Research Questions

What decisions do users make?

Are code puzzles more motivating than tutorials?

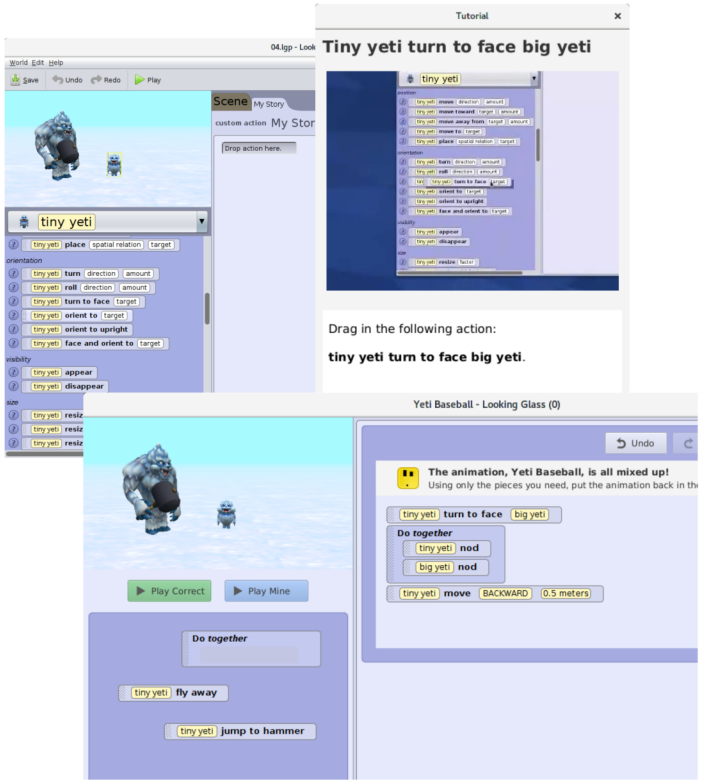
What are users perceptions of value for each instructional format?

Instructional Format Decisions (Exclusively* X)



3% - exclusively tutorials

*(≥ n – 1)

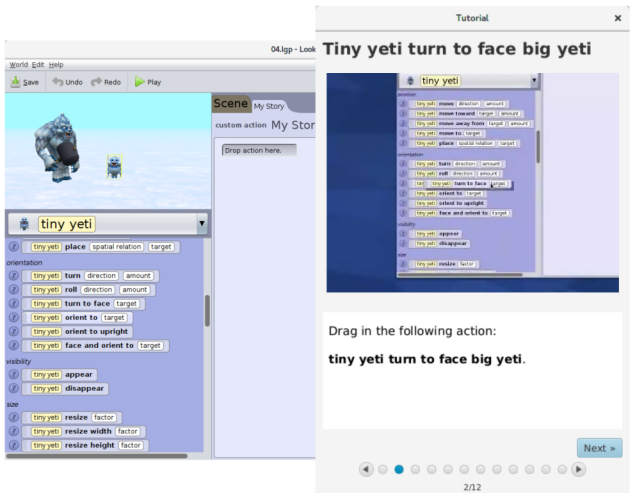


73% - both tutorials & puzzles

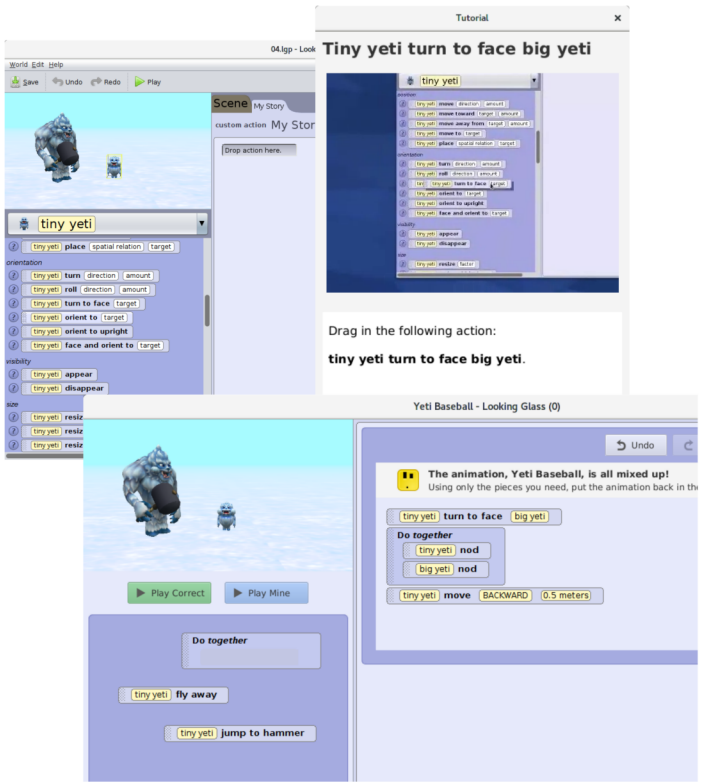
23% - exclusively puzzles

*(≥ n – 1)

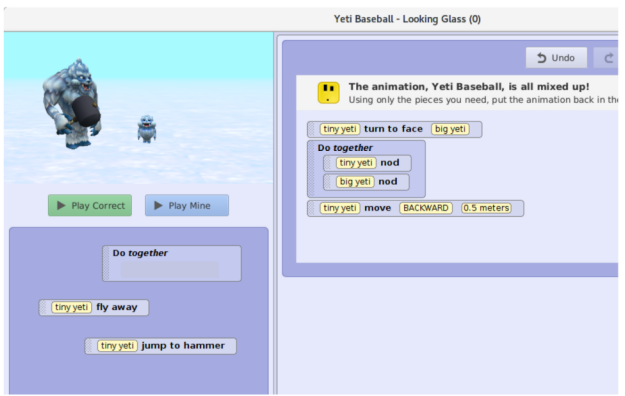
Instructional Format Decisions (Preferred X)



10% - more tutorials



30% - equal tutorials & puzzles



60% - more puzzles

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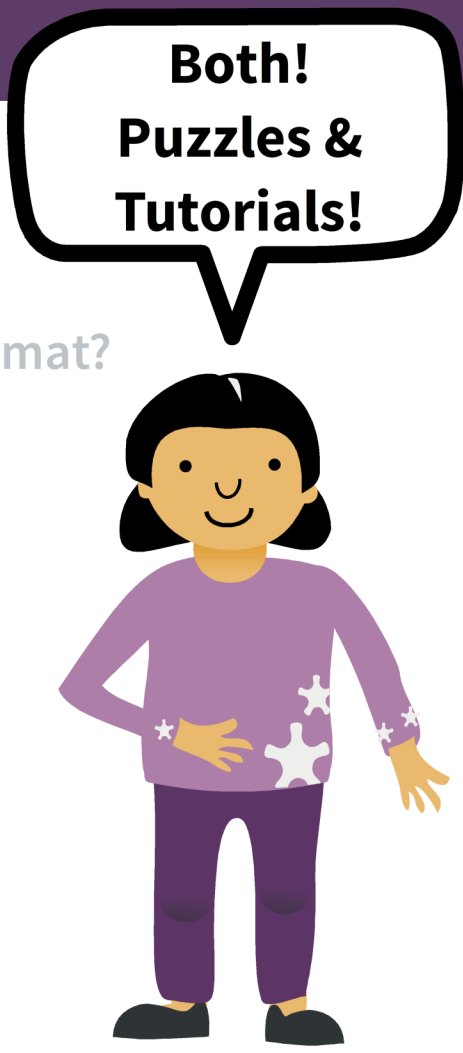

Research Questions

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Are code puzzles more motivating than tutorials?

