Oh...So close!

Children's close counterfactual reasoning and emotion inferences

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Abstract

How we feel about an outcome often depends on how close an alternative outcome was to occurring. In four experiments, we investigated whether predominantly White, middle-class, Canadian children ($N = 425$, Experiments 1-3) and American adults ($N = 227$, Experiment 4) consider close counterfactual alternatives when inferring other people's emotions. In Experiment 1, 6-year-olds (but not 4- and 5-year-olds) inferred that an agent would feel sadder about winning a mediocre prize if she later found out that a more attractive one could have easily been won. However, children of all ages failed to judge whether the better outcome could have easily happened. In Experiment 2, when 5- and 6-year-olds knew the locations of the prizes beforehand, they inferred that an agent would be equally happy about winning a mediocre prize regardless if she almost won a better prize or not. Again, they did not recognize when the better outcome was a close counterfactual possibility. In Experiment 3, we included extra cues to the closeness of the alternative and both 5- and 6-year-olds inferred that she would feel sadder about winning a mediocre prize, and 6-year-olds acknowledged that the attractive prize was a close counterfactual alternative. In Experiment 4, adults considered close counterfactuals when inferring emotions. Our findings suggest that close counterfactuals influence children's emotion inferences before they become able to acknowledge their closeness.

Keywords: emotion attribution, happiness, close counterfactuals, social cognition, cognitive development

Introduction

People's emotional reactions depend not only on actual events, but also on counterfactual events that did not happen, but easily could have (Kahneman & Miller, 1986). Consider the classic scenario from Kahneman and Tversky (1982), in which Mr. Tees missed his flight by five minutes, while Mr. Crane missed his flight by 30 minutes. Who is more upset? Most people agree that Mr. Tees is more upset. This is presumably because the counterfactual world in which Mr. Tees made his flight seems *closer* than one where Mr. Crane made his. Besides affecting judgments about others' emotional reactions (e.g., Johnson, 1986; Kahneman & Tversky, 1982; Medvec & Savitsky, 1997), the closeness of counterfactuals also affect emotional reactions firsthand (e.g., Markman & Tetlock, 2000; McMullen & Markman, 2002; also see Medvec et al., 1995, for evidence of this in Olympic medalists' emotions as rated by others).

Many factors can affect the perceived closeness of a counterfactual outcome (Roese & Olson, 2014). In the example of Mr. Tees and Mr. Crane, closeness depended on temporal proximity – it feels like Mr. Tees could have easily made his flight because he was barely late. But counterfactual closeness can also depend on spatial and numerical proximity (e.g., Ong et al., 2015; Teigen, 1996; Turnbull, 1981). Additionally, counterfactual closeness can depend on probability (e.g., Kahneman & Varey, 1990; Roese & Olson, 2014). If the prior probability of an event is high then even when it does not occur, people may judge that it nearly did, and this may affect emotions (e.g., Bell, 1985). In a gambling task, people felt worse about winning nothing if their initial chances of winning money were high compared to low, presumably because they were closer to winning in the former case (Mellers et al., 1997; van Dijk & van der Pligt, 1997).

One indication that a counterfactual possibility is viewed as especially close comes from the way people describe it. People often express counterfactuals using conditionals, like “If Mr.

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Tees had left 5 minutes earlier, he would have caught his flight”. Such conditionals can be used to express far-fetched and distant counterfactuals (e.g., If Mr. Tees had teleported to the airport, he would have caught his flight). However, when counterfactuals are viewed as especially close to reality, they are described without conditionals, and as facts about reality itself, as in “the passenger almost caught his flight.”. Kahneman and Varey (1990) termed these “close counterfactuals”, and explored factors leading people to judge that a counterfactual outcome “almost happened”. Subsequent researchers noted and investigated other non-conditional phrases used to express close counterfactuals. For example, besides describing a passenger who narrowly misses a flight as having “almost caught it”, people might also say that the passenger “barely missed it” (Mandel, 2003) or “could easily have caught it” (Teigen, 1995).

Here we explore children’s ability to consider close counterfactual alternatives when inferring other people’s emotions. Children can reason counterfactually by age 4 (e.g., Beck et al., 2006; German & Nichols, 2003; Harris et al., 1996; but also see Beck et al., 2010). For example, children learned that a box lights up if one block is placed on it, but not if a different block is used. When the box lit up after both blocks were put on it, 4- and 5-year-olds reasoned counterfactually about whether it would have lit up if each block had not been placed on it (Nyhout & Ganea, 2019b). Children can also consider *close* counterfactuals when the actual outcome and the counterfactual alternative are spatially close. In one study, children watched as two toy horses galloped along a table; one horse fell and the other stopped just at the edge. Around age 5, children were able to say which of the two horses almost fell (Beck & Guthrie, 2011).

