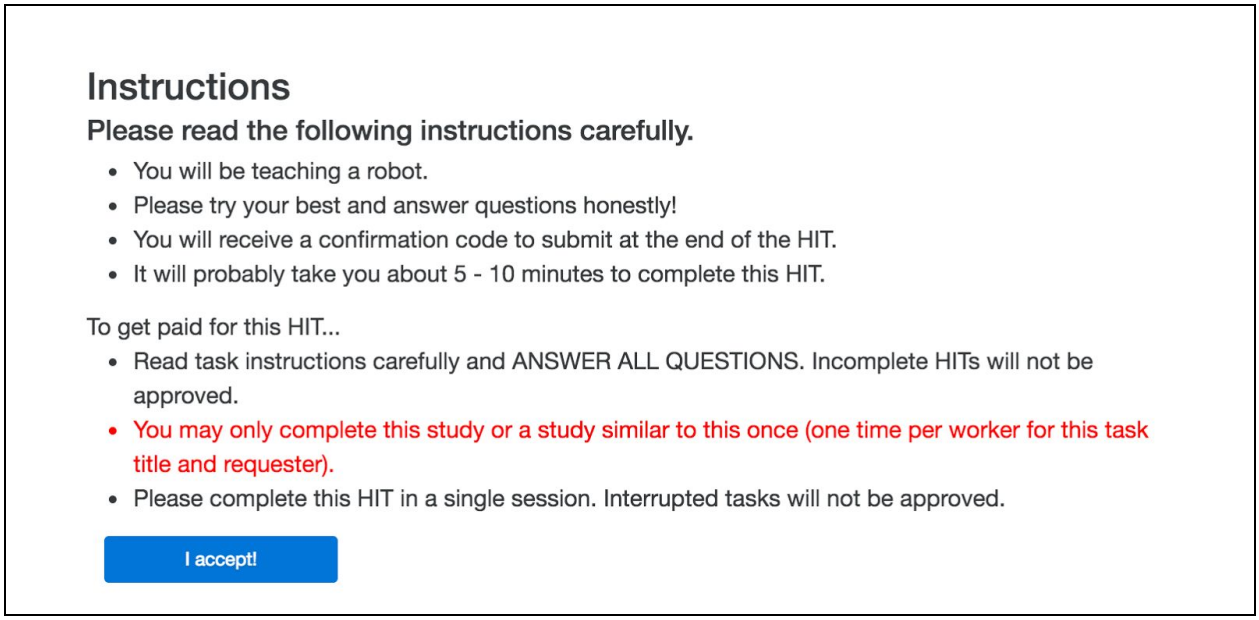
The Label Complexity of Mixed-Initiative Classifier Training

Supplementary Material - Experiment Flow

This document describes the flow and mechanics of the Mechanical Turk experiment along with the screenshots.

1. General Instructions

Participants are given identical instructions in all conditions. They must accept the instructions to proceed to the tasks.



2. Task Instructions

All participants are given identical task descriptions for the specific threshold or interval classifier.

(1) Threshold classifier task

Task

Imagine you are looking to buy a car. Car prices go from $10000 to $30000, but you will only accept a car priced at $**19000 or below**.

You have a robot assistant who knows that your acceptable price falls at or below a threshold, but it does not know what your acceptable threshold is.

Your task is to teach your robot what your acceptable threshold is:

- You can only give examples like "$_ is acceptable" or "$_ is unacceptable."
- You cannot afford any car over $19000 by even $1 because you only have $19000 in your bank account.
- Provide the **fewest number of examples** possible while still making sure your robot has clearly understood your price threshold.

(2) Interval classifier task

Task

Imagine you are looking to buy a car. Car prices go from $500 to $1500, but you will only accept a car in the range of $**1260** to $**1360**.

You have a robot assistant who knows that your acceptable price falls into a range, but it does not know what your acceptable range is.

Your task is to teach your robot what your acceptable price range is:

- You can only give examples like "$_ is acceptable" or "$_ is unacceptable."
- You believe any car under $1260 by even $1 will break down.
- You cannot afford any car over $1360 by even $1 because you only have $1360 in your bank account.
- Provide the **fewest number of examples** possible while still making sure your robot has clearly understood your price range.

2.1. Teacher education by analogues

If the participant is in the teacher education by analogues condition, the optimal teaching sets for two other hypothetical problems are displayed below the task instructions.

(1) Threshold classifier task

Hints

- If your price threshold was $20000 or below, you could show your robot these 2 examples: $20000 is acceptable, $20001 is unacceptable
- If your price threshold was $24000 or below, you could show your robot these 2 examples: $24000 is acceptable, $24001 is unacceptable

