

Supplemental information

1. Experiment 1

1.1. Description and results of filters for inclusion of a participant's data in the analyses.

The data from thirty-two participants were excluded for failing to indicate a location at least halfway towards the second location on the single 'True Representation' trial (in which the object was moved in full view of both protagonists – see below), one for exceeding a 22-minute experiment time threshold (based on a prediction of an allowable average 20 seconds per screen on each trial, plus up to 10 minutes to read and complete consent forms and instructions), three for providing responses on fewer than 5 out of 9 word searches (see below), and five for incomplete or inaccurate manual calibration of the trough size on their screen, in which participants clicked on the edges of the trough on their screens (more than +/- 4 pixels from true trough size of 584 pixels). Additionally, one participant from the Belief condition was removed for failing to complete the experiment. Finally, data from one trial was removed from two participants' data due to the premature termination of the preceding word search.

Trial list

1.

Sally and Ann are outside playing in the sandpit. Sally hides a red toy dog in the sand here, and then goes inside to get a drink of water.

While Sally is inside the house, Ann finds the toy dog and hides it here.

Then Sally comes back. Where did she put the red toy dog before she went inside?

2.

Judy and her dad are planting flowers in the planter box to surprise her mum. Judy's dad buries the flower here.¹

While Judy's dad is gone, Judy puts the flower here.

Then Judy's dad comes back. Where did he bury the flower before he left?

3.

Max and his mum have just come home from the grocery store and are putting the groceries away. Max puts away the ice cream in the freezer here and then goes outside to play.

While Max is outside, his mum opens the freezer and moves the ice cream here.

When Max comes back inside, where is he going to look for the ice cream?

4.

Todd and Sam are taking a bubble bath together while playing with toys. Todd drops a truck in the water here and then goes to get a towel.

¹ It came to our attention that we had failed to include one segment of the original text from a memory trial in Sommerville et al.'s (2013) study. Specifically, in the second scenario, Judy's dad's absence was explained by his going to the shed to get a shovel. Since the text made clear the crucial point that Judy's dad was absent while the object was moved (i.e. "While Judy's dad was away..."), we were not concerned that participants would place Judy's dad in the scene while the object was moved. Nevertheless, we performed identical analyses with this trial excluded, finding that bias on long-distance memory trials (of which this trial was one) still failed to differ significantly from zero ($Mdn_{bias} = 2.0\%$, $Z = 0.457$, $p = .648$, $r = .07$). The marginally greater bias on belief trials compared to memory trials became significant with this trial removed ($Z = 2.258$, $p = .024$, $r = .25$), but this imposed no requirement to modify our interpretation of the results.

While Todd is gone, Sam moves the toy truck to here.

When Todd comes back, where will he look for the truck?

5. (TRUE BELIEF)

Carmen and Richard are taking ornaments off the Christmas tree and putting them in a box. Carmen takes an ornament and places it here.

While she is watching, Richard moves the ornament here. Then Carmen leaves the room to go blow her nose.

When Carmen comes back she wants to look for the ornament again. Where will she look for it?

6.

Jenny and Billy are walking in the forest. Jenny leaves her backpack near a tree here, and then goes near the stream to cool down.

While Jenny is gone, Billy moves her backpack here.

When Jenny comes back, where will she look for her backpack?

7.

Oscar and Penny are delivering newspapers on the street. Oscar leaves a bundle of newspapers here, and then goes off to eat his lunch.

While Oscar is gone, Penny moves the bundle of newspapers here.

When Oscar comes back, where will he look for the newspapers?

8.

Mario and his mother are putting away clothes. Mario puts his socks here, and then goes to get a snack.

While Mario is gone, his mother moves his socks here.

Then Mario comes back. Where did he put his socks before he left?

9.

Sayeed and his grandma came home from an afternoon in the park. Sayeed's grandma puts her keys here, and then goes to make dinner.

While Sayeed's grandma is gone, Sayeed takes the keys and places them here.

Then Sayeed's grandma comes back to look for her keys. Where did she put the keys before she went to make dinner?

2. Experiment 2

2.1. Description and results of filters for inclusion of a participant's data in the analyses.

One participant was removed for not completing the experiment, one for taking longer than 22 minutes, three for failing to successfully complete calibration, three for failing to respond on at least 4 out of 9 word searches, five for calibrating trough sizes greater than 4 pixels away from 584, and 21 for failing the True Representation trial.

Trial List.

1.

