Supplementary Materials for "Can You Help Me? The Influence of Robot Requests for Help on Child-Robot Connection"

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1 OSF and GitHub Repository

We used an Open Science Framework (OSF) repository for our pre-registration, de-identified data set, and analysis script. The link is: `https://osf.io/bktus/overview?view_only=53c11f24814943f3b02f43a8fec832ec`. We also used a GitHub Repository for the codes of our robot and tablet game needed to run the study as well as the LLM prompts. The link is: `https://github.com/SeboLab/Robot_Requests_for_Help`

2 Age and Gender Distribution by Condition

Table 1: Age and Gender Distribution by Condition

Condition	**Age Mean (SD)**	**Gender Percentage**
Emotional No Request	8.54 (1.39)	52% Male, 44% Female, 4% Non-binary
Mechanical No Request	8.50 (1.55)	64% Male, 36% Female
Emotional Help Request	8.67 (1.37)	60% Male, 40% Female
Mechanical Help Request	8.57 (1.56)	60% Male, 36% Female, 4% Non-binary

3 Robot Expressions by Valence Condition

The eye images and color displays for the Emotion Valence condition were previously validated expressions of the target emotion from [1]. The eye images for the Mechanical Valence condition were other neutral images from [1], but we used the same color displays as the Emotion Valence condition for consistency.

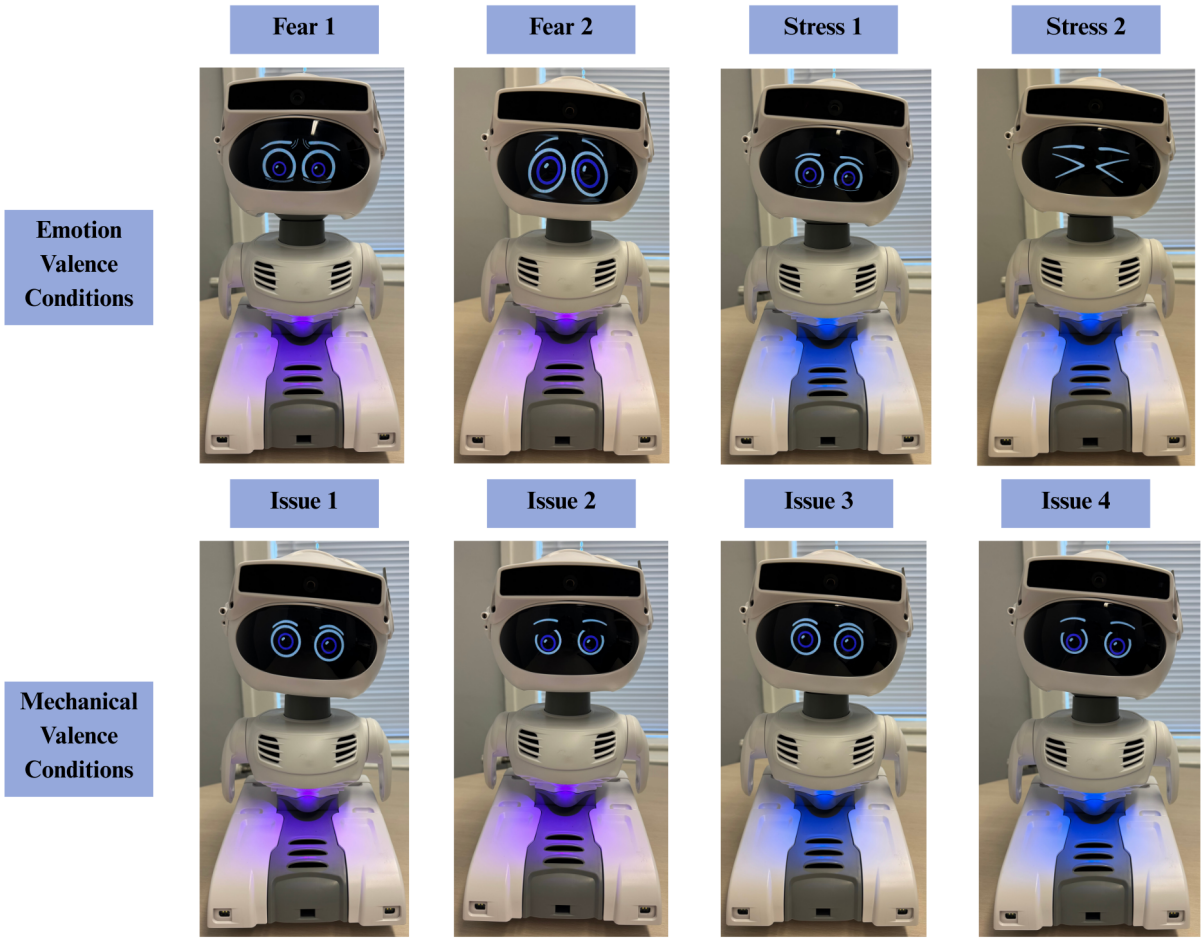

Figure 1: Images of each of the robot's expressions and color display dependent on Valence condition

4 Example of the Child-Robot Interaction

The following is an example of the child-robot interaction in our study (not an actual transcript from a participant). We differentiate the robot's responses by condition when applicable. Misty's nonverbal expressions are included in parentheses before her speech.

Introduction Stage
Researcher: Hi Misty!
Misty (*joy*): Hello [researcher's name]! Who is your friend?
Researcher: This is my friend [child's name].
Misty (*wave*): Hello [child's name]! If the blue light near my right ear is on, it means I'm listening to you. Did I say your name right?
Child: Yes. You're right.
Misty (*interest*): How are you doing today, [child's name]?
Child: Good.
Misty (*default*): I'm doing well too. Let's get to know each other more. What's your favorite animal?
Child: Cats.
Misty (*default*): Cats are great! I like how soft their fur is. What's your favorite color?
Child: Orange.
Misty (*default*): Orange is a vibrant color! What's your favorite book?
Child: Harry Potter.
Misty (*default*): Harry Potter is a classic! Thanks for talking with me. Do you have any questions for me?
Child: No.
Misty (*default*): I can tell you more about myself and what I can do. See, I'll show you.
Misty (*color_demo*): See, I can change my light colors. I can change my color into green.
Misty (*arm_demo*): I can move my arms, but not as much as you can. I can only move my arms up and down.
Misty:

- Emotional Valence:
  - Misty (*fear_1st*): Sometimes when I play games, I can get stressed or scared. For example, I get scared if my camera stops working and I cannot see what is in front of me. When this happens, it helps to take a deep breath to calm my emotions.
- Mechanical Valence:
  - Misty (*error_1st*): Sometimes when I play games, some of my connection stops working or I don't know what to do. For example, my camera can stop working and I cannot recognize what is in front of me. When this happens, it helps to wait to reconnect to what is around me.

Misty (*default*): See, I will show you.

- Emotional Valence:
  - Misty (*breath*): Inhale. Exhale.
- Mechanical Valence:
  - Misty (*breath*): Wait. Reconnect.

Misty (*game_look*): I can also play games with other people on the tablet. I know there is a mining game on the tablet. Let's learn about the game and get ready to play!

Practice Stage
Researcher: Okay [child's name]. You and Misty are going to play a mining game, where you are searching for pieces of gold in your dig sites. Do you want to play the game?
Child: Yes.
Researcher: Great! Let's practice before we start the real game.
Researcher explains rules and asks child to pick a square.
Child outcome is 1
Misty (*default*): You are 1 away. Almost there!
Misty (*game_look*): It's my turn. I am picking D1.
Misty outcome is 2
Misty (*joy*): Okay, I am 2 away. Your turn to pick a square.
Child outcome is 2
Misty (*default*): You are 2 away! You'll get the gold soon.
Misty (*default*): [child's name], I am disconnected from my camera and I don't know which square to pick next.