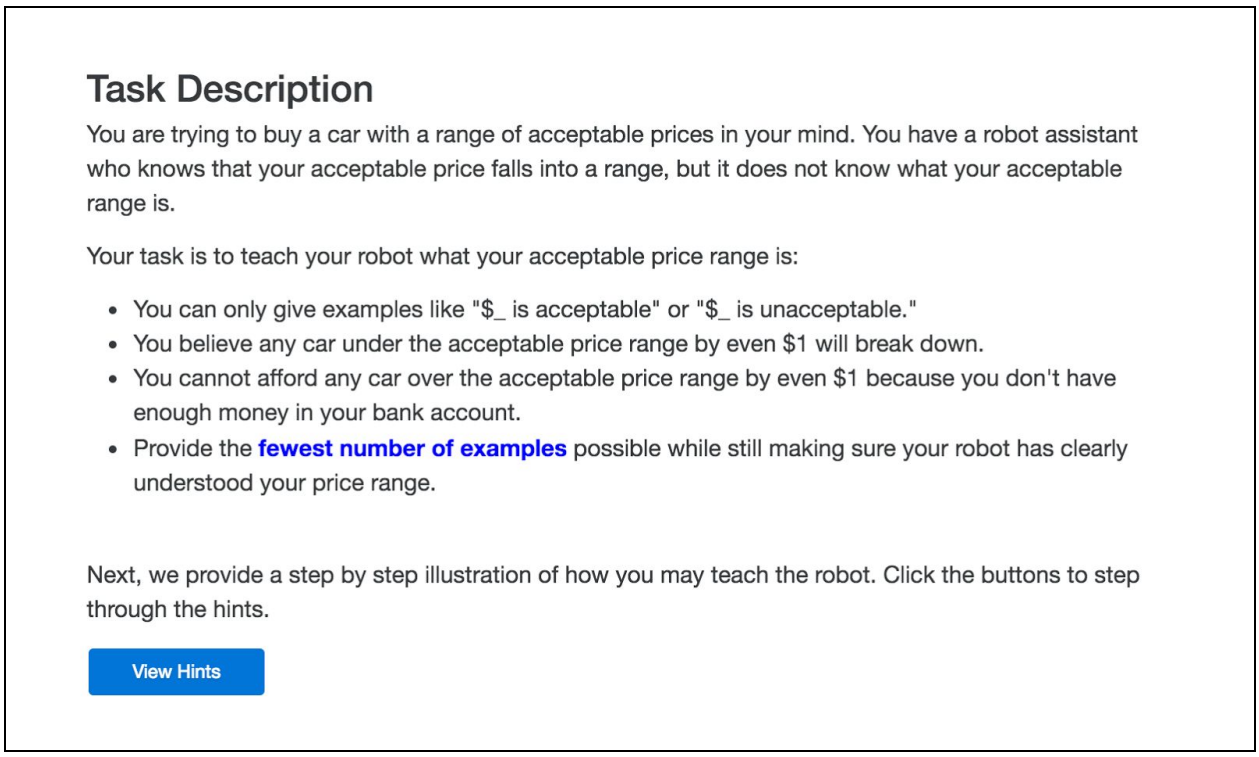
(2) Interval classifier task

Hints

- If your price range were $900 to $1000, you could show your robot these 4 examples: $899 is unacceptable, $900 is acceptable, $1000 is acceptable, $1001 is unacceptable.
- If your price range were $600 to $700, you could show your robot these 4 examples: $599 is unacceptable, $600 is acceptable, $700 is acceptable, $701 is unacceptable.

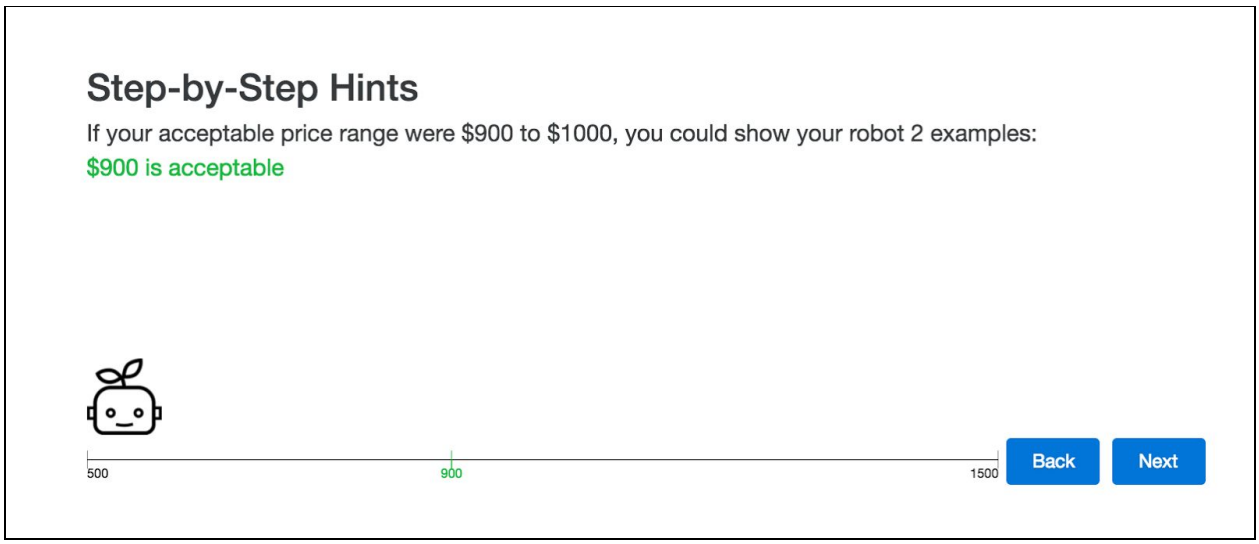
2.2. Teacher education by explanation

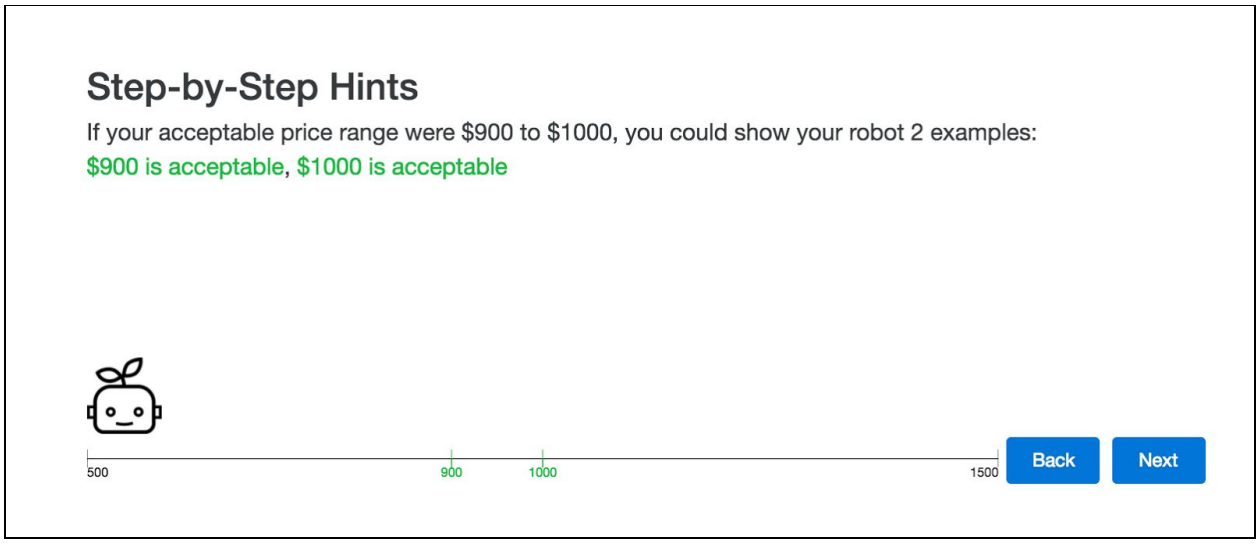
If the participant is in the teacher education by explanation condition (only applicable to interval classifier task), before proceeding to the actual task, the participants are shown step-by-step tutorial for a hypothetical problem with three quizzes that they can page through.



2.2.1 Detailed Explanation of Optimal Teaching Set

At first, we provide a detailed explanation for a hypothetical problem with acceptable ranges between $900 and $1000. We illustrate the effect of providing examples and labels on the robot's hypothesis space with a number line visualization.





Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable

Okay, if $900 and $1000 are acceptable, all prices **in-between** must also be acceptable!

Back Next

Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable

But wait... I'm still not completely sure what is unacceptable. Please clarify.

Back Next

Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable.

To make your unacceptable ranges clear, you could show your robot that:

But wait... I'm still not completely sure what is unacceptable. Please clarify.

Back Next

Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable.

To make your unacceptable ranges clear, you could show your robot that:
$899 is unacceptable

But wait... I'm still not completely sure what is unacceptable. Please clarify.

Back Next

Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable.

To make your unacceptable ranges clear, you could show your robot that:
$899 is unacceptable

Okay, if $900 to $1000 is acceptable **and** $899 is unacceptable, then all prices below $899 must also be unacceptable!

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Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable.

To make your unacceptable ranges clear, you could show your robot that:
$899 is unacceptable

But wait... What about prices $1001 and above?