Sally and Ann are outside playing in the sandpit. Sally has a red toy dog, and Ann is filming her with a camera. While Ann is watching and filming her, Sally buries the red toy dog in the sand here. Ann then goes inside with the camera to get a drink of water.

While Ann is inside the house, Sally digs the red toy dog out and hides it here. She smooths over the sand so it looks undisturbed.

After a while, Ann comes back, still holding the camera.

- a) Where does she think the red toy dog is?
- b) Where will the camera show the red toy dog is?

2.

Tom and Rachel are in the front garden. Tom has the spare house key, and Rachel is filming him with a camera. While Rachel is watching and filming him, Tom buries the spare house key in the garden here. Rachel then goes inside with the camera to make a cup of tea.

While Rachel is inside the house, Tom digs the spare house key out and hides it here. He smooths over the earth so it looks undisturbed.

After a while, Rachel comes back, still holding the camera.

- a) Where does she think the spare house key is?
- b) Where will the camera show the spare house key is?

3.

(removed from analyses owing to confusion over protagonist roles)

Max and Audrey are putting toys in the big toy trunk in the living room. Max has a tennis ball, and Audrey is filming him with a camera. While Audrey is watching and filming him, Max buries the tennis ball in the trunk here. Audrey then goes to the kitchen with the camera to get a cookie.

While Audrey is in the kitchen, Max digs the tennis ball out and hides it here. He puts everything else in the trunk back where it was so it looks undisturbed.

After a while, Max comes back, still holding the camera.

- a) Where does he think the tennis ball is?
- b) Where will the camera show the tennis ball is?

4.

Rebecca and Steve are in the restaurant kitchen. Rebecca has the tips jar, and Steve is filming her with a camera. While Steve is watching and filming her, Rebecca buries the tips jar in the freezer here. Steve then goes outside with the camera to smoke a cigarette.

While Steve is outside, Rebecca digs the tips jar out and hides it here. She puts everything else in the freezer back where it was so it looks undisturbed.

After a while, Steve comes back, still holding the camera.

- a) Where does he think the tips jar is?
- b) Where will the camera show the tips jar is?

5. (TRUE BELIEF)

Astrid and Jessica are in the ball pit. Astrid has a chocolate egg, and Jessica is filming her with a camera. While Jessica is watching and filming her, Astrid buries the chocolate egg in the ball pit here.

While Jessica is still watching and filming her, Astrid digs the chocolate egg out and hides it here. She smooths over the balls so they look undisturbed. Jessica then goes inside with the camera to get a drink.

After a while, Jessica comes back, still holding the camera.

- a) Where did Astrid hide the chocolate egg?

6.

Peter and Jason are by the hotel garden pond. Peter has a bag of jewels, and Jason is filming him with a camera. While Jason is watching and filming him, Peter buries the bag of jewels in the pond here. Jason then goes inside with the camera to make a call.

While Jason is inside, Peter digs the bag of jewels out and hides it here. He watches the surface of the pond until it looks undisturbed.

After a while, Jason comes back, still holding the camera.

- a) Where does he think the bag of jewels is?
- b) Where will the camera show the bag of jewels is?

7.

Chloe and James are hiking in the snow. James has a bottle of beer, and Chloe is filming him with a camera. While Chloe is watching and filming him, James buries the bottle of beer in the snow here. Chloe then goes into their tent with the camera to check her emails.

While Chloe is away, James digs the bottle of beer out and hides it here. He then smooths over the snow so it looks undisturbed.

After a while, Chloe comes back, still holding the camera.

- a) Where does she think the bottle of beer is?
- b) Where will the camera show the bottle of beer is?

8.

Sarah and Alan are on the beach. Sarah has their passports, and Alan is filming her with a camera. While Alan is watching and filming her, Sarah buries the passports in the sand here. Alan then goes to a shop with the camera to get some ice cream.

While Alan is away, Sarah digs the passports out and hides them here. She then smooths over the sand so it looks undisturbed.

After a while, Alan comes back, still holding the camera.

- a) Where does he think the passports are?
- b) Where will the camera show the passports are?

9.

John and Alice are in the garden with a planter. John has a flower bulb, and Alice is filming him with a camera. While Alice is watching and filming him, John buries the flower bulb in the planter here. Alice then goes inside with the camera to get some water.

While Alice is away, John digs the flower bulb out and hides it here. He then smooths over the soil so it looks undisturbed.

After a while, Alice comes back, still holding the camera.

- a) Where does she think the flower bulb is?
- b) Where will the camera show the flower bulb is?