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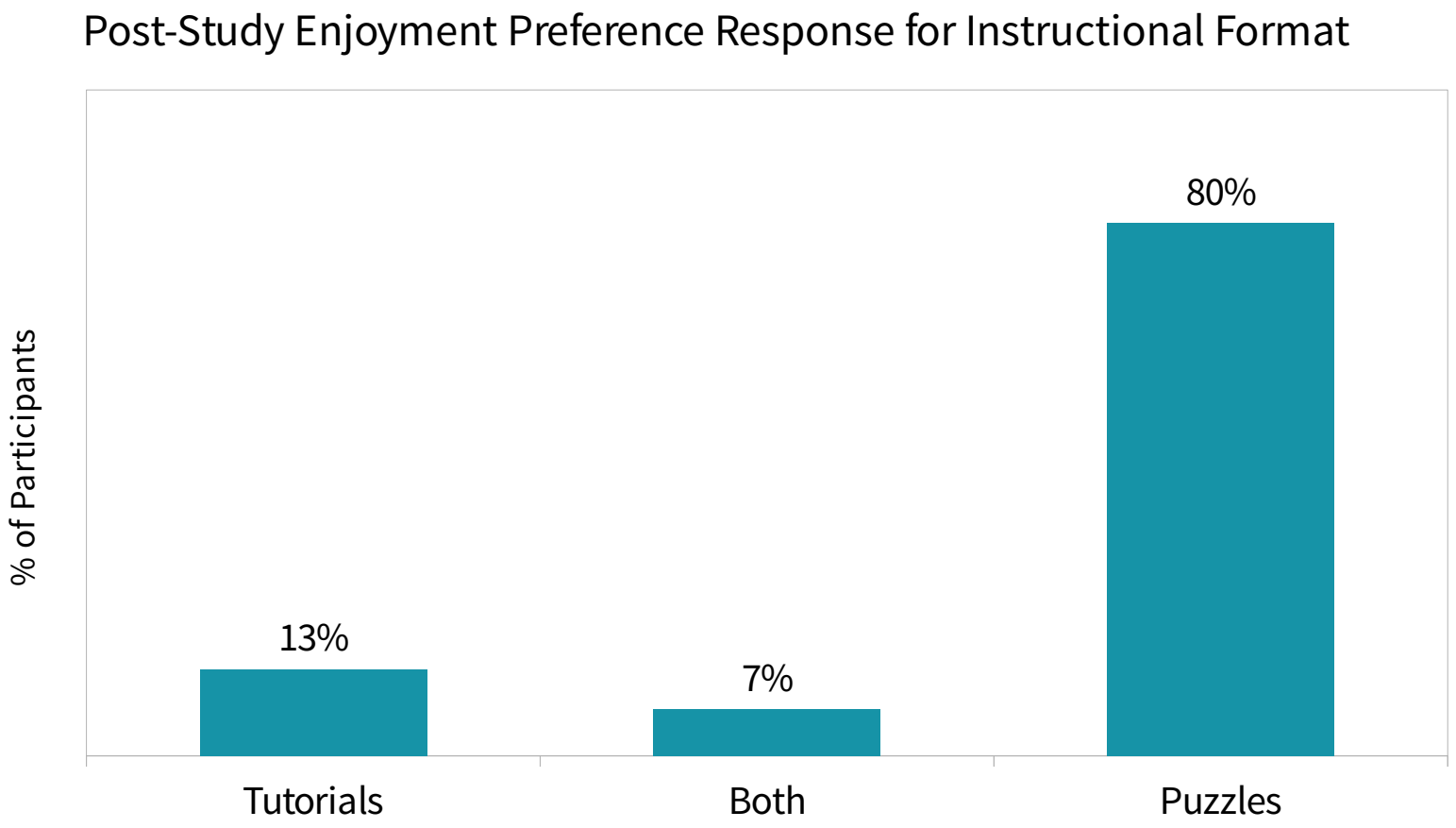
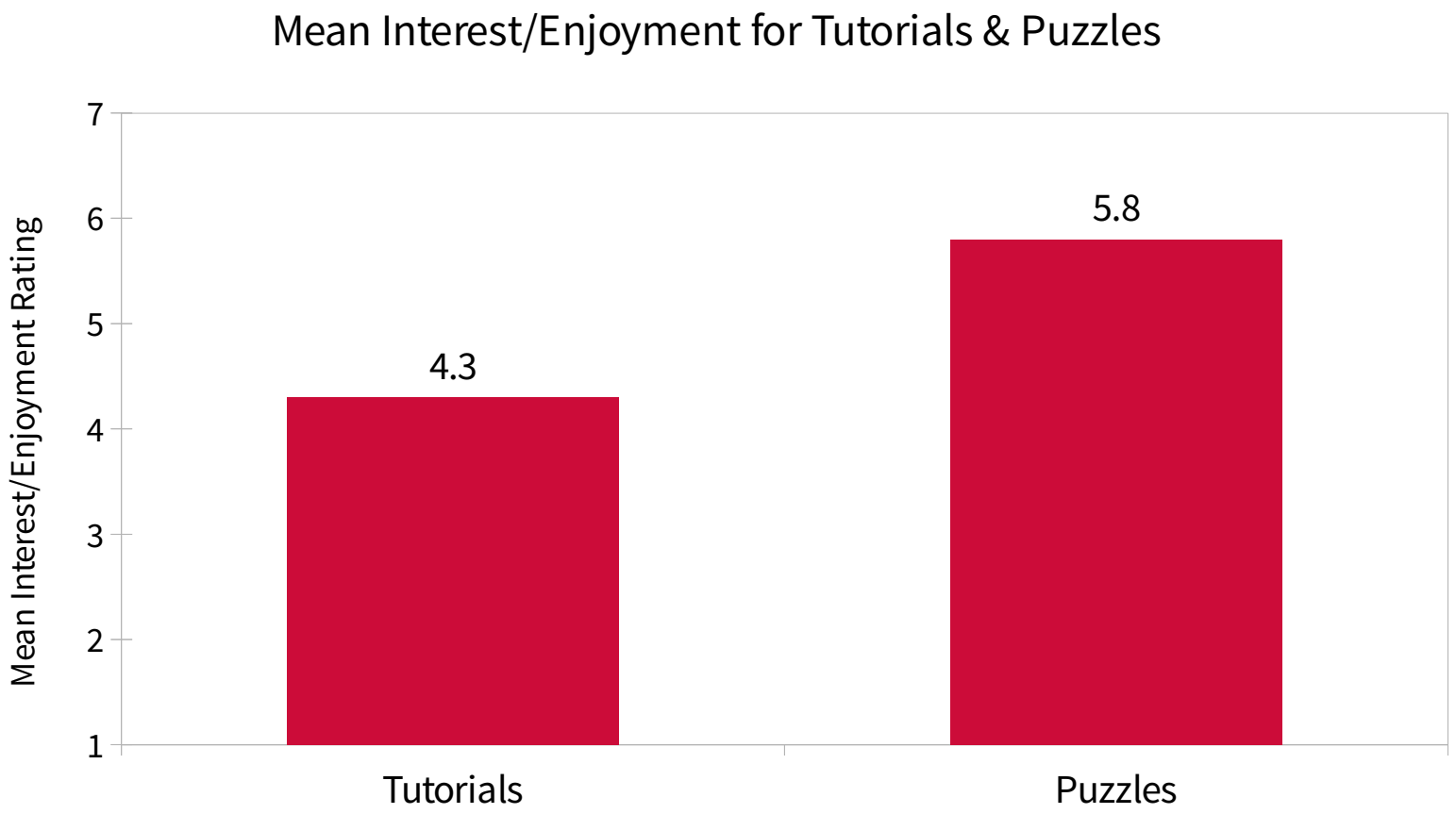
Post-Study Interview: Which do you enjoy more?