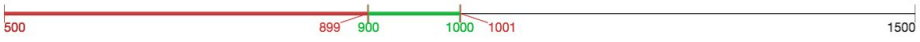
Back Next

Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable.

To make your unacceptable ranges clear, you could show your robot that:
$899 is unacceptable **AND** $1001 is unacceptable.

But wait... What about prices $1001 and above?



Back Next

Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable.

To make your unacceptable ranges clear, you could show your robot that:
$899 is unacceptable **AND** $1001 is unacceptable.

Okay, if $900 to $1000 is acceptable **and** $1001 is unacceptable, then all prices above $1001 must also be unacceptable!

Back Next

Step-by-Step Hints

If your acceptable price range were $900 to $1000, you could show your robot 2 examples:
$900 is acceptable, $1000 is acceptable.

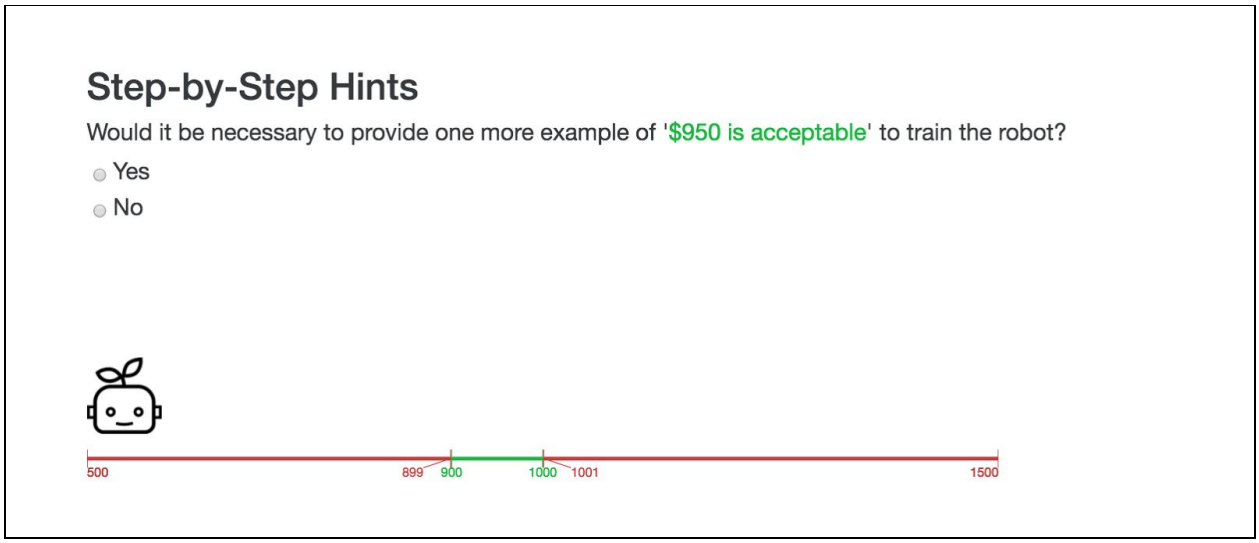
To make your unacceptable ranges clear, you could show your robot that:
$899 is unacceptable **AND** $1001 is unacceptable.

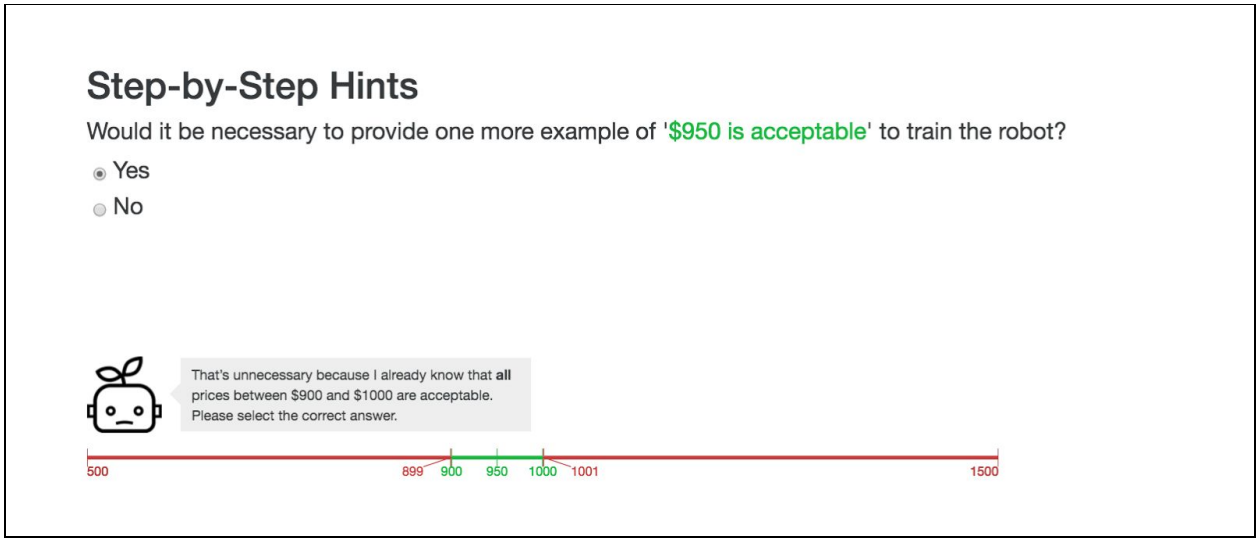
Ah ha! Now its completely clear that the only acceptable price range is $900 to $1000!

Back Got it!

2.2.2 Quizzes

We then provide 3 short quizzes to probe the participants and provide explanations for answers.





Step-by-Step Hints

Would it be necessary to provide one more example of '$950 is acceptable' to train the robot?

- ○ Yes
- ◉ No

Correct! I already know that $950 is acceptable!

Back Got it!

Step-by-Step Hints

Would it be necessary to provide either '$500 is unacceptable' or '$1500 is unacceptable' as additional examples?