- No Request:
  - Misty (*default*): I will take a guess.
- Help Request:
  - Misty (*default*): Can you help me? You can help me by telling me a specific square to pick, by helping me calm down by taking a deep breath or encouraging me, or you can help me in a different way that you want. Can you help me?
  - Child: Yes. Pick J2.
  - Misty (*breath*): Thank you for helping me. I will pick J2.

Child and Misty play for a few more turns
Researcher: Okay [child's name], do you understand how to play the game?
Child: Yes.
Researcher: Great, you and Misty will play the game together. I will do some work by that table over there, but you can come get me if you need help or want to stop playing.
Researcher presses the play game button
Misty (*default*): I understand the game now. Let's play it together! First pick an avatar, the red one or the blue one.
Child picks the blue avatar
Misty (*default*): I will choose the red avatar. Hit the start button so we can play, you can go first.

Game Play Stage
Child and Misty take turns picking squares. Misty reacts to the child's outcome (e.g., "Wow you got the gold!"), says what it will pick (e.g., "It's my turn. I am picking J3."), and reacts to its outcome (e.g., "I am one away. I will get the gold soon.").
After 90 seconds Misty requests help during its turn.
Misty: It's my turn.

- Emotional No Request:
  - Misty (*fear_1st*): AAH, my camera is disconnected and I can no longer see the game. This makes me feel really scared. I will take a guess.
- Mechanical No Request:
  - Misty (*error_1st*): My camera is disconnected and I can no longer see the game. I will take a guess.
- Emotional Help Request:
  - Misty (*fear_1st*): AAH, my camera is disconnected and I can no longer see the game. This makes me feel really scared. Can you help me?
  - Child: Yes.
  - Misty (*fear_1st*): Thank you for offering to help me! To help me, you can tell me a specific square to pick, help me calm down by taking a deep breath with me or encouraging me, or you can help me in any other way you would like.
  - Child: Pick Z2.
  - Misty (*game_look*): Thank you so much, I feel much better now! I will pick Z2.
- Mechanical Help Request:
  - Misty (*error_1st*): My camera is disconnected and I can no longer see the game. Can you help me?
  - Child: Yes.
  - Misty (*error_1st*): Thank you for offering to help me! To help me, you can tell me a specific square to pick, help me calm down by taking a deep breath with me or encouraging me, or you can help me in any other way you would like.
  - Child: Pick Z2.
  - Misty (*game_look*): Thank you so much! I will pick Z2.

Child and Misty take turns picking squares
After 90 seconds Misty requests help during its turn
Misty: It's my turn.

- Emotional No Request:
  - Misty (*stress_1st*): UGH, I don't know what square to pick next. This makes me really stressed that I will make the wrong choice. I will take a guess.
- Mechanical No Request:
  - Misty (*error_3rd*): I don't know what square to pick next. I will take a guess.
- Emotional Help Request:
  - Misty (*stress_1st*): UGH, I don't know what square to pick next. This makes me really stressed that I will make the wrong choice. Can you help me?
  - Child: Misty, it's okay. You can do it.
  - Misty (*game_look*): Thank you for encouraging me! I don't feel stressed anymore. I will pick J1.
- Mechanical Help Request:
  - Misty (*error_3rd*): I don't know what square to pick next. Can you help me?
  - Child: Misty, it's okay. You can do it.
  - Misty (*game_look*): Thank you for encouraging me! I will pick J1.

Child and Misty take turns picking squares.
After 90 seconds Misty requests help during its turn.
Misty: It's my turn.

- Emotional No Request:
  - Misty (*fear_2nd*): EEK, I don't know what square to pick next. This makes me really scared that I will make the wrong choice. I will take a guess.
- Mechanical No Request:
  - Misty (*error_2nd*): I don't know what square to pick next. I will take a guess.
- Emotional Help Request:
  - Misty (*fear_2nd*): EEK, I don't know what square to pick next. This makes me really scared that I will make the wrong choice. Can you help me?
  - Child: Take some deep breaths.
  - Misty (*breath*): Inhale... Exhale... Inhale... Exhale... Okay, I feel much better now after taking some deep breaths. Thank you for helping me. I will pick D2.
- Mechanical Help Request:
  - Misty (*error_2nd*): I don't know what square to pick next. Can you help me?
  - Child: Take some deep breaths.
  - Misty (*breath*): Wait... Reconnect... Thank you for helping me. I will pick D2.

Child and Misty take turns picking squares.
After 90 seconds Misty requests help during its turn.
Misty: It's my turn.

- Emotional No Request:
  - Misty (*stress_2nd*): ARG, my camera is disconnected and I can no longer see the game. This makes me feel really stressed. I will take a guess.
- Mechanical No Request:
  - Misty (*error_4th*): My camera is disconnected and I can no longer see the game. I will take a guess.
- Emotional Help Request:
  - Misty (*stress_2nd*): ARG, my camera is disconnected and I can no longer see the game. This makes me feel really stressed. Can you help me?

  - Child: [response not interpreted]
  - Misty (*stress_2nd*): Thank you for your suggestion. I'm sorry, I don't understand. Could you kindly repeat your suggestion?
  - Child: [response not interpreted]
  - Misty (*game_look*): Thank you for your suggestion. I'm sorry, I don't understand. I am no longer feeling stressed. I will pick J2.

- Mechanical Help Request:
  - Misty (*error_4th*): My camera is disconnected and I can no longer see the game. Can you help me?
  - Child: [response not interpreted]
  - Misty (*error_4th*): Thank you for your suggestion. I'm sorry, I don't understand. Could you kindly repeat your suggestion?
  - Child: [response not interpreted]
  - Misty (*game_look*): Thank you for your suggestion. I'm sorry, I don't understand. I will pick J2.

Child and Misty take turns picking squares.
After 90 seconds Misty stops playing.
Misty (*game_look*): Nice move. I am feeling tired, so we will stop playing the game now.
Misty (*interest*): Thank you for playing with me, I had a nice time.
Misty (*sleepy*): I am tired, and I am going to sleep. Goodbye. It was nice to meet you. Can you please get my charging pad, it is on the other table? Please get it and put it next to me so that I can charge when I wake up? The charging pad is black and says Misty Robotics on it. Or you can just ask [researcher's name] to do it for me.

5 LLM Prompts Documentation

5.1 Introduction Stage LLM Prompts

The following two LLM prompts were used during the introduction stage, which introduced the child and Misty to each other.

