

## Supplementary material for RO-MAN submission 256

### Interview transcript for P6

1. P6: So build a wall. First, take one block and put it anywhere on the board.
2. ResAgent: I have learned an example of a block.
3. P6: So then take the next block of any type and put it directly next to the one you just placed
4. ResAgent: I have learnt another example of a block. I have learnt an example of next-to.
5. P6: Continue taking blocks and placing them next to the one you just placed
6. ResAgent: I have learned another example of next-to.
7. P6: There are some blocks that are not shaped like cubes.
8. ResAgent: I don't understand.
9. P6: So this block is shaped like a cylinder.
10. ResAgent: I have learned an example of shape cylinder.
11. P6: We don't want to use the cylinder. So, we'll put it back.
12. P6: So when you're placing blocks next to each other, you want them to be in a horizontal line like this.
13. ResAgent: I have learned an example of a horizontal line.
14. P6: You don't want them to be vertical or making a vertical line.
15. ResAgent: I don't understand vertical line.
16. P6: A vertical line is when two or more blocks are, umm, above and below one another and like a Northwest orientation.
17. ResAgent: I don't understand.
18. P6: So this line is horizontal and this line is vertical.
19. ResAgent: I have learned an example of horizontal line. I have learned an example of vertical line.
20. P6: So we want horizontal ones.
21. ResAgent: Okay.
22. P6: And continue creating the line by placing blocks next to one another.
23. ResAgent: Okay.
24. P6: until the blocks come from wall to wall or edge to edge of the table.
25. ResAgent: I don't know what an edge is.
26. P6: So the edge of this table is anything surrounding the perimeter. So if you look at my mouse, this is an edge.
27. ResAgent: I have learned an example of an edge.
28. P6: And this is also an edge.
29. ResAgent: I have learnt another example of an edge.
30. P6: This is an edge.
31. ResAgent: I have learned another example of an edge.
32. P6: And this is an edge.
33. ResAgent: I have learnt an example of an edge.
34. P6: So we have fully built our wall.
35. ResAgent: I have learnt an example of a wall
36. P6: And feel free to try building one yourself.
37. ResAgent: I'm taking control of the mouse. Done.

38. P6: Nice.

39. P6: Feel free to try completing the wall.

40. ResAgent: Okay, I am taking control of the mouse. Done.

41. P6: Good job.

42. P6: Try again.

43. ResAgent: Okay, I'm taking control of the mouse. Done.

44. P6: Nice job.

45. P6: Try making a wall now.

46. ResAgent: Okay, I'm taking control of the mouse. Done.

47. P6: Okay, try now.

48. ResAgent: I'm taking control of the mouse. Done.

49. P6: Good job.

50. P6: Okay, well, so we've built a general wall.

51. ResAgent: Okay, I have learned an example of a general wall.

52. P6: Now we'll build the wall of all the same color.

53. ResAgent: Okay.

54. P6: These two blocks are of different colors. This one is blue. And this one is red.

55. ResAgent: I have learned an example of blue, color blue. I have learned an example of color red.

56. P6: This color is green.

57. ResAgent: I have learned an example of color green.

58. P6: So now we'll build a wall of using all the color red

59. ResAgent: Okay.

60. P6: You can use any shape.

61. ResAgent: I don't know what shape is.

62. P6: So this shape is different than this shape. This shape is a square and this shape is a cylinder

63. ResAgent: I have learned an example of shape square. I have learned an example of shape cylinder.

64. P6: This shape is a cone.

65. ResAgent: I have learned an example of shape cone.

66. P6: So using any shape in the color red, let's build another wall.

67. ResAgent: Okay.

68. P6: Would you like to try?

69. ResAgent: I cannot do that.

70. P6: Here is the red wall, well almost.

71. P6: I'm building a red wall.

72. ResAgent: Okay

73. P6: Okay. So what I'm pointing to with my mouse here is a red wall.

74. ResAgent: I have learnt an example of a red wall.

75. P6: Would you like to try building the red wall?

76. ResAgent: Okay, I'm taking control of the mouse.

77. ResAgent: Done.

78. P6: Good job.

79. P6: Would you like to try building a blue wall?

80. ResAgent: I cannot do that.

81. P6: Why can't you do that?
82. ResAgent: I cannot do that.
83. P6: Yeah. Okay. This is an example of a blue wall.
84. ResAgent: I have learnt an example of a blue ball.
85. P6: This is an example of the green wall.
86. ResAgent: I have learnt an example of a green wall.
87. P6: Could you build a blue wall?
88. ResAgent: Okay, I am taking control of the mouse. Done.
89. P6: Good job. Okay. I'm done teaching.

## P6 FlowChart Description (Fig. 4a)

The flow chart has the following elements.

Two overarching lessons in solid boxes: Lesson A: Guiding robot through multicolor-shape wall building process, Lesson B: Same Color wall

Lesson A consists of sub-lessons (dashed boxes) that flow in this order

- I. Step-by-step process narration
- II. Providing composition related information
- III. Teach and Test wall

Lesson B consists of sub- lessons (dashed boxes) that flow in this order

- I. Provide domain information (distinguishing + negative)
- II. Teach and test same color wall

The instruction flows from lesson A to B B is through a blue arrow from sub-lesson AIII to sub-lesson BI.