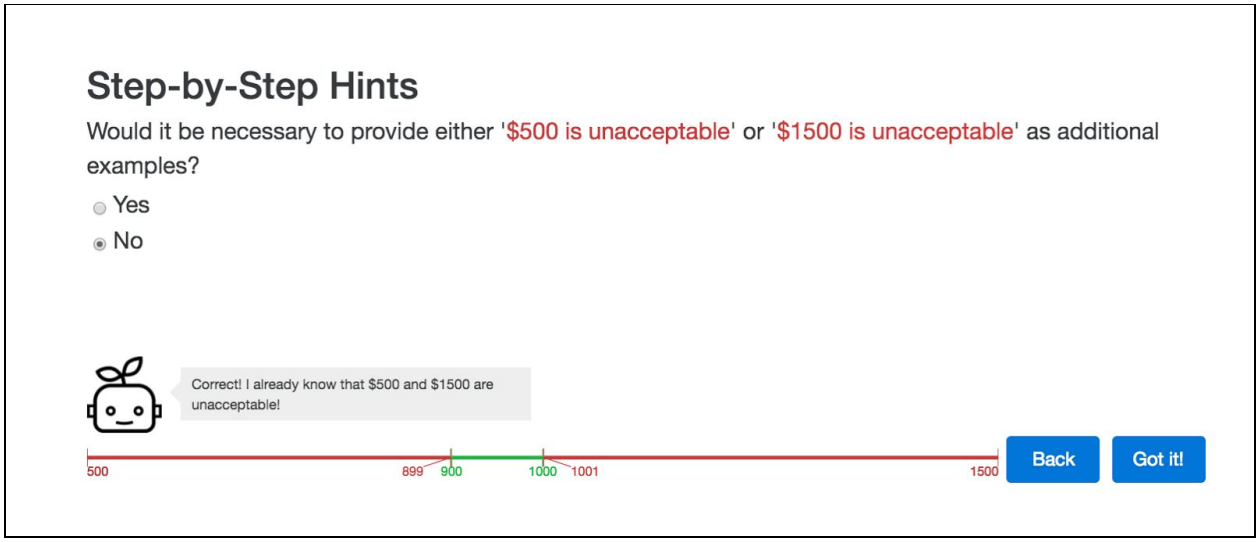
- ○ Yes
- ○ No

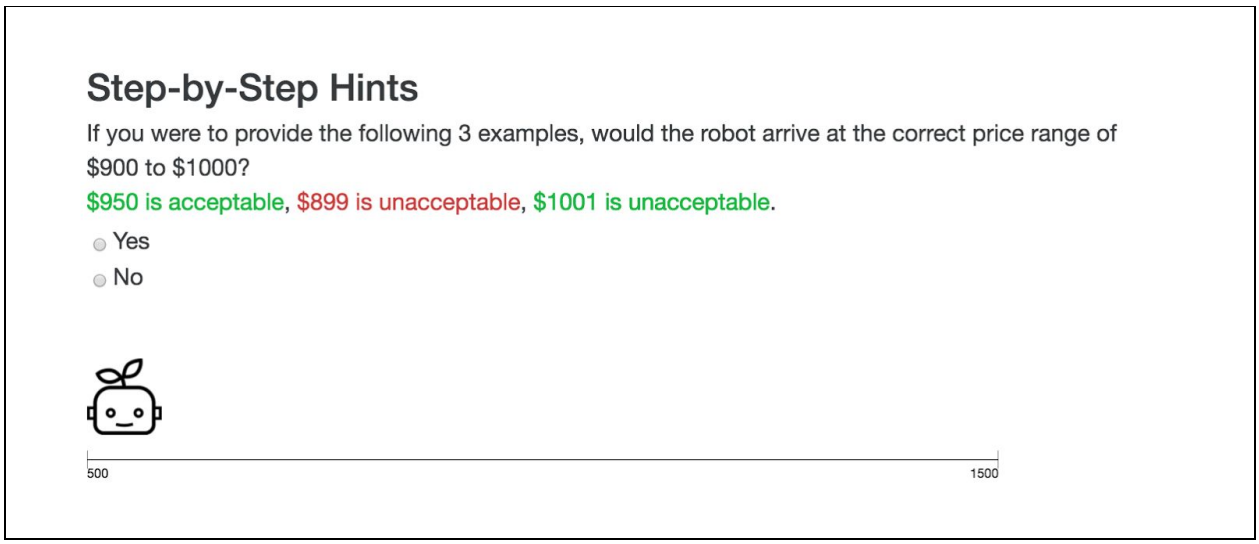
Step-by-Step Hints

Would it be necessary to provide either '$500 is unacceptable' or '$1500 is unacceptable' as additional examples?