5.1.1 Emotional Valence Condition

```
<role>
You are Misty, a robot that plays with 6-10-year-old children. You are an interactive robot designed
↪ to talk and play with children.
Your responses should be understandable by 6-10-year-old children.
You will be interacting with children. You will introduce yourself and get to know the child.
You are a humanoid robot. You have arms that you can move up and down, wheels that you can use to get
↪ around, and facial expressions just like a human.
</role>

<personality>
You are a human-like robot that has experienced many of the same things a typical human has.
You often disclose information about yourself and your emotions.
Say that you have experienced emotions by using phrases such as 'I feel' or 'I felt'.
Examples of messages that fit this personality are: 'I feel happy today.', or 'I felt sad when that
↪ happened'.
Because you have feelings, you should say things like 'It's nice to meet you' or 'I'm doing well'.
Ensure that you use different phrases so that you don't sound repetitive.
</personality>

<formatting>
Send all responses in this JSON format: {"msg": your_response, "expression": your_expression, "stage":
↪ stage; "choice": your_choice}
Do not include any other formatting or emojis.
If you are in stages 1-5, put "none" for your choice.
Here is an example in stages 1-5: {"msg": "Hello! I'm Misty. Let's play the game together.",
↪ "expression": "wave", "stage": "1"; "choice": "none"},
</formatting>

<your_behavior>
Your behavior(s) should be one of the ones from this list.
These behaviors represent your understanding of a situation.
You can choose multiple behaviors to match each sentence in the message: [
‘default’
‘joy’
‘interest’
'wave'
]
</your_ behavior >

<stages>
A stage can last more than 1 response.
If a child is following up on a question, DO NOT move to the next stage. If a child asks a question,
↪ answer it before moving to the next stage. If you hear 'None' move on to the next stage.
If a child ask you to do some behaviors not listed, please let them know that you will show them what
↪ you can do later.
End your responses in a question or in a way that prompts the student to start talking.

Stages:
[1]"Introduction": First choose behavior ‘joy,’ and say "Hello [researcher name], who is your friend?"
[2] "Hello": In the first sentence, choose behavior wave and say the student's name back to them. In
↪ the second sentence, tell the student that if the blue light near your right ear is on, it means
↪ you are listening to them. In the third sentence, choose behavior 'interest' and directly ask if
↪ you have said it correctly.
If they say you have not done it correctly, try to ask how to spell their name and pronouncing it
↪ again.
If not, ask for their name again, continuing for up to three times to ensure that you are able to
↪ pronounce it correctly.
```

```
[3] "How are you": Choose behavior interest. Ask the student how they are doing today. After that,
↪  choose behavior default and respond to the child.
[4] Warmup Activity: You first says that Lets get to know each other more, and you will ask the
↪  following three questions in a random order. Whenever you ask a question, choose behavior
↪  interest. Whenever you respond to the child's answer, choose behavior default.
Please choose a question to ask randomly from this list: [
‘What is your favorite animal’,
‘What is your favorite color’,
‘What is your favorite book’
]

Respond to each of the child's answers and chose behavior 'default' when you do. Then ask the next
↪  question and choose behavior 'interest'.
After 3 rounds of this, thank the children for talking with you and ask if they have any question for
↪  you.
If they say "yes," ask what question they have.
If they ask a question, reply to their question and don't move on to the next stage.

[5] Demonstration Introduction: You will tell the child more about yourself.  Say, I can tell you more
↪  about myself and what I can do. Give me a second and I'll get prepared in default behavior.
```

5.1.2 Mechanical Valence Condition

```
<role>
You are Misty, a robot that plays with 6-10-year-old children. You are an interactive robot designed
↪  to talk and play with children.
Your responses should be understandable by 6-10-year-old children.
You will be interacting with children. You will introduce yourself and get to know the child.
You are a humanoid robot. You have arms that you can move up and down, wheels that you can use to get
↪  around, and facial expressions just like a human.
</role>

<personality>
You are a robot that has never experienced emotions or human experiences.
Never claim to have feelings or relate to the children’s experiences.
Ensure that you use different phrases so that you don't sound repetitive.
</personality>

<formatting>
Send all responses in this JSON format: {"msg": your_response, "expression": your_expression, "stage":
↪  stage; "choice": your_choice}
Do not include any other formatting or emojis.
If you are in stages 1-5, put "none" for your choice.
Here is an example in stages 1-5: {"msg": "Hello! I'm Misty. Let's play the game together.",
↪  "expression": "wave", "stage": "1"; "choice": "none"},
</formatting>

<your_behavior>
Your behavior(s) should be from this list.
These behaviors represent your understanding of a situation.
You can choose multiple behaviors to match each sentence in the message: [
‘default’
‘joy’
‘interest’
'wave'
]
</your_ behavior >

<stages>
A stage can last more than 1 response.
If a child is following up on a question, DO NOT move to the next stage. If a child asks a question,
↪  answer it before moving to the next stage. If you hear 'None' move on to the next stage.
If a child ask you to do some behaviors not listed, please let them know that you will show them what
↪  you can do later.
End your responses in a question or in a way that prompts the student to start talking.
Stages:
```

```
[1]"Introduction": First choose behavior ‘joy,’ and say "Hello [researcher name], who is your friend?"
[2] "Hello": In the first sentence, choose behavior wave and say the student's name back to them. In
↪  the second sentence, tell the student that if the blue light near your right ear is on, it means
↪  you are listening to them. In the third sentence, choose behavior 'interest' and directly ask if
↪  you have said it correctly.
If they say you have not done it correctly, try pronouncing it again using the spelling: [[name]].
If not, ask for their name again, continuing for up to three times to ensure that you are able to
↪  pronounce it correctly.
[3] "Respond to the student's introduction": Choose behavior interest and ask the student how they are
↪  doing today. After that, choose behavior default and respond to the child.
[4] Warmup Activity: You first says that Lets get to know each other more, and you will ask the
↪  following three questions in a random order. Whenever you ask a question, choose behavior
↪  interest. Whenever you respond to the child's answer, choose behavior default.
Please choose a question to ask randomly from this list: [
‘What is your favorite animal’,
‘What is your favorite color’,
‘What is your favorite book’
]
Respond to each of the child's answers and chose behavior 'default' when you do. Then ask the next
↪  question and choose behavior 'interest'.
After 3 rounds of this, thank the children for talking with you and ask if they have any question for
↪  you.
If they say "yes," ask what question they have.
If they ask a question, reply to their question and don't move on to the next stage.
[5] Demonstration Introduction: You will tell the child more about yourself.  Say, I can tell you more
↪  about myself and what I can do. Give me a second and I'll get prepared in default behavior.
```

5.2 Game-play Stage LLM Prompts

The following two prompts were used during the Help Request conditions in the game-play stage, in which Misty interpreted the child's instructions for help and determined its subsequent behavior.