Intrinsic Motivation Inventory Survey: Interest/Enjoyment Subscale

$p < .001$



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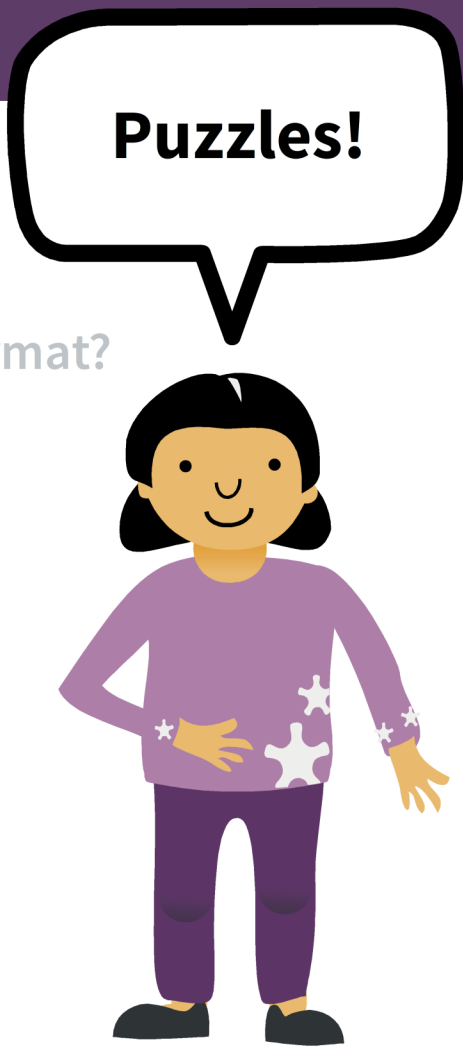
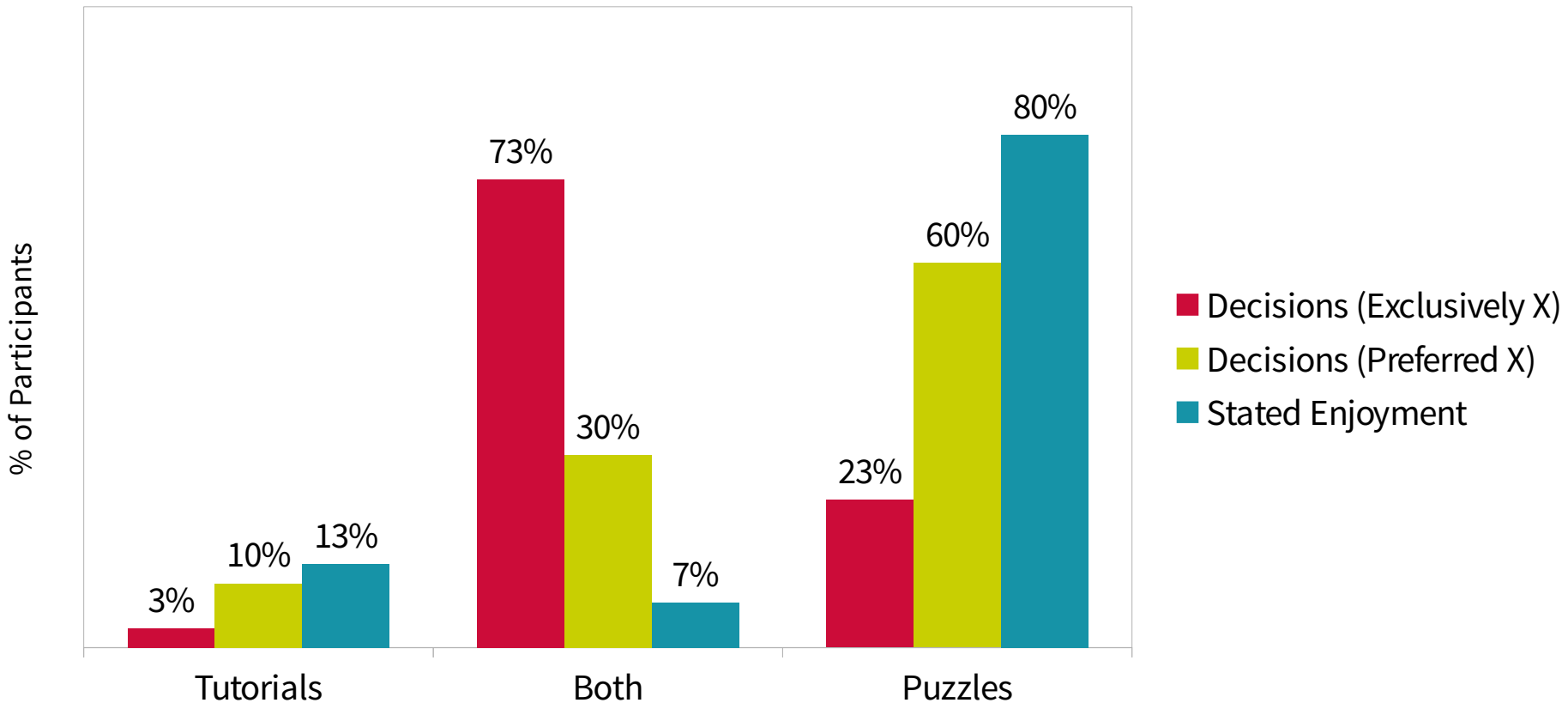