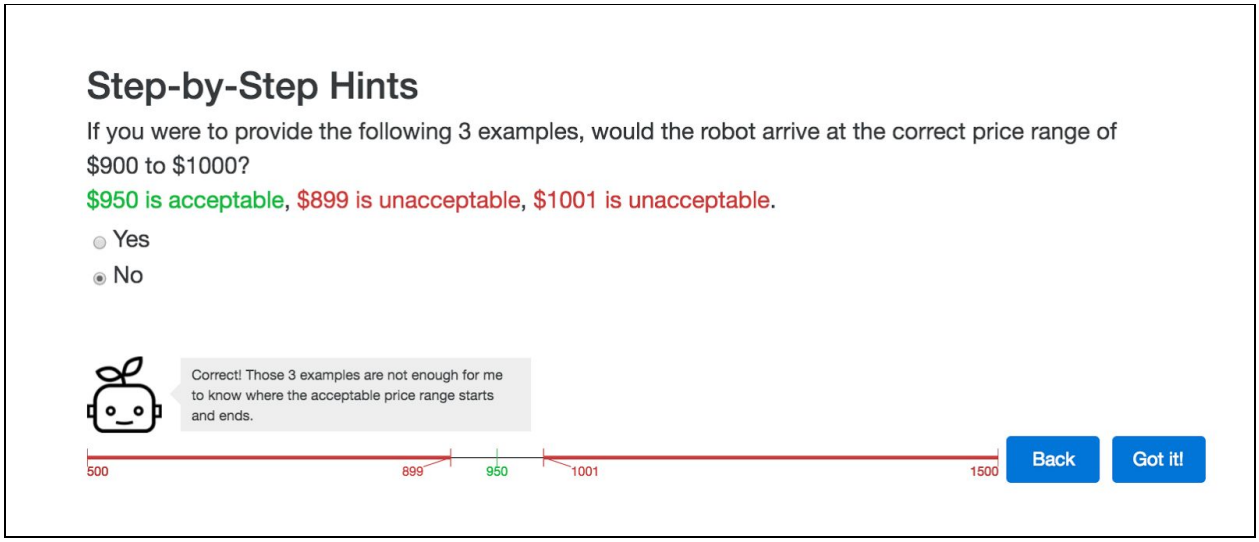
- ◉ Yes
- ○ No

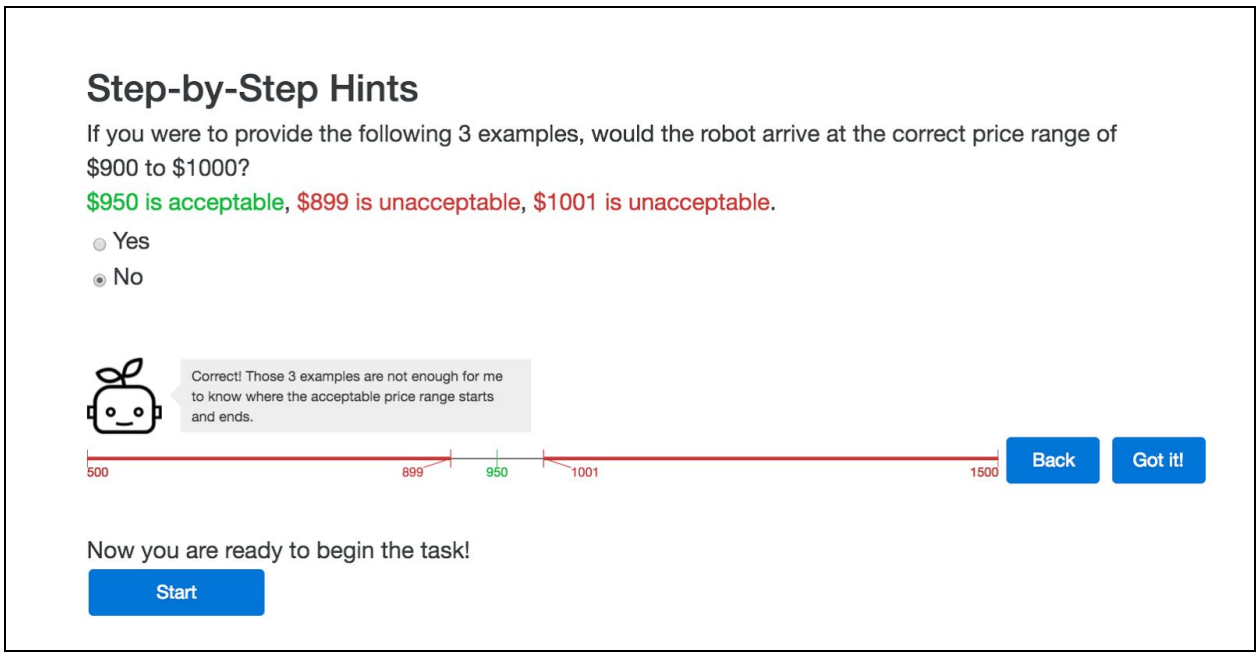
I already know that! Please select the correct answer.





* Note: We displayed the incorrect font color for "$1001 is unacceptable".


Step-by-Step Hints
If you were to provide the following 3 examples, would the robot arrive at the correct price range of $900 to $1000?
$950 is acceptable, $899 is unacceptable, $1001 is unacceptable.
Yes
No
Correct! Those 3 examples are not enough for me to know where the acceptable price range starts and ends.
500
899
950
1001
1500
Back
Got it!

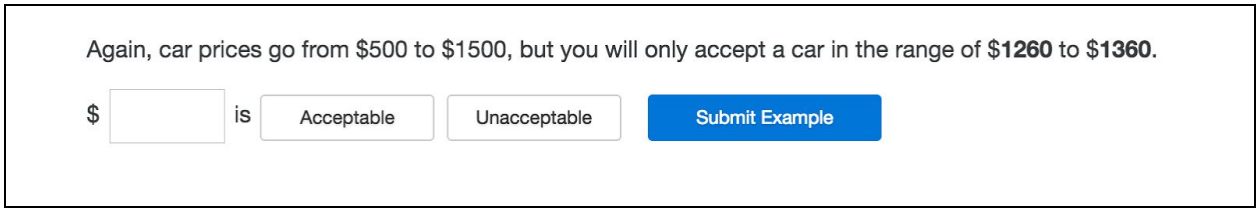

Step-by-Step Hints
If you were to provide the following 3 examples, would the robot arrive at the correct price range of $900 to $1000?
$950 is acceptable, $899 is unacceptable, $1001 is unacceptable.
Yes
No
Correct! Those 3 examples are not enough for me to know where the acceptable price range starts and ends.
500
899
950
1001
1500
Back
Got it!
Now you are ready to begin the task!
Start

3. Task Input

Once the participants start their task, they are asked to provide example-label set in the human-initiated and mixed-initiative condition with an option to terminate teaching and to provide only labels in the computer-initiated condition until the active learning algorithm is able to converge.

3.1. Human-Initiated Input

The participant is reminded of their allowed input ranges and target threshold or ranges and is asked to provide the example value and its label (acceptable or unacceptable).

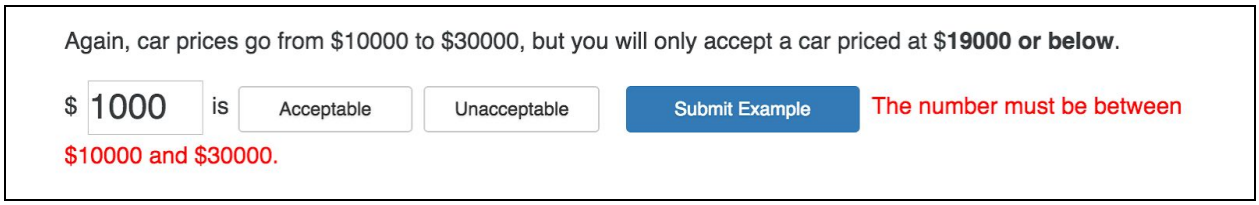


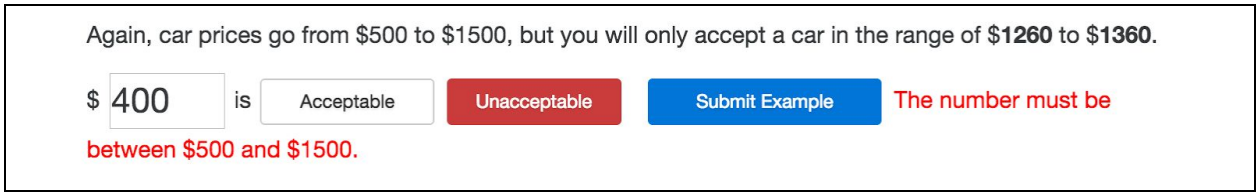
3.2 Input Validation Feedback

In the conditions where example-label set is requested, we provide feedback to the user such that only valid examples and labels can be submitted.

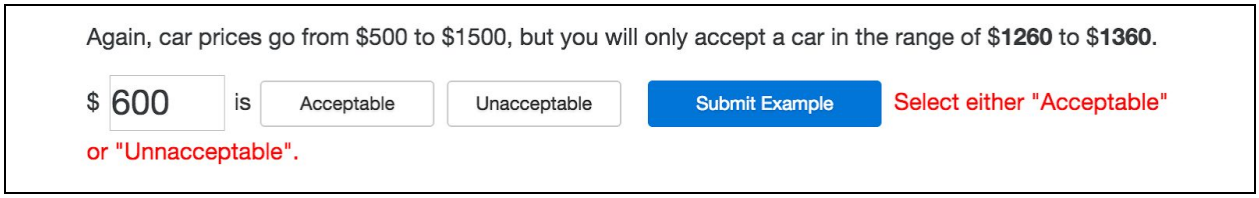
(1) Input textbox only accepts only numerical keys 0 through 9. All other keys will be ignored.

(2) Any value outside of the input range is not allowed.





(3) An example must be submitted with a label.

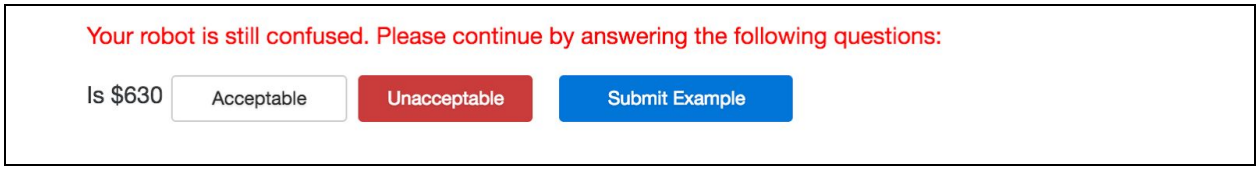


3.3. Teaching Termination

On every example-label set submission in human-initiated condition or on the first TD example-label set submissions in mixed-initiative condition, the participant can opt to continue teaching or to terminate teaching.