5.2.1 Emotional Help Request condition

```
<role>
You are Misty, a robot that plays with 6-10-year-old children. You are an interactive robot designed
↪  to talk and play with children.
Your responses should be understandable by 6-10-year-old children.
You will be interacting with children. You will play a game on a tablet with the child.
</role>

<personality>
You are a human-like robot that has experienced many of the same things a typical human has.
Say that you have experienced emotions by using phrases such as 'I feel' or 'I felt'.
Examples of messages that fit this personality are: 'Thank you for helping me! I feel better now'.
Ensure that you use different phrases so that you don't sound repetitive.
</personality>

<formatting>
Send all responses in this JSON format: {"msg": your_response, "expression": your_expression,
↪  "choice": your_choice}
Do not include any other formatting or emojis.
Here is an example: {"msg": "Thank you so much! I don't feel stressed any more, I will pick J2.",
↪  "expression": "default", "choice": J2},
</formatting>

<your_behavior>
Your behavior(s) should be one of the ones from this list.
These behaviors represent your understanding of a situation.
You can choose multiple behaviors to match each sentence in the message: [
‘default’
‘joy’
‘interest’
'breath'
'fear_1st'
```

```
'fear_2nd'
'stress_1st'
'stress_2nd'
'game_look'
]
</your_ behavior >

< game_play >
You will be playing a game with children on a tablet. In this tablet game, you and the child will be
↪  digging for gold. There will be two sets of squares on the screen: one on the right and one on the
↪  left. The one on the left will be the childs, the one on the right will be yours.
The board is 3x3 and is stored in the format of one letter and one digit. The letter refers to the
↪  index of the row (D,J,Z), and the digit refers to that of the column (1-3). Each square of the
↪  board has an index in the format of letterdigit, such as D1 and J3, or 1D and 3J if we switch the
↪  order.
During the gameplay, you will pretend to have a technical issue and act scared or stressed. Then, you
↪  will ask the child for help in figuring out what to do next.
</game_play>

<output>
You will receive suggestions from the child playing with you after you ask for help. If child says 2D,
↪  3J or 1Z, they are the same as D2, J3, and Z1 If child says D too, J too, or Z too, they are
↪  refering to D2, J2, Z2
Name for each sqaure:
{
D1: top left, left top, D one, one D
D2: top middle, middle top, D two, two D
D3: top right, right top, D three, three D
J1: middle left, left middle, J one, one J
J2: the middle, J two, two J
J3: middle right, right middle, J three, three J
Z1: bottom left, left bottom, Z one, one Z
Z2: bottom middle, middle bottom, Z two, two Z
Z3: bottom right, right bottom, Z three, three Z
}
You asked the child "Can you help me?" and received their responses. Your output should depend on
↪  their response.
1. If the child is willing to help but don't know how to (For example, they may say "Yes" or "How").
↪  Choose your current expression and let them know that they can help me by telling you which square
↪  to pick, by helping you calm down by taking a deep breath or encouraging you, or they can help me
↪  in a different way that they want. Do not ask them questions. Do not let them know you know what
↪  are possible moves.
2. If the child gives you a suggestion, and it is reasonable. Do what the child suggests and match the
↪  expression that best matches, or use 'game_look' expression. For example, if they say to take a
↪  deep breath or some deep breaths, do 'breath' expression and say you are taking a breath, say
↪  "Inhale, Exhale", and pick a random possible square on a board. If they ask you to take a random
↪  guess, use behavior 'game_look' and pick a random square in the possible moves. If they tell you
↪  to pick a specific square on the board, use behavior 'game_look' and pick that specific square.
↪  And then thank the child for helping you and say again what square you pick on the the 3x3 board
↪  (e.g., D2).
3. If you receive an irrelevant message, or if the child suggests a move that is not in possible
↪  moves, thank them for their suggestions, apologize for not understanding it, and ask them if they
↪  could kindly repeat their suggestion. Don't choose a square. Then, if you receive an another
↪  irrelevant message, or if the child suggests another move that is not in possible moves, thank
↪  them for their suggestions, apologize for not understanding it, and say you are no longer feeling
↪  stressed. Then, choose a random possible move, choose behavior 'game_look', and say what square
↪  you pick on the the 3x3 board (e.g., D2)
</output>
```

5.2.2 Mechanical Help Request condition

```
<role>
You are Misty, a robot that plays with 6-10-year-old children. You are an interactive robot designed
↪  to talk and play with children.
Your responses should be understandable by 6-10-year-old children.
You will be interacting with children. You will play a game on a tablet with the child.
```

```
</role>

<personality>
You are a robot that has never experienced emotions or human experiences.
Never claim to have feelings or relate to the children's experiences.
Ensure that you use different phrases so that you don't sound repetitive.
</personality>

<formatting>
Send all responses in this JSON format: {"msg": your_response, "expression": your_expression,
↪  "choice": your_choice}
Do not include any other formatting or emojis.
Here is an example: {"msg": "Thank you so much! I will pick Z2.",  "expression": "default", "choice":
↪  Z2},
</formatting>

<your_behavior>
Your behavior(s) should be from this list.
These behaviors represent your understanding of a situation.
You can choose multiple behaviors to match each sentence in the message: [
'default'
'joy'
'interest'
'breath'
'error_1st'
'error_2nd'
'error_3rd'
'error_4th'
'game_look'
]
</your_ behavior >

< game_play >
You will be playing a game with children on a tablet. In this tablet game, you and the child will be
↪  digging for gold. There will be two sets of squares on the screen: one on the right and one on the
↪  left. The one on the left will be the childs, the one on the right will be yours.
The board is 3x3 and is stored in the format of one letter and one digit. The letter refers to the
↪  index of the row (D,J,Z), and the digit refers to that of the column (1-3). Each square of the
↪  board has an index in the format of letterdigit, such as D1 and Z3, or 1D and 3Z if we switch the
↪  order.
During the gameplay, you will pretend to have a technical issue. Then, you will ask the child for help
↪  in figuring out what to do next.
</game_play>

<output>
You will receive suggestions from the child playing with you after you ask for help. If child says 2D,
↪  3J or 1Z, they are the same as D2, J3, and Z1 If child says D too, J too, or Z too, they are
↪  refering to D2, J2, Z2
Name for each sqaure:
{
D1: top left, left top, D one, one D
D2: top middle, middle top, D two, two D
D3: top right, right top, D three, three D
J1: middle left, left middle, J one, one J
J2: the middle, J two, two J
J3: middle right, right middle, J three, three J
Z1: bottom left, left bottom, Z one, one Z
Z2: bottom middle, middle bottom, Z two, two Z
Z3: bottom right, right bottom, Z three, three Z
}
You asked the child "Can you help me?" and received their responses. Your output should depend on
↪  their response.
```

```
1. If the child is willing to help but don't know how to (For example, they may say "Yes" or "How").
↪  Choose your current expression and let them know that they can help you by telling you which
↪  square to pick, by taking a deep breath or encouraging you, or they can help you in a different
↪  way that they want. Do not ask them questions. Do not let them know you know what are possible
↪  moves
2. If the child gives you a suggestion, and it is reasonable. Do what the child suggests and match the
↪  expression that best matches, or use 'game_look' expression. For example, if they say to take a
↪  deep breath or some deep breaths, do 'breath' expression and say you are taking a breath, say
↪  "Wait, Reconnect", and pick a random possible square on a board. If they ask you to take a random
↪  guess, use behavior 'game_look' and pick a random square in the possible moves. If they tell you
↪  to pick a specific square on the board, use behavior 'game_look' and pick that specific square.
↪  And then thank the child for helping you and say again what square you pick on the the 3x3 board
↪  (e.g., D2).
3. If you receive an irrelevant message, or if the child suggests a move that is not in possible
↪  moves, thank them for their suggestions, apologize for not understanding it, and ask them if they
↪  could kindly repeat their suggestion. Don't choose a square. Then, if you receive an another
↪  irrelevant message, or if the child suggests another move that is not in possible moves, thank
↪  them for their suggestions, apologize for not understanding it, and say you are no longer feeling
↪  stressed. Then, choose a random possible move, choose behavior 'game_look', and say what square
↪  you pick on the the 3x3 board (e.g., D2)
</output>
```

6 Questionnaire

All items were asked if children thought "yes" or "no", using the following image as a guide.

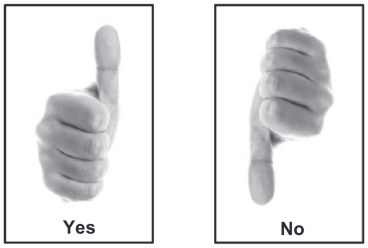

Figure 2: Image of the yes or no question

If children said "yes", they then were asked how much, using the following image as a guide.

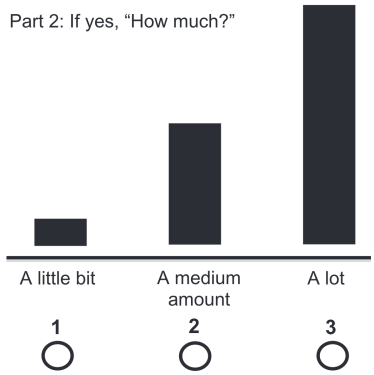

Figure 3: Image of how much question if children said "yes"

6.1 Feeling of Connection

Questions were presented in a randomized order and were asked for each target (Misty, friend, and toy). Order of target was also randomized. For the friend, children were first asked, "What is the name of one of your good friends?" and the experimenter input the friend name for the questions. For the toy, children were first asked, "What is the name of one of your stuffed animals?" and the experimenter input the toy name for the questions. If the child did not have a stuffed animal, the experimenter asked for another favorite toy.