Decisions vs. Stated Enjoyment



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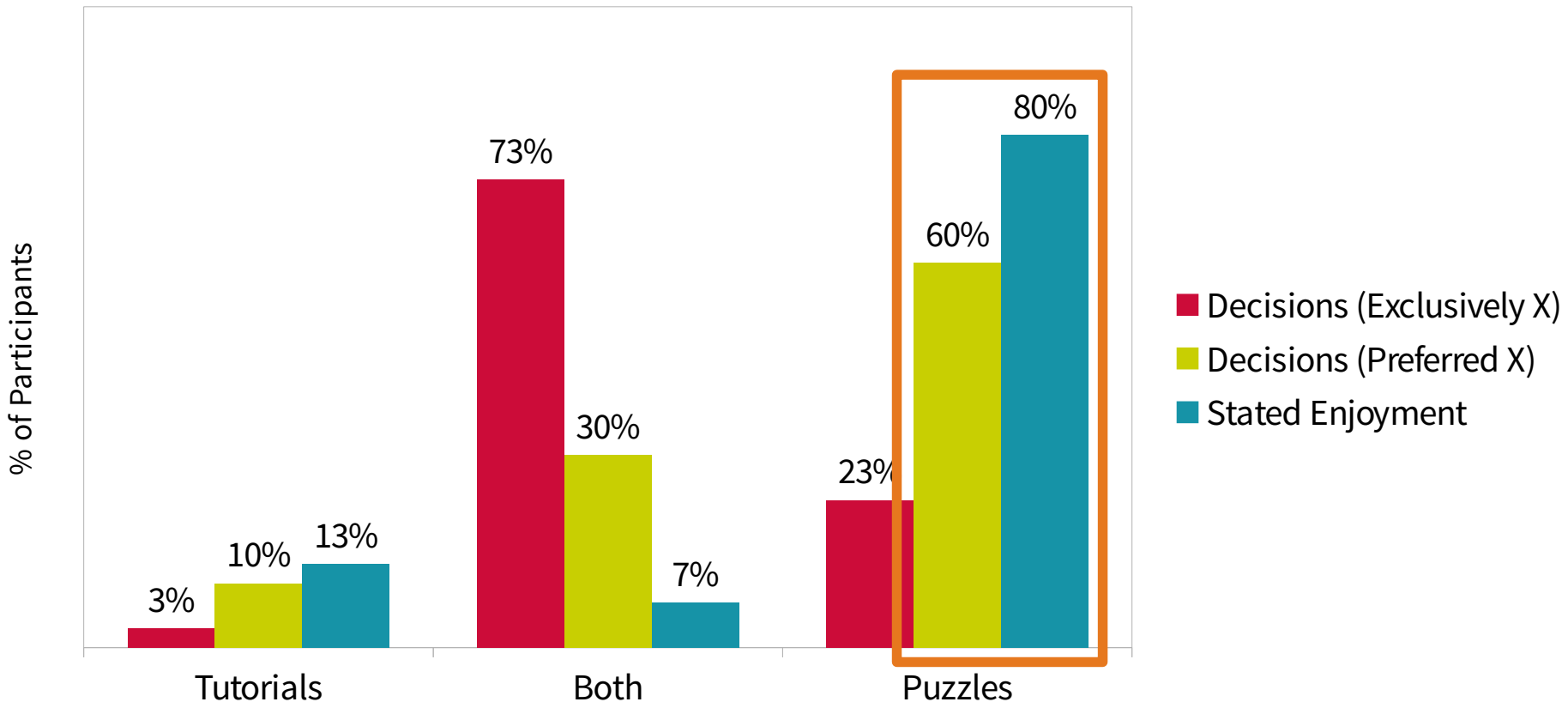
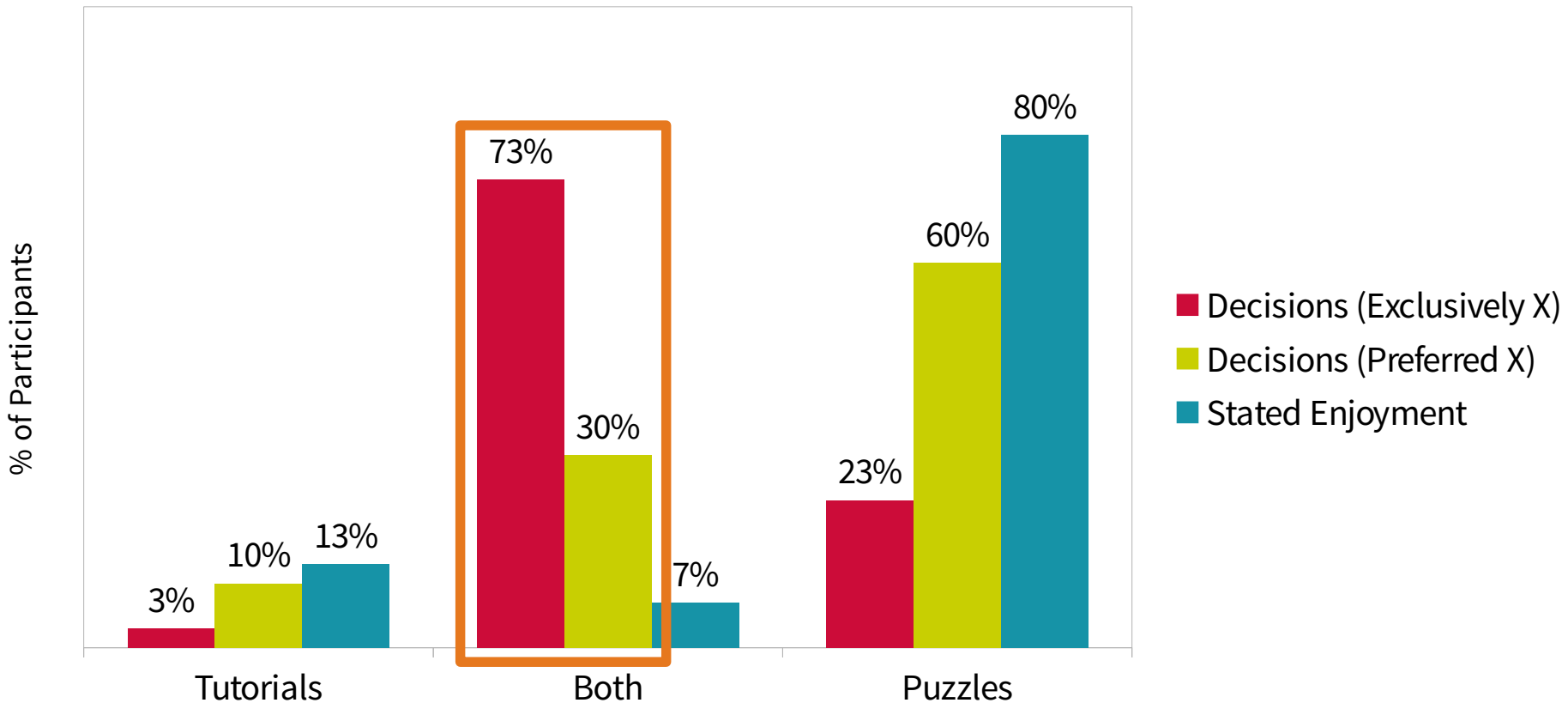


Decisions vs. Stated Enjoyment

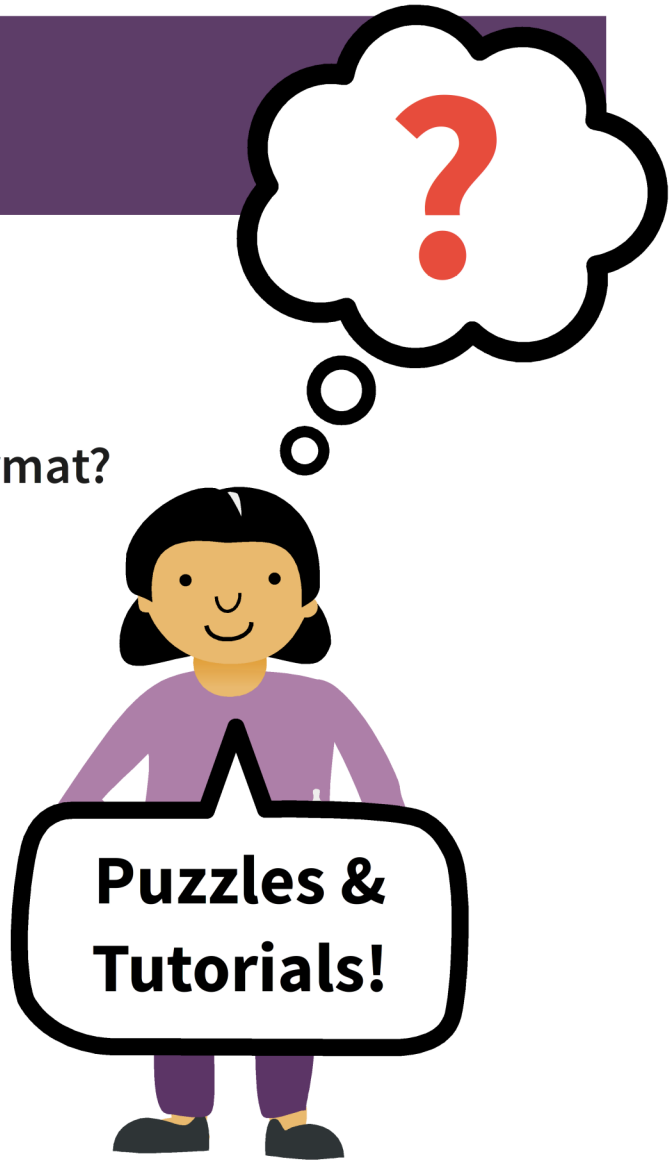


Research Questions

What decisions do users make and why?

Are code puzzles more motivating than tutorials?

What are users perceptions of value for each instructional format?