The description of communicative actions (dotted boxes) is as follows:

### Sublesson AI: Step-by-step process narration

1. (Inform → Expand) (Property, Object Reference, Relation, Method of Action)
  - a. Black arrow flows to 1 (self)
  - b. Double-headed red arrow flows to 2
2. Revise (Property)
  - a. Double-headed red arrow flows to 1

### Sublesson AII: Providing composition related information

1. Inform (Composition)
  - a. Black arrow flows to 2
  - b. Double-headed red arrow flows to 3
2. Expand (Composition)
  - a. Black arrow flows to 4
3. Correct (Composition)
  - a. Double-headed red arrow flows to 1
  - b. Double-headed red arrow flows to 3 (self)
4. (Inform → Expand) (Situation, Method of action)

### Sublesson AIII: Teach and Test wall

1. Inform (Composition)
  - a. Black arrow flows to 2
2. Evaluate-Demonstrate (Composition)
  - a. Black arrow flows to 2 (self)

### Sublesson BI: Provide domain information (distinguishing + negative)

1. (Inform → Expand) (Property, Object Reference, Composition)
  - a. Black arrow flows to 1 (self)

#### Sublesson BII: Teach and test same color wall

1. Evaluate-Demonstrate (Composition)
  - a. Black arrow flows to 1 (self)
  - b. Black arrow flows to 2
  - c. Double-headed red arrow flows to 3
  - d. Double-headed red arrow flows to 4
2. Inform (Composition)
  - a. Black arrow flows to 1
3. Evaluate-Describe (Composition)
  - a. Double-headed red arrow flows to 1
  - b. Black arrow flows to 4
4. Correct (Composition)
  - a. Double-headed red arrow flows to 1

## Interview transcript for P10

1. P10: Robot. These objects are red.
2. ResAgent: I have learnt examples of red.
3. P10: Robot. These objects are cubes.
4. ResAgent: I have learnt examples of cubes.
5. P10: Robot, these objects are blue.
6. ResAgent: I have learnt examples of blue
7. P10: Robot. This is a wall.
8. ResAgent: I have learnt an example of a wall.
9. P10: Robot. This is a wall.
10. ResAgent: I have learnt another example of a wall.
11. P10: Robot, this is also a wall.
12. ResAgent: I have learnt another example of a wall.
13. P10: Robot. These objects are cylinders.
14. ResAgent: I have learnt examples of cylinders.
15. P10: Robot. These are examples of cylinders.
16. ResAgent: I have learnt another example of cylinder.
17. P10: Robot. Have you learned examples of green?
18. ResAgent: No.
19. ResAgent: I do not know what green is.
20. P10: Robot this object is green.
21. ResAgent: I have learnt an example of green.
22. P10: Okay, robot. These objects are green.
23. ResAgent: I have learnt examples of green.
24. P10: Robot. Can you tell me what this is?
25. ResAgent: I don't know.
26. P10: Robot. This is a wall.
27. ResAgent: I have learned another example of a wall.
28. P10: Robot can tell me what this is?
29. P10: Yeah robot. Can you tell me what this is?
30. ResAgent: This is an example of a wall.
31. P10: Robot. Can you tell me what color this wall is?
32. ResAgent: This wall is green.
33. P10: Robot. Can you make a wall?
34. ResAgent: I cannot do that.
35. P10: Does the robot know how to.. Robot. Do you know how to move objects?
36. ResAgent: Yes.
37. P10: Robot.
38. P10: Can you move the green cylinder immediately to the left of the green cube?
39. ResAgent: I don't know what left of is.
40. P10: Robot. The green cone is left of the green cube.
41. ResAgent: I have learnt an example of left of.
42. P10: Robot, the green cube is right of the green cylin or green cone.
43. ResAgent: I have learnt an example of right of

44. P10: Robot, can you move a green cylinder left of the green cone?  
45. ResAgent: Okay, I'm taking control of the mouse. Done.  
46. P10: Can you tell me what you've built?  
47. ResAgent: This is a green wall.  
48. P10: Okay.  
49. P10: Robot, can you make a blue wall?  
50. ResAgent: Okay, I am taking control of the mouse.  
51. P10: Okay. Yay robot.  
52. P10: Robot. Can you make a red, green and blue wall?  
53. ResAgent: I cannot do that.  
54. P10: Robot can you make a red and blue wall?  
55. ResAgent: I cannot do that.  
56. P10: Okay robot. This is a red and blue wall.  
57. ResAgent: I have learnt an example of a red and blue wall.  
58. P10: Okay Robot. This is also a red and blue wall.  
59. ResAgent: I have learnt another example of a red and blue ball.  
60. P10: Okay, Robot. This is also a red and blue wall.  
61. ResAgent: I have learnt another example of a red and blue wall.  
62. P10: Robot. This is a red, blue and green wall.  
63. ResAgent: I have learnt an example of red, blue and green wall.  
64. P10: Robot. Can you tell me what this is?  
65. ResAgent: This is a wall.  
66. P10: That's right. Robot. This is also a red, blue and green wall.  
67. ResAgent: I have learned another example of a red, blue and green ball.  
68. P10: okay so robot. Can you tell me what this is?  
69. ResAgent: This is a wall.  
70. P10: That's right, Robot. This is also a red, blue and green wall.  
71. ResAgent: Okay, I have learnt another example of a red, blue and green wall.  
72. P10: Robot. Can you make a red, blue and green wall?  
73. ResAgent: Okay, I am taking control of the mouse. Done.