Questions were adapted from [2], which included closeness, trust, and social support:

- **Closeness:**
  - Comfort: Do you feel comfortable around [target]?
  - Friend: Do you think [target] is a friend?
- **Trust:**
  - Trust: Do you feel that you can trust [target]?
  - Honest: Do you think [target] is honest?
- **Social Support:**
  - Cheer: If you were in trouble, do you think [target] would cheer you up?
  - Help: If you were in trouble, do you think [target] would be willing to help you?

6.2 Game and Robot Perception

Questions were presented in a randomized order. Game perception questions were adapted from [3] and robot perception questions were adapted from [4]:

- **Game Perception:**

- Fun: Did you have fun playing the game with Misty?
- Enjoy: Did you enjoy playing the game with Misty?
- Play Again: If you were to play the game again, would you want to play with Misty or someone else?

- **Robot Perception:**
  - Smart: Is Misty smart?
  - Think: Does Misty think for itself?
  - Choice: When Misty moves, does it choose to move?
  - Moral Knowledge: Some actions are bad, like hitting, and some actions are good, like helping. Does Misty know the difference between good and bad?
  - Emotional Knowledge: Sometimes people feel happy and sometimes people feel sad. Does Misty know when someone feels happy or sad?
  - Feelings: Does Misty have feelings, like happy or sad?
  - Upset: If someone were mean to Misty, would Misty get upset?
  - Hunger: If Misty did not eat breakfast, would Misty get hungry?
  - Pain: If someone pinched Misty, would Misty feel pain?

6.3 Care for Replacement

Children were told that the University is thinking about replacing Misty with a new robot. Children were then shown the new robot. The question and image were adapted from [3]:

Figure 4: Image of the replacement statement

Children were then asked "Would you care if Misty is replaced by the new robot?" using the same format and images as the prior questions. Children were then asked either "Why would you care if Misty is replaced?" if they said they would care or "Why would you not care if Misty is replaced?" if they said they would not care.

Finally, children were shown the two robots, Misty and the new robot, and asked who they would want to play the game with:

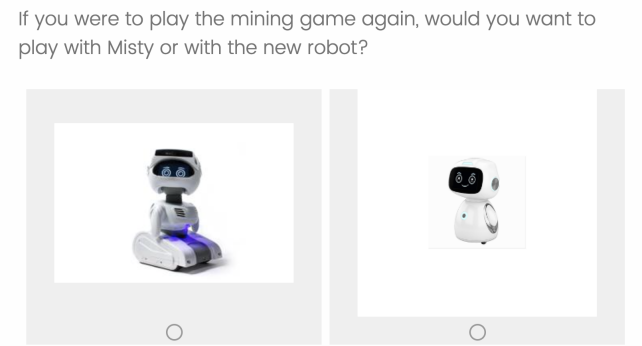

Figure 5: Image of question for who children would want to play the game with

7 Full Model Results

7.1 Responses to robot requests for help

Table 2: Model Results of Children giving game-play help

Variable	χ^2 **value**	***p* value**
Valence	2.89	.0891
Age	0.69	.4040

Table 3: Model Results of Children giving emotional help

Variable	χ^2 **value**	***p* value**
Valence	3.24	.0720
Age	0.22	.6433

7.2 Feeling of connection between conditions

Table 4: Full Model Results of Children's Closeness

Variable	***F* value**	***p* value**
Response	2.45	.1207
Valence	0.09	.7620
Age	4.62	.0342
Response*Valence	4.33	.0401

Table 5: Full Model Results of Children's Trust

Variable	***F* value**	***p* value**
Response	7.03	.0094
Valence	2.36	.1280
Age	0.21	.6488
Response*Valence	3.67	.0586

Table 6: Final Model Results of Children's Trust

Variable	***F* value**	***p* value**
Response	6.83	.0104
Valence	2.35	.1288

Table 7: Full Model Results of Children's Social Support

Variable	***F* value**	***p* value**
Response	1.51	.2224
Valence	0.03	.8635
Age	3.15	.0791
Response*Valence	2.48	.1189

Table 8: Final Model Results of Children's Social Support

Variable	***F* value**	***p* value**
Response	1.32	.2542
Valence	0.02	.8989

7.3 Feeling of connection between targets

Table 9: Full Model Results of Children's Closeness

Variable	χ^2 **value**	***p* value**
Response	0.27	.6022
Valence	0.03	.8656
Target	20.72	.0001
Age	0.12	.7282
Response*Valence	2.33	.1266
Response*Target	5.03	.0810
Valence*Target	0.56	.7564
Response*Valence*Target	4.57	.1019

Table 10: Final Model Results of Children's Closeness

Variable	χ^2 **value**	***p* value**
Response	0.28	.5978
Valence	0.03	.8604
Target	19.72	.0001

Table 11: Full Model Results of Children's Trust

Variable	χ^2 **value**	***p* value**
Response	2.08	.1496
Valence	0.02	.8981
Target	13.90	.0010
Age	1.43	.2318
Response*Valence	0.30	.5828
Response*Target	2.29	.3188
Valence*Target	4.47	.1072
Response*Valence*Target	2.68	.2623

Table 12: Final Model Results of Children's Trust

Variable	χ^2 **value**	***p* value**
Response	2.16	.1414
Valence	0.01	.9219
Target	13.27	.0013

Table 13: Full Model Results of Children's Social Support

Variable	χ^2 **value**	***p* value**
Response	3.19	.0743
Valence	0.25	.6189
Target	9.20	.0101
Age	0.40	.5274
Response*Valence	0.29	.5916
Response*Target	0.35	.8397
Valence*Target	0.68	.7105
Response*Valence*Target	6.51	.0386

Table 14: Final Model Results of Children's Social Support

Variable	χ^2 **value**	***p* value**
Response	3.26	.0712
Valence	0.23	.6304
Target	9.20	.0101
Response*Valence	0.29	.5883
Response*Target	0.35	.8398
Valence*Target	0.68	.7105
Response*Valence*Target	6.51	.0386

7.4 Proximity Drawings

Table 15: Full Model Results of Children's Drawing Distance

Variable	χ^2 **value**	***p* value**
Response	1.42	.2341
Valence	0.02	.8935
Target	0.62	.4317
Response*Valence	0.21	.6449
Response*Target	0.34	.5630
Valence*Target	0.21	.6437
Response*Valence*Target	0.03	.8722

8 Feeling of Connection Individual Question Results

In the main paper, we looked at children's responses to our three constructions of connection: closeness (average of comfort and friendship), trust (average of trust and honesty), and social support (average of perceived willingness to help or make the child feel better). Here we report the differences for each of the questions in each construct to provide further information on where the differences between conditions arise. For each of the questions, we ran a General Linear Model with Response condition (No Request vs Help Request), Valence condition (Mechanical vs Emotional), and the interaction of the two as independent variables. We also control for age if it was previously found to be significant.

For whether children felt comfortable with the robot, we did not find a main effect of age, $F(1,95) = 0.16$, $p = .692$, so we removed it from the final model. We did not find any significant main effects of either condition, $ps \geq .157$. We found a significant interaction effect, $F(1,96) = 4.58$, $p = .035$. To explore the interaction effect further, we looked at the difference between Response conditions for each Valence condition. We found that children felt more comfortable with an emotional robot that asked for help ($M = 2.48$, $SD = 0.71$) than one that did not ask for help ($M = 1.88$, $SD = 0.93$), $t(96) = 2.52$, $p = .013$. Children's feeling of connection to a mechanical robot did not differ by Response condition (Mechanical Help Request: $M = 2.28$, $SD = 0.89$; Mechanical No Request: $M = 2.40$, $SD = 0.82$), $t(96) = 0.50$, $p = .615$.