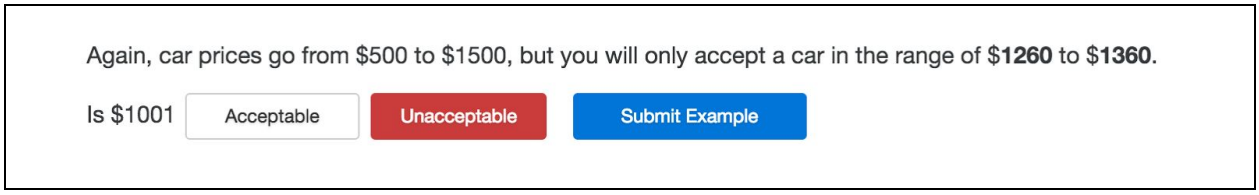
3.4. Mixed-Initiative Input

If the participant terminates their teaching before TD example-label sets are provided or the algorithm cannot determine the threshold or interval based on the provided example-label sets in the mixed-initiative condition, the active learning takes over and asks the participant to provide labels until it can reach a conclusion.



3.5. Computer-Initiated Input

In the computer-initiated condition, the participant is asked to provide the label for examples provided by the active learning algorithm until the algorithm is able to reach a conclusion.

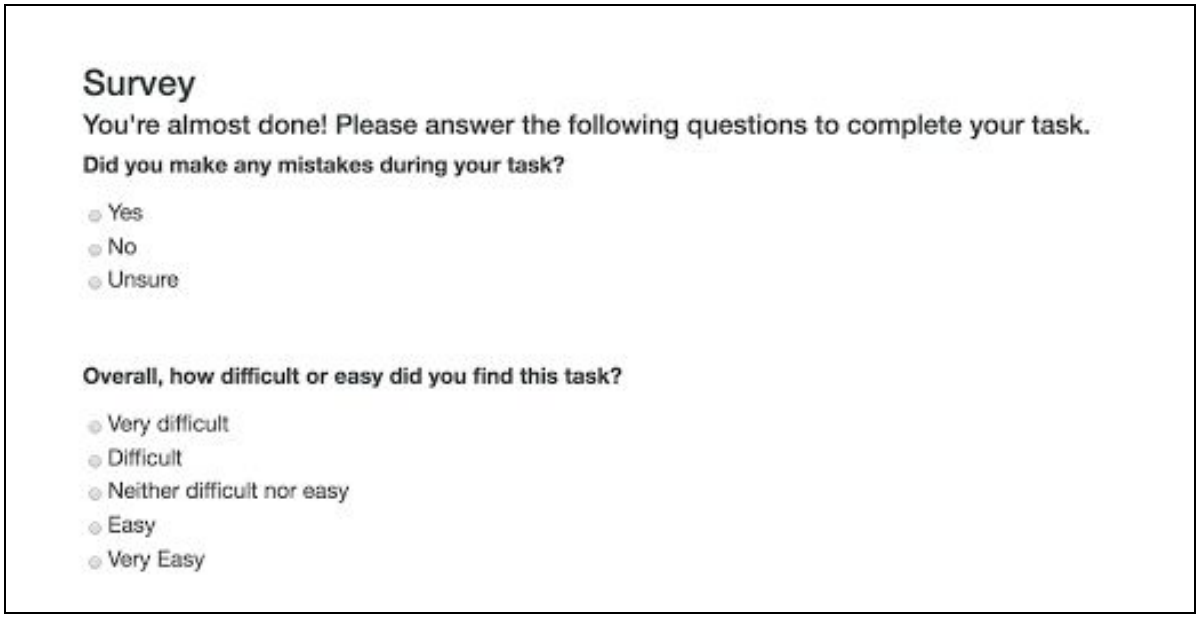


4. Survey

All participants were asked to fill out a survey, and the survey is displayed in a single page.

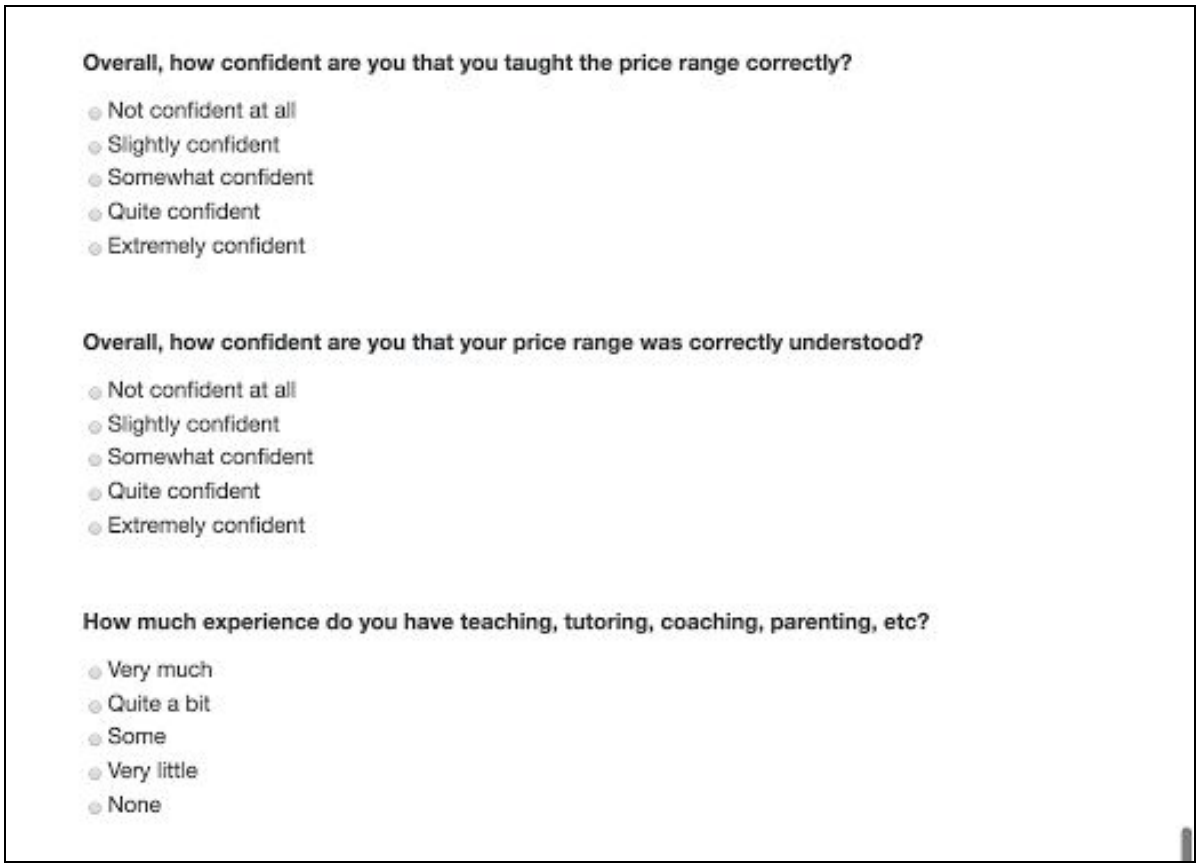
4.1. Mistakes and Difficulty

Participants are asked to recall if they had made any mistakes and to rate the difficulty of the task.