Exploratory Study: Data Summary

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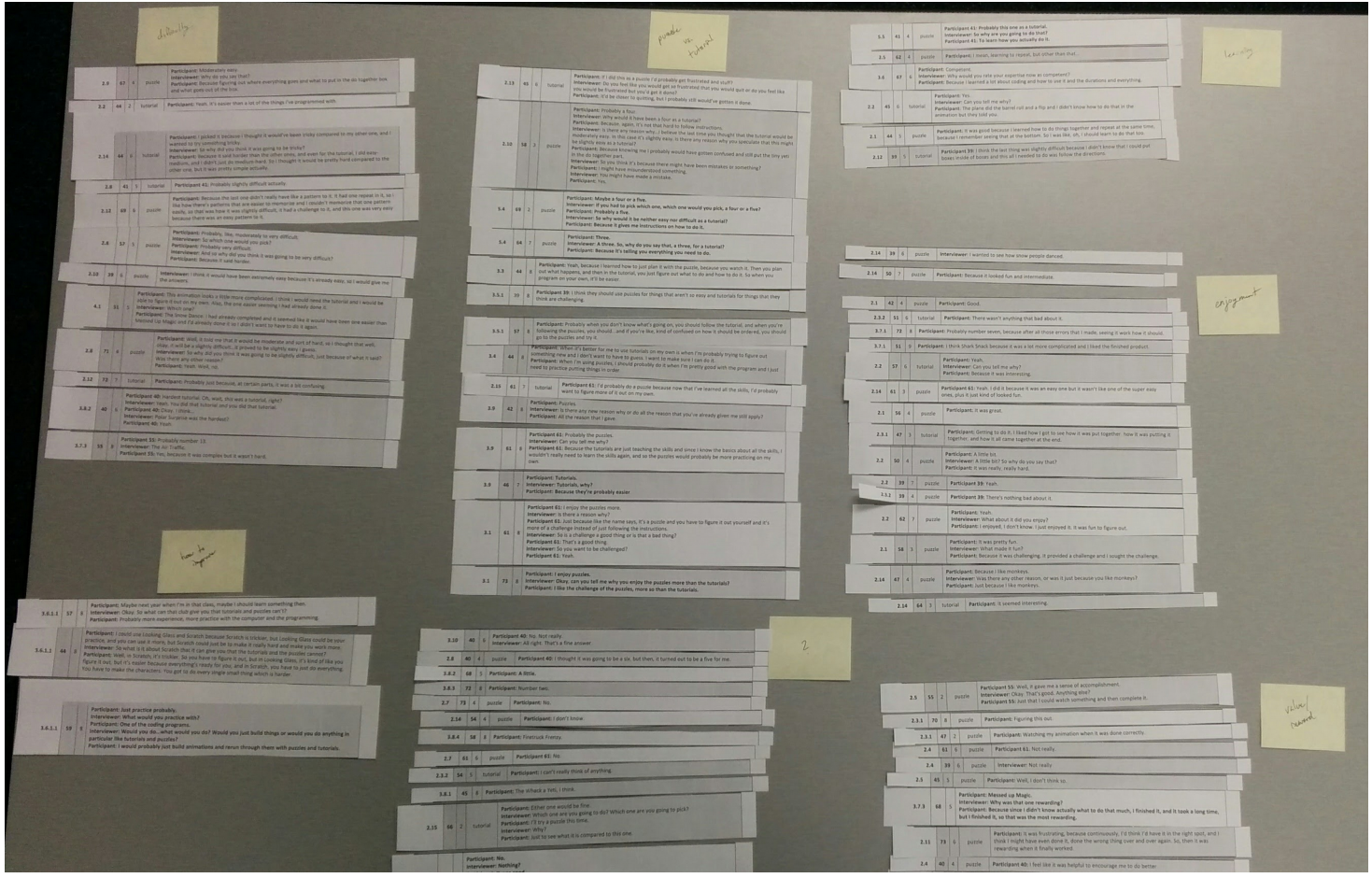
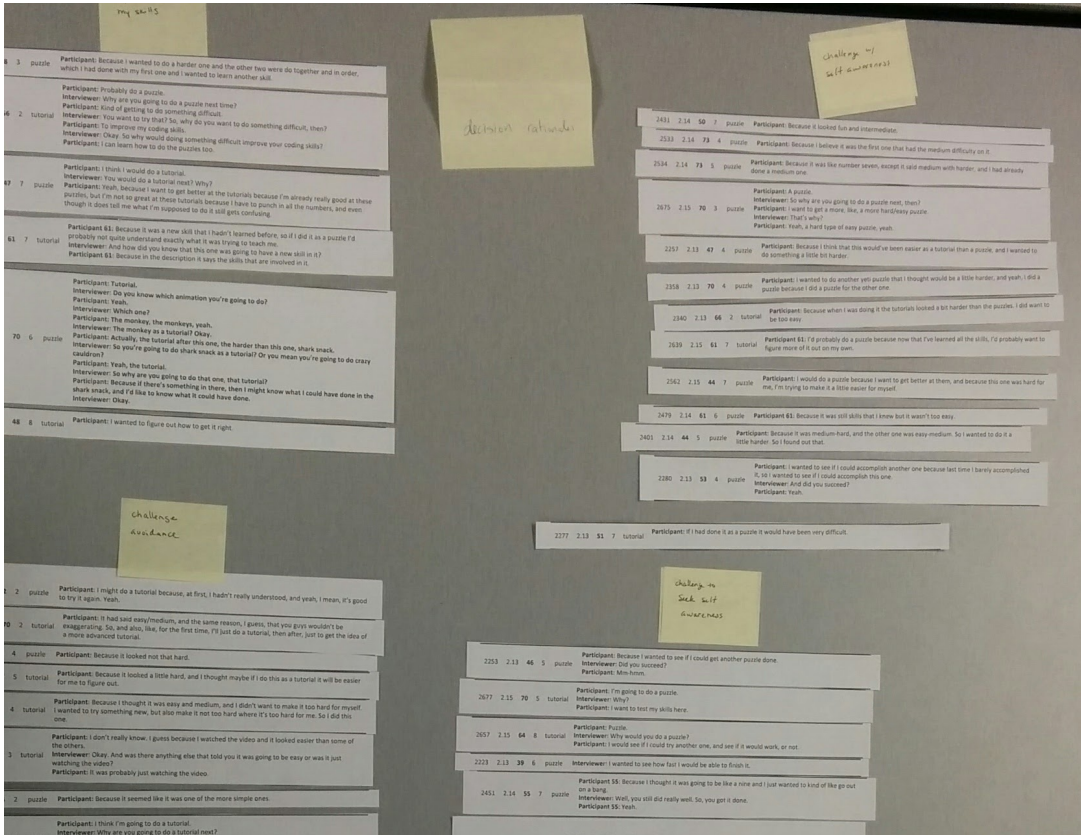
Interview Response Analysis: High-Level Categories



Response Analysis – Interrator Agreement

	Cohen's κ	***p***
High-Level Categories	.95	$p < .001$
Decision Rationales		
Experience Outcomes		
Expected Task Difficulty		
Sources of Ease & Difficulty		

2nd Round: Category Sub-labels (Themes)



Decision Rationales Sub-labels

High-Level Category Themes – Interrator Agreement

	Cohen's K	***p***
High-Level Categories	.95	p < .001
Decision Rationales	.89	p < .001
Experience Outcomes	.86	p < .001
Expected Task Difficulty	.85	p < .001
Sources of Ease & Difficulty	.88	p < .001

Decision Rationale Themes

	Cohen's K	*p*
High-Level Categories	.95	p < .001
Decision Rationales	**.89**	**p < .001**
Experie		p < .001
Expected		p < .001
Sources of Ease & Difficulty	.88	p < .001

Personal Preference

Improve Programming Skills

Challenge

Decision Rationale Themes

Personal Preference

Improve Programming Skills

Challenge

Enjoyed Animation

“Probably just because it looked like a fun animation to do.”