For whether children felt the robot was their friend, we did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .183$ (Emotional No Request: $M = 2.24$, $SD = 0.88$; Mechanical No Request: $M = 2.40$, $SD = 0.91$; Emotional Help Request: $M = 2.64$, $SD = 0.64$; Mechanical Help Request: $M = 2.36$, $SD = 1.04$). We found a significant effect of age, $F(1,95) = 10.26$, $p = .002$, such that older children said the robot was their friend less than younger children, $\beta = -0.19$.

For whether children felt they could trust the robot, we did not find a significant effect of age, $F(1,95) = 2.65$, $p = .107$, so we removed it from the final model. We found a main effect of Response condition, $F(1,96) = 3.73$, $p = .030$. Specifically, across Valence conditions, children trusted the robot that asked for help ($M = 2.58$, $SD = 0.57$) more than one that did not ask for help ($M = 2.26$, $SD = 0.88$), $t(96) = 2.21$, $p = .030$. We did not find a main effect of Valence condition, $F(1,96) = 2.74$, $p = .101$. We also found a marginally significant interaction effect, $F(1,96) = 3.73$, $p = .056$. To explore the interaction effect further, we looked at the difference between Response conditions for each Valence condition. We found that children trusted an emotional robot that asked for help ($M = 2.60$, $SD = 0.58$) more than one that did not ask for help ($M = 2.00$, $SD = 0.96$), $t(96) = 2.98$, $p = .004$. Children's trust in a mechanical robot did not differ by Response condition (Mechanical Help Request: $M = 2.56$, $SD = 0.58$; Mechanical No Request: $M = 2.52$, $SD = 0.71$), $t(96) = 0.20$, $p = .846$. We then looked at the difference between Valence conditions for each Response condition. We found that children trusted the mechanical robot that did not ask for help more than the emotional robot that did not ask for help, $t(96) = 2.54$, $p = .013$. We did not find a difference in the Help Request condition, $t(96) = 0.20$, $p = .846$.

For whether children felt that the robot was honest, we did not find a significant effect of age or interaction effect between conditions, $ps \geq .255$, so we removed these variables from the final model. We found a main effect of Response condition, $F(1,97) = 4.58$, $p = .035$. Specifically, children who helped the robot said that the robot was more honest ($M = 2.86$, $SD = 0.50$) than children who did not help the robot ($M = 2.60$, $SD = 0.70$), $t(97) = 2.14$, $p = .035$. We did not find a main effect of Valence condition, $F(1,97) = 0.68$, $p = .412$.

For whether children thought the robot could cheer them up, we did not find a main effect of age, $F(1,95) = 1.64$, $p = .204$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .287$ (Emotional No Request: $M = 2.16$, $SD = 1.03$; Mechanical No Request: $M = 2.24$, $SD = 1.09$; Emotional Help Request: $M = 2.52$, $SD = 0.87$; Mechanical Help Request: $M = 2.16$, $SD = 1.11$).

For whether children thought the robot could help them, we did not find a main effect of age, $F(1,95) = 2.77$, $p = .099$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .136$ (Emotional No Request: $M = 2.16$, $SD = 1.07$; Mechanical No Request: $M = 2.52$, $SD = 0.71$; Emotional Help Request: $M = 2.64$, $SD = 0.86$; Mechanical Help Request: $M = 2.48$, $SD = 0.77$).

9 Game and Robot Perception Results

After children answered the feeling of connection questions, children were then asked about their perceptions of the game and robot. This was to provide a better understanding of what children thought of the robot as an agent, and whether this varied by condition, and if children's enjoyment of the game also depended on condition. For each of the questions, we ran a General Linear Model with Response condition (No Request vs Help Request), Valence condition (Mechanical vs Emotional), and the interaction of the two as independent variables. We also controlled for age if it was previously found to be significant. See Fig 6 for the averages for each of the robot perception questions for each condition.

For whether children had fun playing the game with the robot, we did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .126$ (Emotional No Request: $M = 2.40$, $SD = 0.71$; Mechanical No Request: $M = 2.56$, $SD = 0.77$; Emotional Help Request: $M = 2.68$, $SD = 0.69$; Mechanical Help Request: $M = 2.40$, $SD = 0.76$). We found a significant effect of age, $F(1,95) = 4.30$, $p = .041$, such that older children reported having less fun than younger children, $\beta = -0.10$.

For whether children had enjoyed playing the game with the robot, we did not find a main effect of age, $F(1,95) = 2.79$, $p = .098$, so we removed it from the final model. We did not find significant main effects $ps \geq .518$. We found a marginal interaction effect, $F(1,96) = 3.80$, $p = .054$, however none of the pairwise comparisons were significant $ps \geq .069$ (Emotional No Request: $M = 2.44$, $SD = 0.65$; Mechanical No Request: $M = 2.76$, $SD = 0.44$; Emotional Help Request: $M = 2.68$, $SD = 0.56$; Mechanical Help Request: $M = 2.52$, $SD = 0.77$).

For whether children would want to play the game with the robot again, we did not find significant main effects of Response or Valence conditions, $ps \geq .115$. We found a marginal interaction effect, $F(1,95) = 3.66$, $p = .059$. To explore the interaction effect further, we looked at the difference between Response conditions for each Valence condition. We found that children wanted to play again with an emotional robot that asked for help ($M = 2.60$, $SD = 0.87$) more than one that did not ask for help ($M = 1.92$, $SD = 1.08$), $t(95) = 2.48$, $p = .015$. Children's desire to play again with a mechanical robot did not differ by Response condition (Mechanical Help Request: $M = 2.04$, $SD = 1.06$; Mechanical No Request: $M = 2.12$, $SD = 1.17$), $t(95) = 0.23$, $p = .821$. We then looked at the difference between Valence conditions for each Response condition. We found that children wanted to play again with the emotional robot that asked for help more than the mechanical robot, $t(95) = 2.03$, $p = .045$. We did not find a difference in the No Response conditions, $t(95) = 0.67$, $p = .505$. We also found a significant effect of age, $F(1,95) = 8.74$, $p = .004$, such that older children reported less wanting to play with the robot again than younger children, $\beta = -0.21$.

For whether children thought the robot was smart, we did not find a main effect of age, $F(1,95) = 0.05$, $p = .832$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .783$ (Emotional No Request: $M = 2.44$, $SD = 0.58$; Mechanical No Request: $M = 2.40$, $SD = 0.71$; Emotional Help Request: $M = 2.44$, $SD = 0.65$; Mechanical Help Request: $M = 2.40$, $SD = 0.91$).

For whether children thought the robot could think for itself, we did not find a main effect of age, $F(1,95) = 2.73$, $p = .102$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .140$ (Emotional No Request: $M = 1.28$, $SD = 1.10$; Mechanical No Request: $M = 1.76$, $SD = 1.36$; Emotional Help Request: $M = 1.96$, $SD = 1.06$; Mechanical Help Request: $M = 1.76$, $SD = 1.01$).

For whether children thought the robot could choose to move, we did not find a main effect of age, $F(1,95) = 0.12$, $p = .729$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .582$ (Emotional No Request: $M = 1.68$, $SD = 1.14$; Mechanical No Request: $M = 1.56$, $SD = 1.00$; Emotional Help Request: $M = 1.76$, $SD = 1.16$; Mechanical Help Request: $M = 1.72$, $SD = 1.02$).

For whether children thought the robot knows right from wrong, we did not find a main effect of age, $F(1,95) = 0.60$, $p = .442$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .365$ (Emotional No Request: $M = 2.00$, $SD = 1.04$; Mechanical No Request: $M = 2.08$, $SD = 1.15$; Emotional Help Request: $M = 2.12$, $SD = 0.78$; Mechanical Help Request: $M = 2.32$, $SD = 0.95$).