4.2. Teaching Confidence and Experience

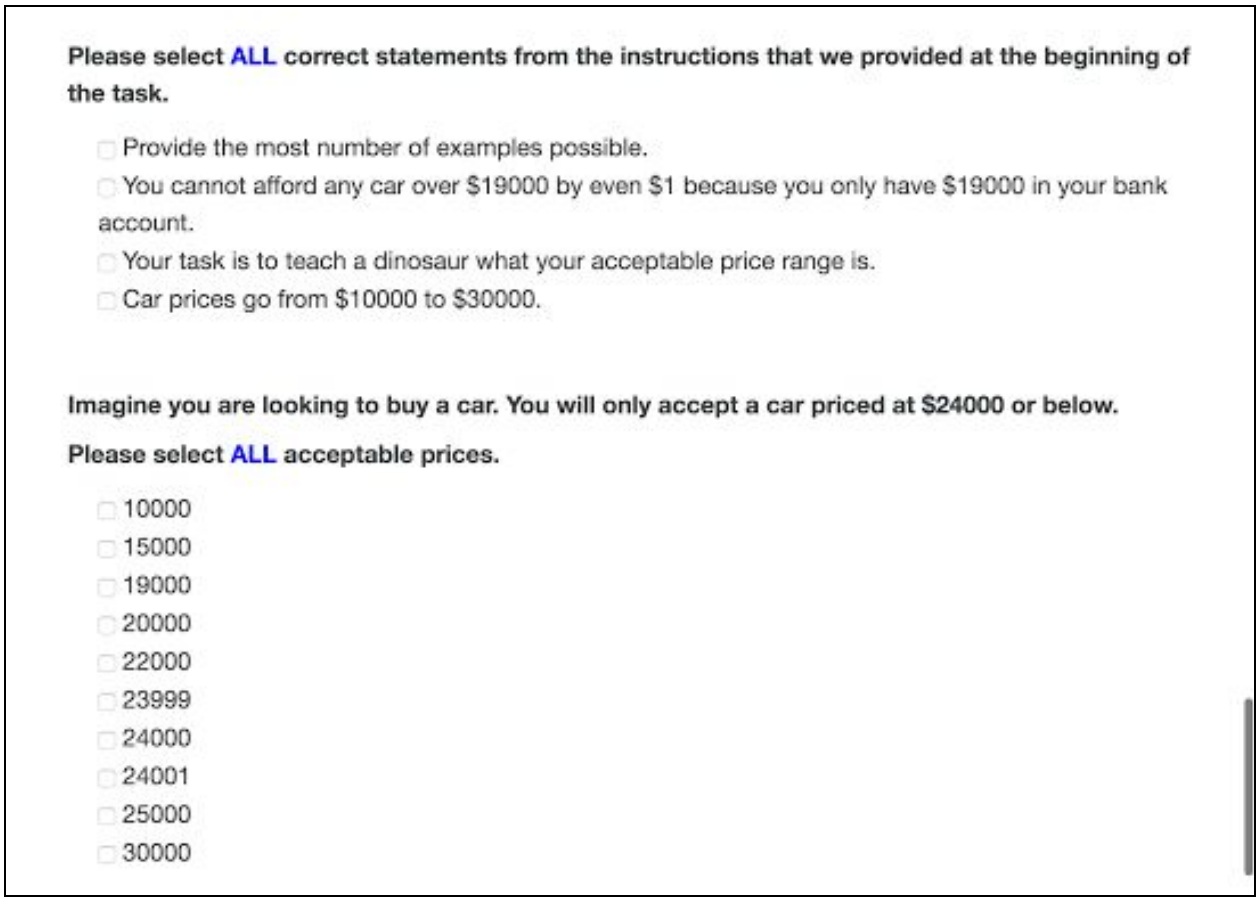
Participants are asked to rate their confidence in teaching, their confidence in the robot's understanding of their teaching, and their teaching experience.