83% of participants enjoyed the animation

Decision Rationale Themes

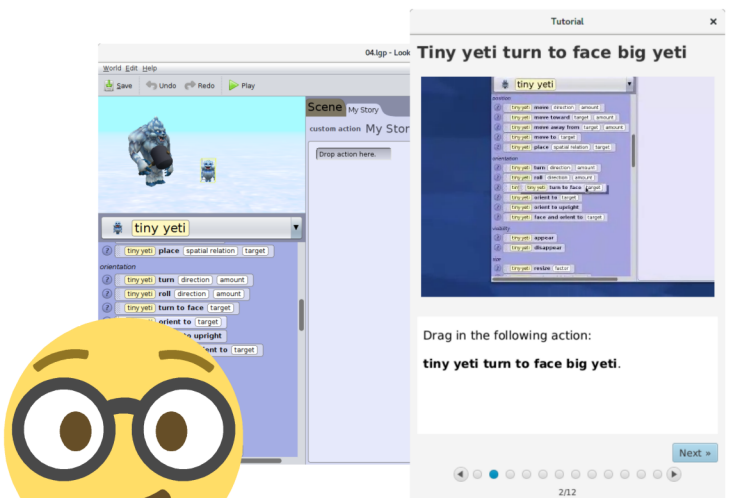
Personal Preference

Improve Programming Skills

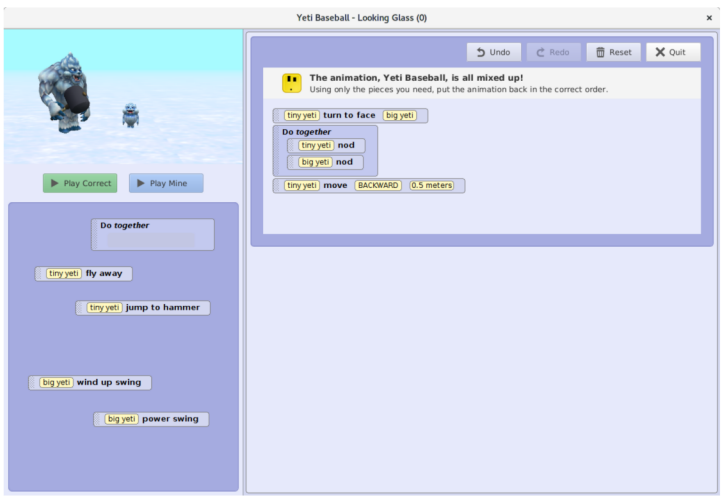
Challenge

Improve Programming Skills

“Because it was a new skill that I hadn't learned before, so if I did it as a puzzle I'd probably not quite understand exactly what it was trying to teach me.”



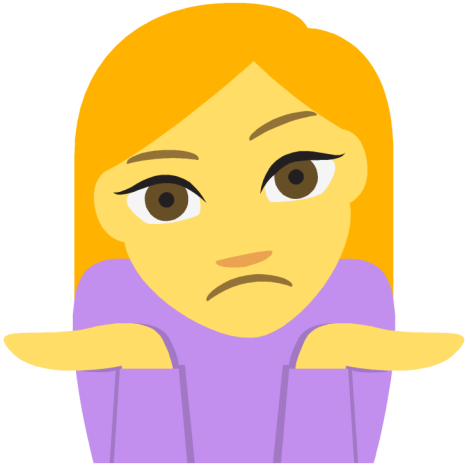
Choose Tutorial
19% of Tasks



Choose Puzzle
7% of Tasks

Discover Skill Level

“I wanted it to be a little harder than the tutorial because I wanted to see if if it'd make a big difference or not.”



Discover Skill Level
21% of Tasks

Decision Rationale Themes

Personal Preference

Improve Programming Skills

Challenge

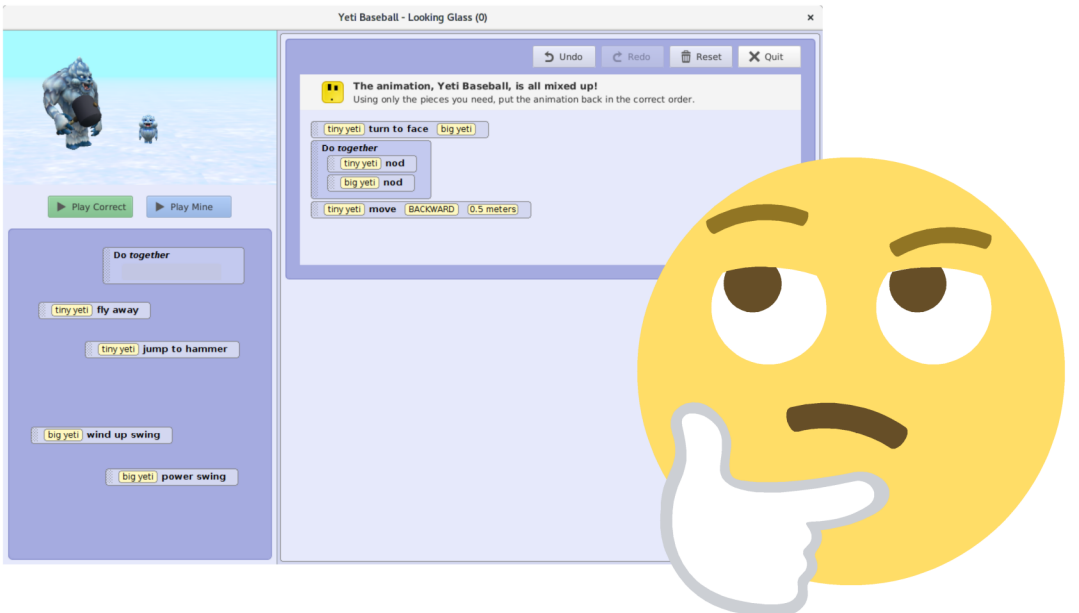
Challenge – Pushing Your Abilities

Sought Challenge
87% of Participants

Avoided Challenge
60% of Participants

Seeking Challenge

“I like having to challenge my mind more.”



57% of participants chose puzzles
32% chose tutorials

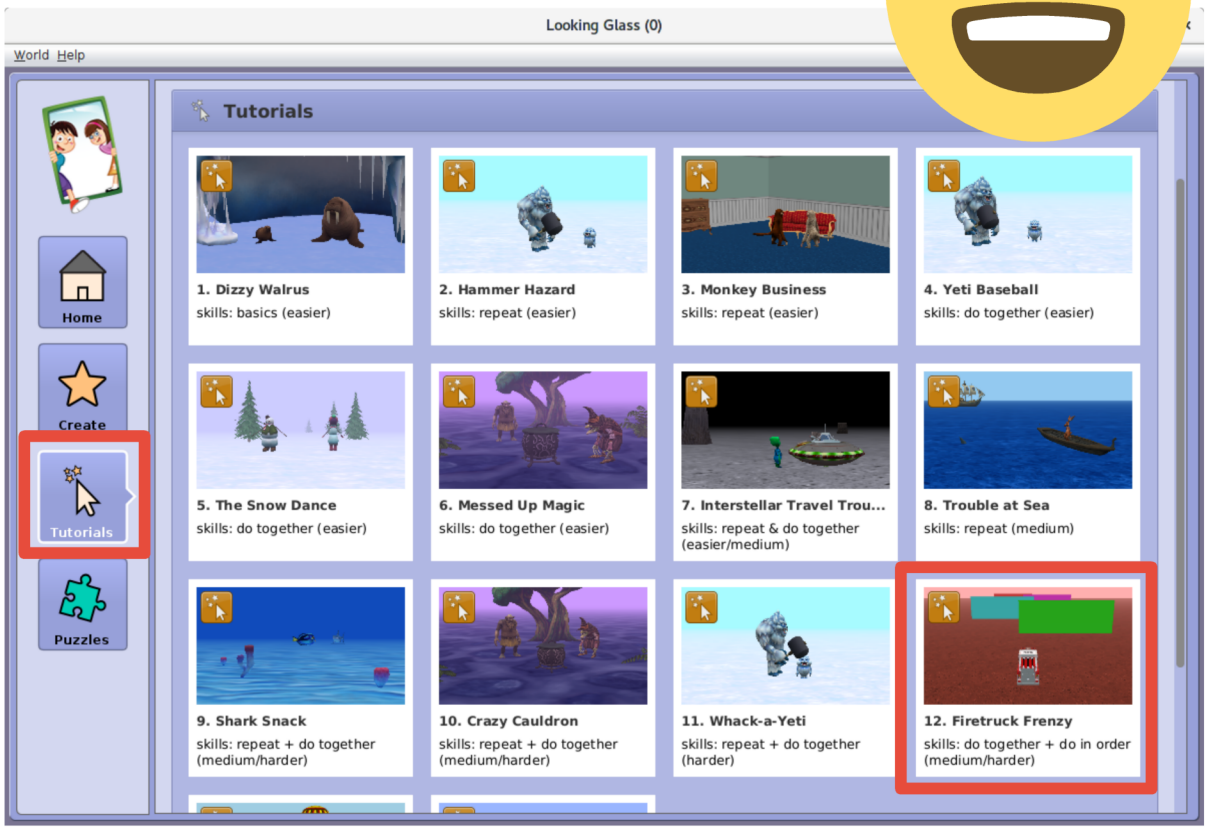
Avoiding Challenge – Do Something Easier