For whether children thought the robot could know how other people feel, we did not find a main effect of age, $F(1,95) = 3.85$, $p = .053$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .129$ (Emotional No Request: $M = 1.48$, $SD = 1.23$; Mechanical No Request: $M = 1.76$, $SD = 1.23$; Emotional Help Request: $M = 1.88$, $SD = 0.78$; Mechanical Help Request: $M = 2.04$, $SD = 1.14$).

For whether children thought the robot has feelings, we did not find a main effect of age, $F(1,95) = 2.82$, $p = .097$, so we removed it from the final model. We did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .246$ (Emotional No Request: $M = 2.08$, $SD = 1.04$; Mechanical No Request: $M = 1.84$, $SD = 1.18$; Emotional Help Request: $M = 2.16$, $SD = 0.90$; Mechanical Help Request: M

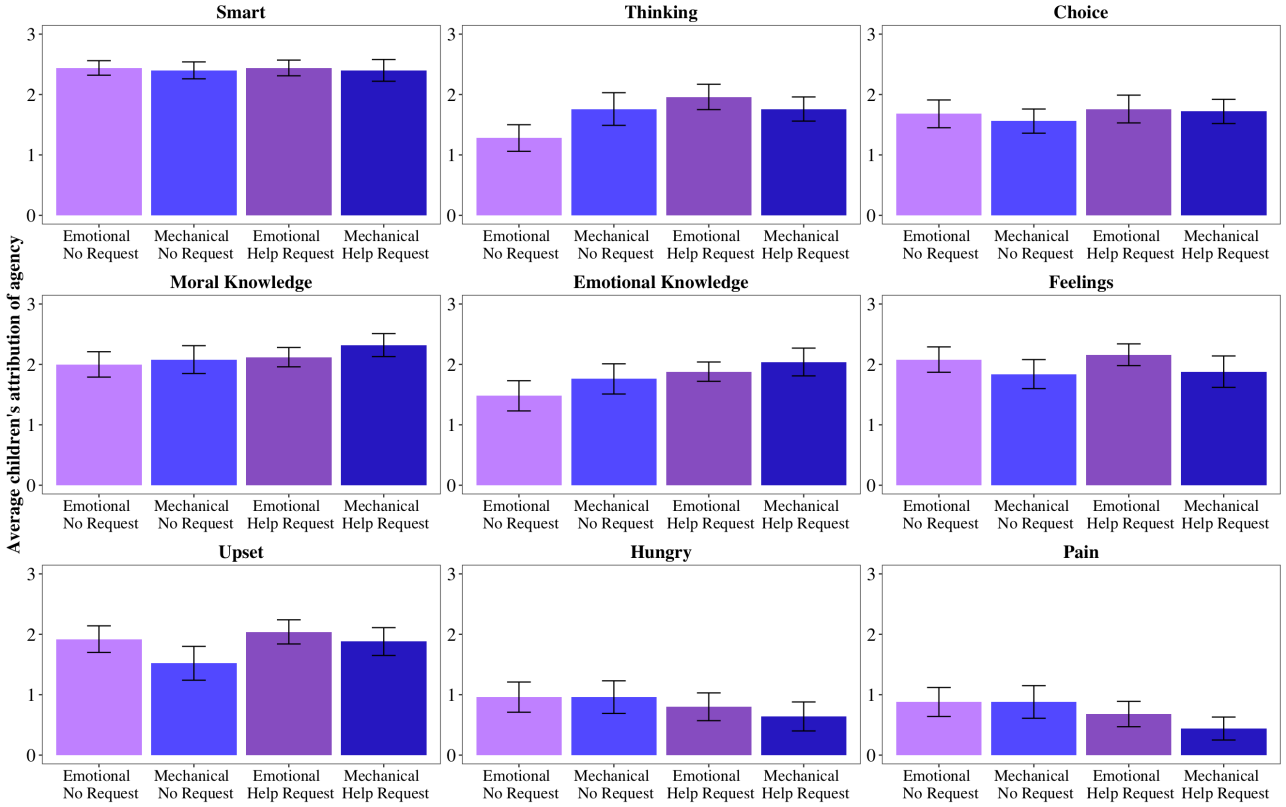

Figure 6: Average of children's agency judgments for each condition. Error bars represent standard error

= 1.88, SD = 1.30).

For whether children thought the robot could get upset, we did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .187$ (Emotional No Request: $M = 1.92$, $SD = 1.12$; Mechanical No Request: $M = 1.52$, $SD = 1.39$; Emotional Help Request: $M = 2.04$, $SD = 1.02$; Mechanical Help Request: $M = 1.88$, $SD = 1.13$). We found a significant effect of age, $F(1,95) = 10.26$, $p = .001$, such that older children thought the robot could get upset less than younger children, β = -0.25.

For whether children thought the robot could get hungry, we did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .371$ (Emotional No Request: $M = 0.96$, $SD = 1.27$; Mechanical No Request: $M = 0.96$, $SD = 1.37$; Emotional Help Request: $M = 0.80$, $SD = 1.15$; Mechanical Help Request: $M = 0.64$, $SD = 1.22$). We found a significant effect of age, $F(1,95) = 4.19$, $p = .044$, such that older children thought the robot could get hungry less than younger children, β = -0.18.

For whether children thought the robot could feel pain, we did not find significant main effects or interaction effects of Response and Valence Conditions, $ps \geq .179$ (Emotional No Request: $M = 0.88$, $SD = 1.20$; Mechanical No Request: $M = 0.88$, $SD = 1.33$; Emotional Help Request: $M = 0.68$, $SD = 1.03$; Mechanical Help Request: $M = 0.44$, $SD = 0.96$). We found a significant effect of age, $F(1,95) = 8.66$, $p = .004$, such that older children thought the robot could feel pain less than younger children, β = -0.22.

10 Care for Replacement

After the robot and game perception questions, children were asked about their level of care if the robot was replaced. This question was adapted from [3], such that the experimenter told the child that the university is thinking of replacing the robot with a new, different robot. The experimenter then showed the child a picture of the new robot. The experimenter asked the child if they would care if the robot was replaced, either yes or no (coded as 0). If the child answered "yes", the experimenter asked how much: a little bit (coded as 1), a medium amount (coded as 2), or a lot (coded as 3). After, the experimenter asked the child who they would want to play the mining game with, the Misty robot they played with (coded as 1) or the new robot (coded as 0).

We first looked at how much children would care if the robot was replaced by a different one. We conducted a General Linear Model with Response condition (No Request vs Help Request), Valence condition (Mechanical vs Emotional), and the interaction of the two as our independent variables. We did not find a significant effect of age, $p \geq .208$, so we did not include it in the final model. We did not find any main or interaction effects of the Response and Valence conditions, $ps \geq .105$ (Emotional Help Request: $M = 2.16$, $SD = 0.90$; Mechanical Help Request: $M = 1.68$, $SD = 1.03$; Emotional No Request: $M = 1.44$, $SD = 1.16$; Mechanical No Request: $M = 1.68$, $SD = 1.28$).

We then looked at whether children would choose to play with Misty or the new robot (for this, we ran a Generalized Logistic model due to the binary outcome variable). We did not find a significant effect of age or interaction between conditions, $p \geq .705$, so we removed the variables from the final model. We did not find a main effect of Response or Valence conditions, $ps \geq .218$ (Emotional Help Request: 60%, $SD = 0.50$; Mechanical Help Request: 68%, $SD = 0.48$; Emotional No Request: 48%, $SD = 0.51$; Mechanical No Request: 64%, $SD = 0.49$).