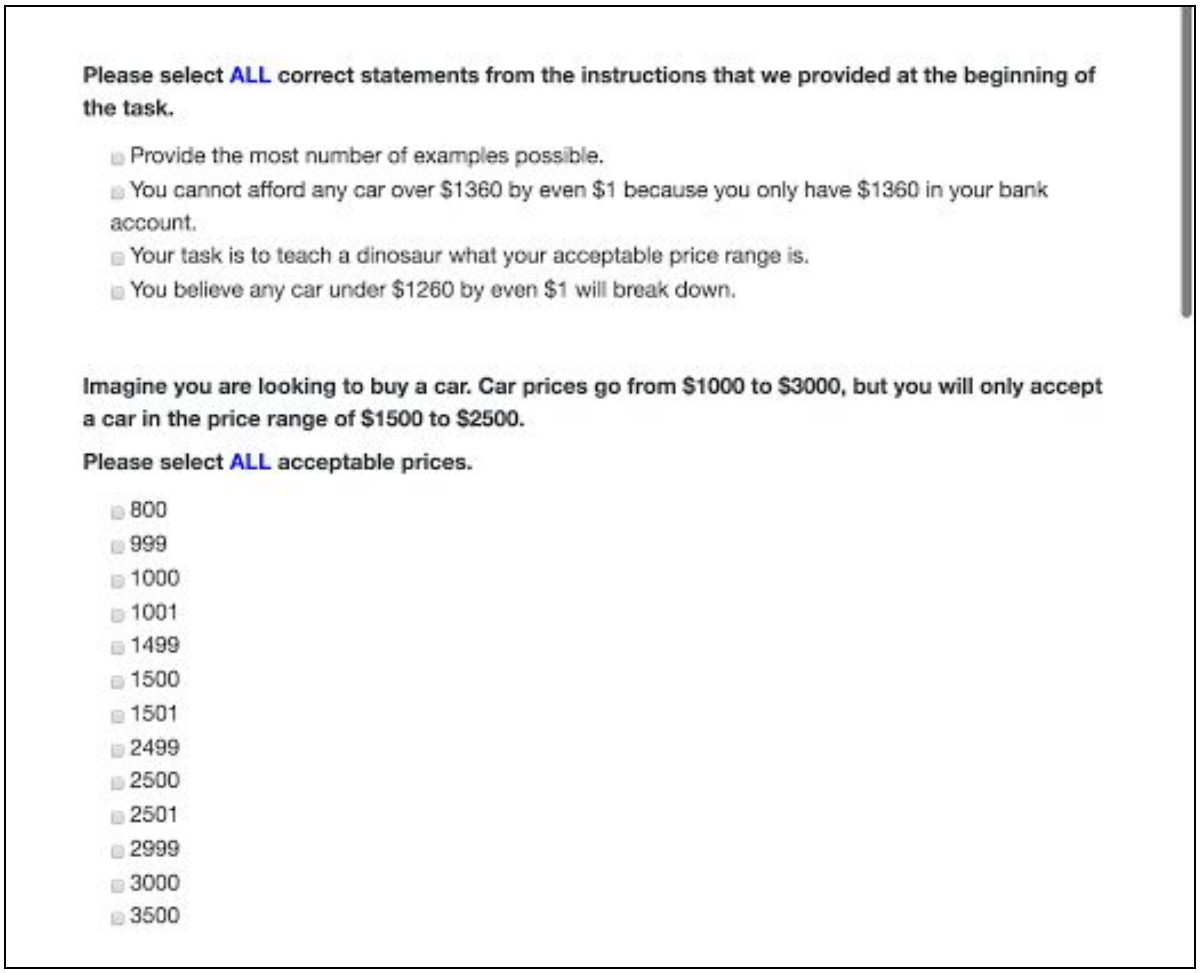
4.3. Attention and Numeracy

Two questions were specifically added to test for the participant's attention to detail and to see if the participant understood the concept of thresholds or ranges.

(1) Threshold classifier task

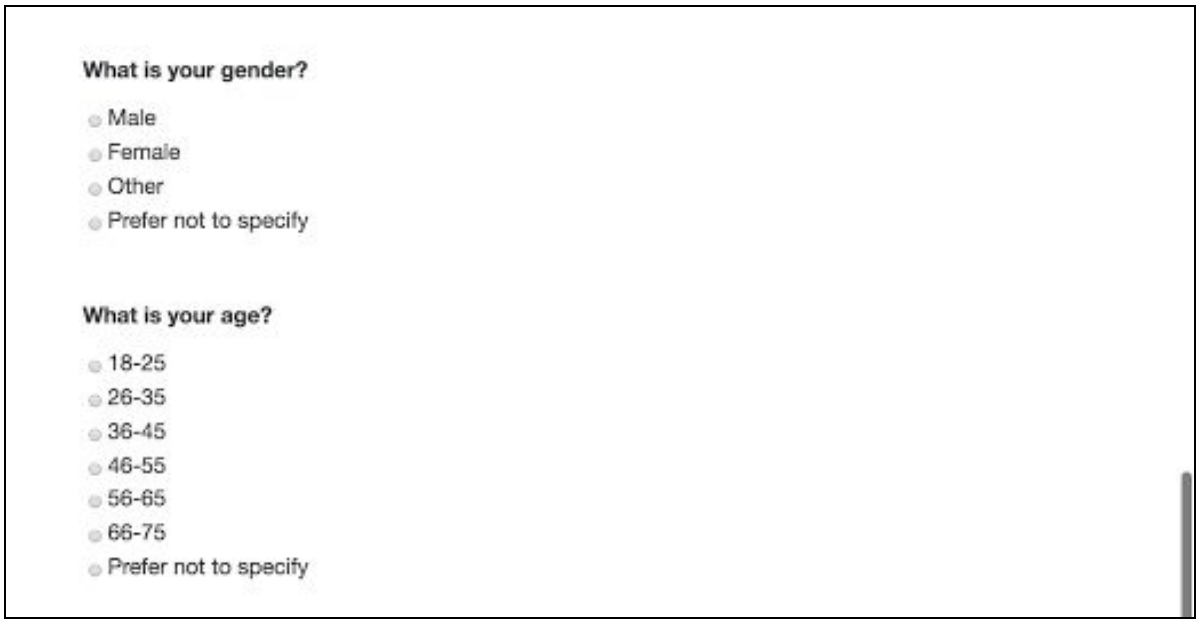


(2) Interval classifier task



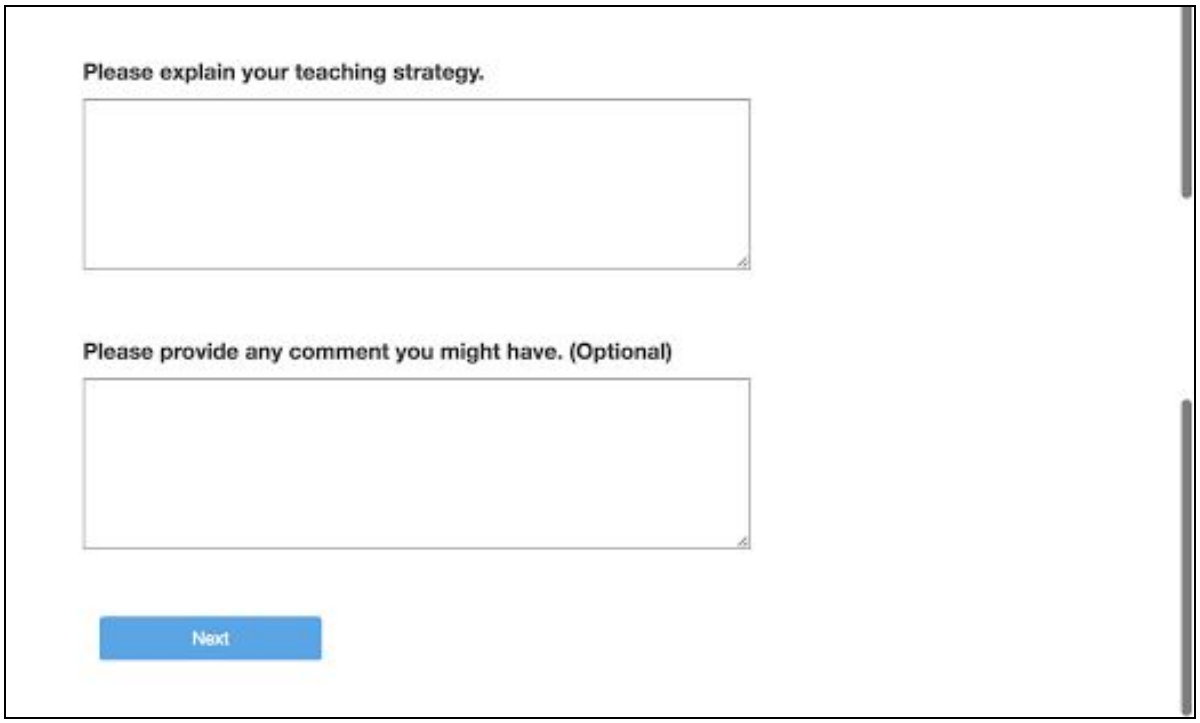
4.4. Demographic Information and Strategy

Basic demographic information is captured.



4.5. Teaching Strategy

Participants were required to provide an explanation for their teaching strategy.



5. Completion

When the participant completes the task and the survey, they are provided a completion code used for submitting the task to Mechanical Turk.