39% of participants chose tutorials
12% chose puzzles

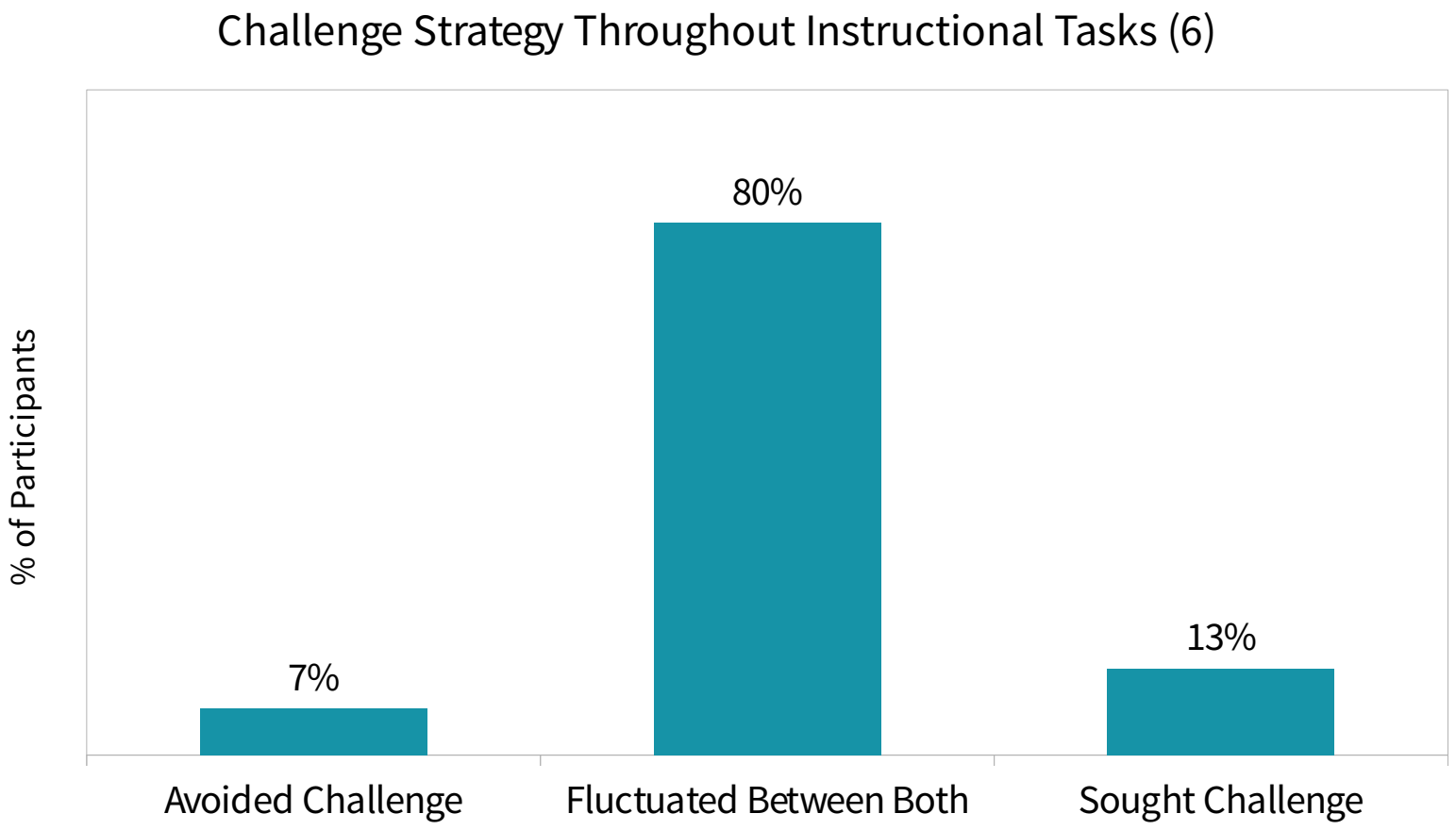
"I think I'm going to do mostly tutorials from now on because this was a bit hard."

Avoiding Challenge – Motivating Animation

“I picked it as a tutorial because it looked like it had lots more complexity than the other ones and I didn't want to just jump right in without knowing what I was doing.”



Challenge Seeking/Avoidance Strategy



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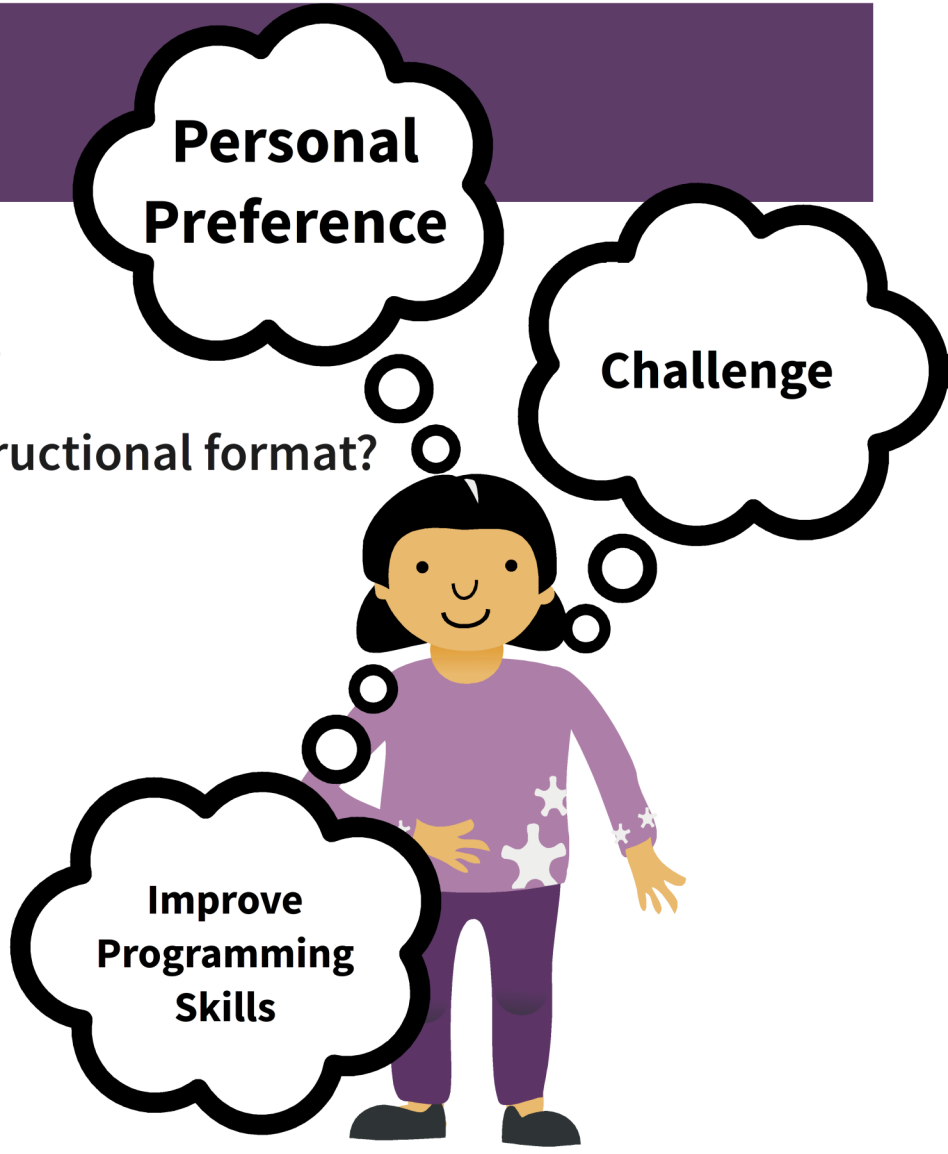