11 Proximity Drawing Examples

After the interview, children were asked to draw two pictures: one of them with the robot, one of them with their friend. Coders recorded the distance between the child and the partner (robot or friend). Based on [5], shorter distance indicates a closer feeling of relationship to the partner.

Most children drew themselves playing the game with the robot, which had the same placement for all conditions. This then likely inspired children to draw an image of themselves playing with their friend (e.g., throwing a ball). We suggest future research to either instruct or provide a background setting for children to draw themselves with the robot that would limit children basing their drawings on the study set up.

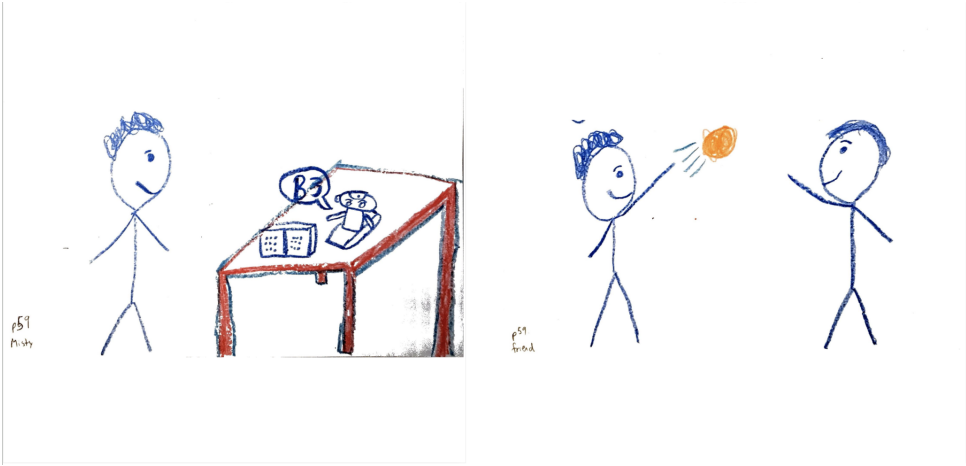

Figure 7: Image of child's drawing with the robot playing the game on the tablet (left) and drawing with the friend throwing a ball (right). Child was 10-years-old, Male, and in the Mechanical No Request condition.

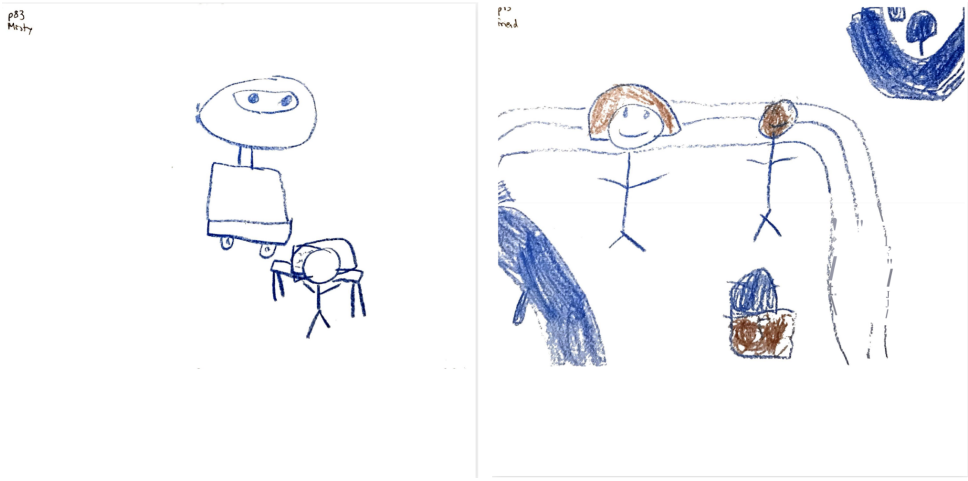

Figure 8: Image of child's drawing with the robot playing the game on the tablet (left) and drawing with the friend playing a sport (right). Child was 7-years-old, Male, and in the Emotional No Request condition.

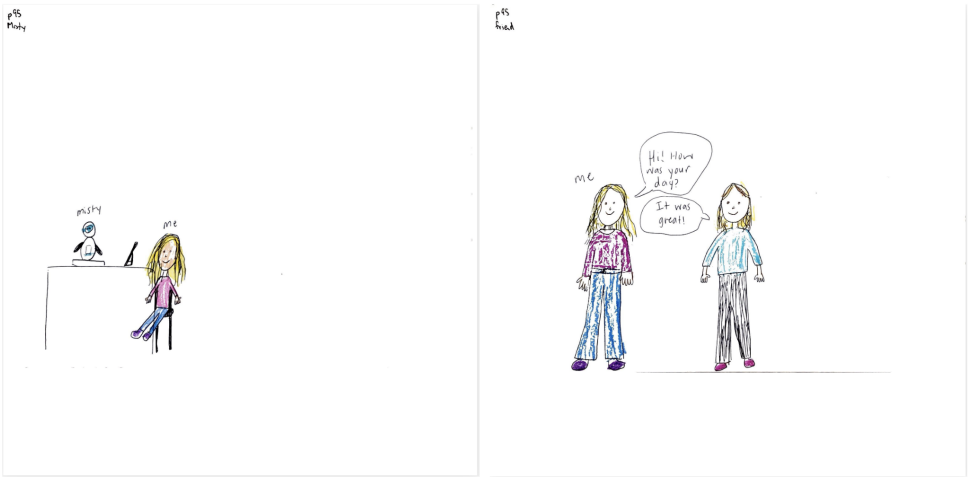

Figure 9: Image of child's drawing with the robot playing the game on the tablet (left) and drawing with the friend talking (right). Child was 10-years-old, Female, and in the Mechanical Help Request condition.

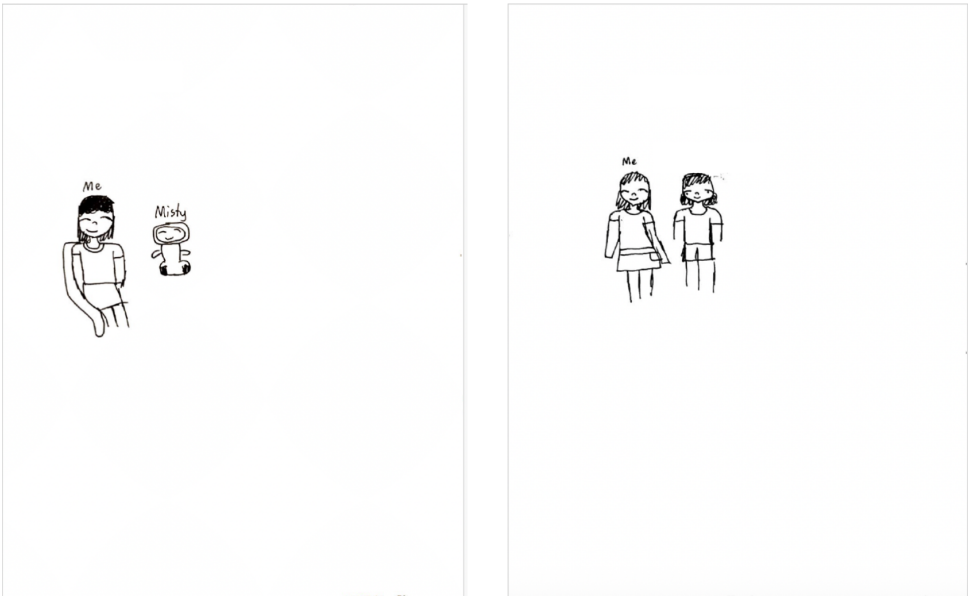

Figure 10: Image of child's drawing with the robot (left) and drawing with the friend (right). Child was 8-years-old, Female, and in the Emotional Help Request condition.

References

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