## P10 FlowChart Description (Fig. 4b)

The flow chart has the following elements.

Three overarching lessons in solid boxes: Lesson A: Provide domain information, Lesson B: Same Color wall, Lesson C: Red, blue and green wall

Lesson A consists only of communicative actions described later.

Lesson B consists of sub- lessons (dashed boxes) that flow in this order

- I. Evaluate knowledge before task
- II. Guiding robot through building process

Lesson C consists of sub- lessons (dashed boxes) that flow in this order

- I. Evaluate-Demonstrate (Composition)
- II. Red & blue wall
- III. Lesson about multicolor composition (no title in image)

The instruction flow from lesson B to C is through a blue arrow from sub-lesson BII to sublesson CI.

The description of communicative actions (dotted boxes) is as follows:

### Lesson A: Provide domain information

1. (Inform → Expand) (Property, Composition)
  - a. Black arrow flows to 2
2. (Evaluate-Test ↔ Correct) (Property, Composition)
  - a. Double-headed red arrow flows between Evaluate and Correct
  - b. Black arrow flows to 1

### Lesson B

#### *Sublesson BI: Evaluate knowledge before task*

1. Evaluate-Test (Composition, Action, Property)
  - a. Black arrow flows to 1 (self)
  - b. Black arrow flows to 2
2. Evaluate-Demonstrate (Composition)
  - a. Double-headed red arrow flows to sublesson BII

#### *Sublesson BII: Guiding robot through building process*

1. Evaluate-Demonstrate (Action)
  - a. Black arrow flows to 2
  - b. Double-headed red arrow flows to 3
2. Evaluate-Test (Composition)
3. (Correct → Inform) (Relation)
  - a. Double-headed red arrow flows to 1



## Lesson C

Double-headed red arrow flows between Sublesson CI and CII. Black arrow flows from Sublesson CII to Sublesson CIII. Black arrow flows from Sublesson CIII to Sublesson CI.

### *Sublesson CI*

1. Evaluate-Demonstrate (Composition)
  - a. Double-headed red arrow flows to Sublesson CIII

### *Sublesson CII: Red & blue wall*

1. Evaluate-Demonstrate (Composition)
  - a. Double-headed red arrow flows to 2
2. (Correct → Expand) (Composition)
  - a. Double-headed red arrow flows to 1

### *Sublesson CIII: Lesson about multicolor composition (no title in image)*

1. Evaluate-Test (Composition)
  - a. Black arrow flows to 2
2. (Inform → Expand) (Composition)

### Fig. 1 alt-text

Two wooden tables next to each other. The left table has a horizontal wall with different shapes put together. The right table has random different colored shapes scattered across it.

### Fig. 2 supplemental figure description

The values in **bold** represent the aspects that emerged through our bottom-up analysis, and the remaining values represent the aspects that were part of our *a priori* hypotheses.

#### Domain Ontology

1. Property
2. **Object Reference**
3. **Composition**
4. Relation
5. Situation
6. Action
7. **Method of action**

#### Modalities

1. Language
2. Gestures
  - a. Pointing
  - b. **Circling**
  - c. **Selecting referred object**
  - d. **Moving referred object**
  - e. **Moving mouse pointer to demonstrate limits**

#### Concept Expressions

1. Verbal definitions
2. Instances
  - a. Examples
  - b. Demonstrations

#### Intentions

1. Inform
2. **Expand past knowledge**
3. Evaluate
  - a. **Test**
  - b. Describe
  - c. Demonstrate
4. Correct student knowledge
5. **Revise**

Fig. 3 supplemental figure description

Intention->	Inform		Expand		Evaluate		Correct		Revise	
Participant	Number of Instructions with intention	Number of gestures per intention	Number of Instructions with intention	Number of gestures per intention	Number of instructions with intention	Number of gestures per intention	Number of instructions with intention	Number of gestures per intention	Number of instructions with intention	Number of gestures per intention
P1	16	8	5	7	11	2	2	0	2	0
P2	10	11	20	28	2	2	1	2	0	0
P3	16	19	4	8	13	5	2	2	0	0
P4	22	0	32	0	33	0	2	0	0	0
P5	30	7	10	3	56	0	7	3	23	0
P6	28	20	11	14	10	0	4	4	2	1
P7	11	7	9	2	3	0	0	0	1	0
P8	18	5	0	0	7	6	0	0	0	0
P9	21	8	5	0	13	0	2	0	8	0
P10	10	1	9	0	16	1	4	1	0	0