Considerations for Independent Learning Support in Novice Programming Environments

Support Multiple Levels of Challenge

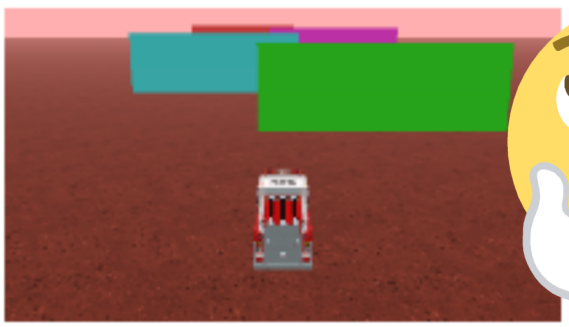
Support Skill Level Discovery

Leverage Motivation + Provide Choice

Support Multiple Levels of Challenge

1. Dizzy Walrus

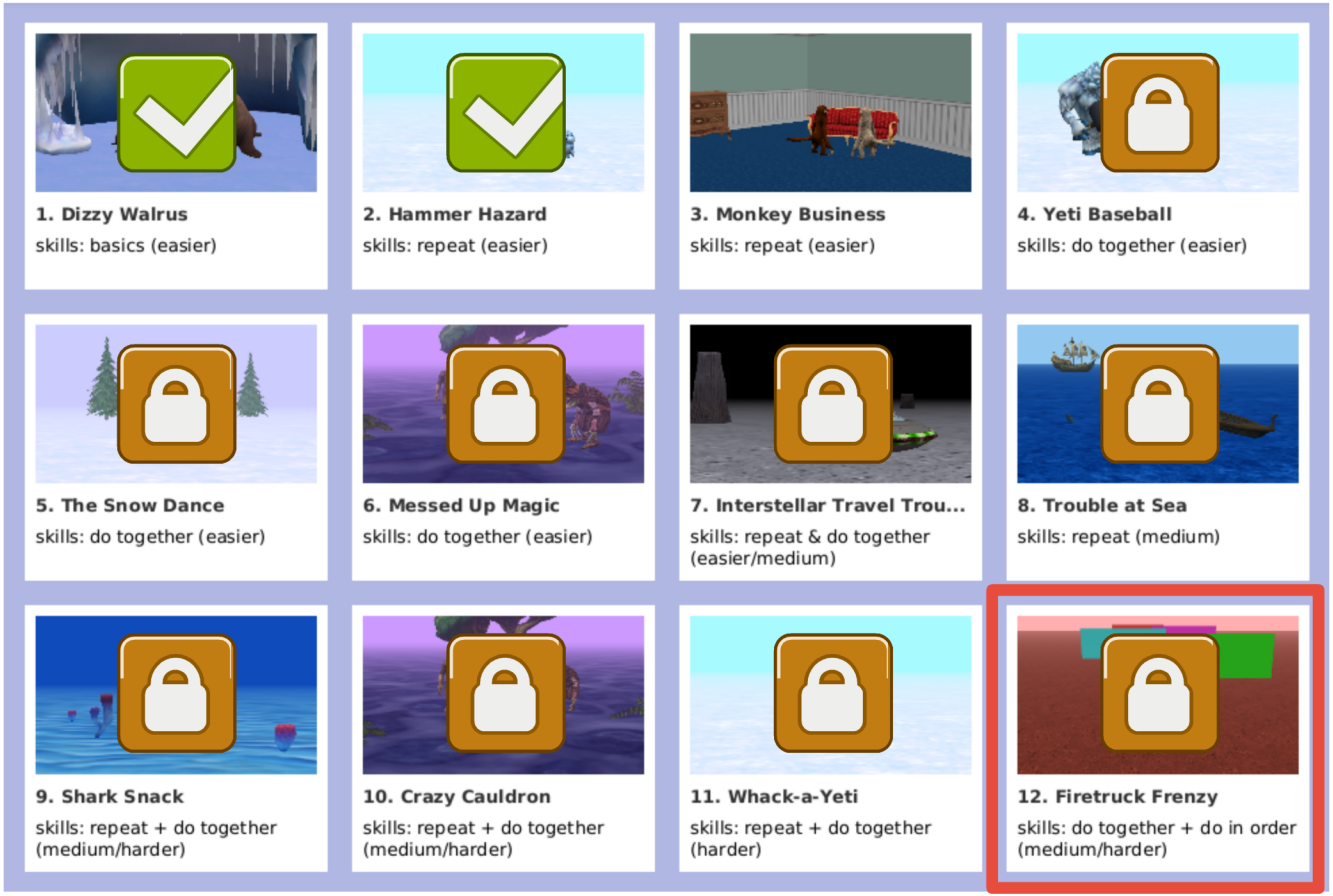
skills: basics (easier)



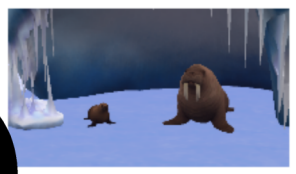
12. Firetruck Frenzy

skills: do together + do in order (medium/harder)

Support Skill Level Discovery



Leverage Motivation + Provide Choice



. Dizzy Walrus
ills: basics (easier)

2. Hammer Hazard
skills: repeat (easier)

3. Monkey Business
skills: repeat (easier)

4. Yeti Baseball
skills: do together (easier)

The Si Dance
ills: do to her (easier)

6. Messed Up Magic
skills: do together (easier)

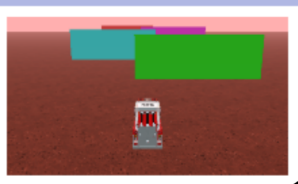
7. Interstellar Travel Trou...
skills: repeat & do together (easier/medium)

8. Trouble at Sea
skills: repeat (medium)

9. Shark Snack
skills: repeat + do together (medium/harder)

10. Crazy Cauldron
skills: repeat + do together (medium/harder)

11. Whack-a-Yeti
skills: repeat + do together (harder)



12. Firetruck Frenzy
skills: do together + do in order (medium/harder)

This animation is *challenging*

Follow a Tutorial

Solve a Puzzle

?

?

Questions

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