Children’s understanding of the emotional consequences of counterfactuals may develop somewhat later. Children do not appear to experience counterfactual emotions until the ages of 5

to 7 (e.g., Guerini et al., in press; O'Connor et al., 2012; Weisberg & Beck, 2010; but see Weisberg & Beck, 2012, for evidence of slightly earlier development), and existing literature suggests that they do not use counterfactual comparisons to infer other people's emotions until at least age 7 (e.g., Amsel & Smalley, 2000; Beck & Crilly, 2009; Guttentag & Ferrell, 2004; see Beck & Riggs, 2014, for a review). For example, in Weisberg and Beck (2010), a character won a mundane prize when choosing between one of two opaque boxes. When it was revealed that the character could have won a better prize (a counterfactual possibility), even 7-year-olds did not predict that he would now be sad about the prize he got. This finding suggests that children do not consider counterfactual alternatives when inferring others' emotions.

However, no studies have examined whether children consider the *closeness* of counterfactual alternatives when inferring emotions. For example, in Weisberg and Beck (2010), the character was not closer to winning one prize over the other. Without comparison conditions that manipulate the closeness or the odds of the counterfactual alternative, we cannot know whether children's emotion inferences depend on close counterfactuals. As we saw with Mr. Tees and Mr. Crane, the closeness of the counterfactual alternatives is critical: a disappointing outcome may be especially disappointing if a desirable outcome nearly happened. If children use close counterfactuals to infer emotions, this will provide further support that counterfactual reasoning is central to children's thinking from early in development (Weisberg & Gopnik, 2013).

One recent finding suggests that young children might consider close counterfactuals when inferring emotions. Children saw two bowlers, one whose ball was on a trajectory to knock down many pins and another whose ball was on a trajectory to knock down none. In the end, both knocked down 3 of 6 pins. Children aged 5 expected the bowler who almost knocked-down

all the pins to feel worse than the one who almost knocked-down none (Asaba et al., 2019).

Children might have based this inference on close counterfactuals – they might have reasoned that the first bowler was more upset because they nearly knocked down all the pins. But as Asaba et al. (2019) suggest, children might have based their inferences on the characters' expectations. Further, children were not asked about their counterfactual thoughts, making it difficult to know whether they were using close counterfactuals to infer emotions.

We conducted three experiments to examine whether children consider close counterfactuals when inferring others' emotions. In each experiment, children heard stories about a girl who won a mundane prize. Across conditions, we manipulated whether the girl later discovered that her odds of winning a more attractive prize had been high or low. When the odds were very high, the closest counterfactual alternative was winning the attractive prize. However, when the odds were low, the closest counterfactual alternative was winning a mundane prize. Thus, the closeness of the counterfactual alternative was manipulated by differences in probability across conditions. If children consider close counterfactuals, they should recognize that the girl would be happier when she had a low chance of winning an attractive prize than when she had a high chance. In later experiments, we added a second cue to counterfactual closeness, spatial proximity. This cue was manipulated by having the girl choose a mundane prize that was closer or further from an attractive one. Children were also asked a question assessing whether they recognized the closeness of the counterfactual alternative where the girl won a more attractive prize.

In our first experiment, we tested children aged 4 to 6, and our later experiments focussed on children aged 5 to 6. We focussed on this age range because it is when children begin to reason counterfactually (e.g., Nyhout & Ganea, 2019b) and when they first use probability and

expectations to infer others' emotions (e.g., Asaba et al., 2019; Doan et al., 2020). Hence, we test 4 – 6-year-olds to see how these two areas of development connect. This age range was also promising because it encompasses a period in which children undergo major development in areas of cognition relevant for counterfactual reasoning, including development of executive functions and linguistic abilities (e.g., for reviews see Beck & Riggs, 2014 and Nyhout & Ganea, 2019a). In our final experiment, we tested adults. Some studies investigating the influence of close counterfactuals on emotions have confounded close counterfactuals with prior beliefs. For example, in gambling tasks, the odds of winning money are known beforehand, so emotion ratings could have been based on participants' prior beliefs about winning instead of whether they were close to winning (e.g., Mellers et al., 1997; van Dijk & van der Pligt, 1997; but for an exception see Ong et al., 2015). We tested adults to address this concern and to provide a reference point for comparison with children's emotion and close counterfactual responses.

Experiment 1

Children heard a story about a girl who chose one of ten closed boxes and won a regular balloon. She then either learned that most of the other boxes contained special balloons or that most contained regular balloons. Children were asked how the girl felt about getting the regular balloon and whether the girl could have easily gotten a special balloon.

Methods

Participants. We tested 180 4-6-year-olds ($M = 5;6$ [years; months]; range = 4;0 – 6;11; 86 girls). There were 60 4-year-olds ($M = 4;5$; range = 4;0 – 4;11; 29 girls), 60 5-year-olds ($M = 5;6$; range = 5;0 – 5;11; 32 girls), and 60 6-year-olds ($M = 6;6$; range = 6;0 – 6;11; 25 girls), with equal numbers of children per age-in-years randomly assigned to each between-subjects condition. Sample sizes for all experiments were decided in advance based on a stopping rule.

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Our lab chose the stopping rule of 30 participants per cell because it sufficed to reveal effects in previous developmental experiments using similar designs (e.g., Asaba et al., 2019; Doan et al., 2020; Shaw & Olson, 2015). In all experiments, children were individually tested at schools and daycares in a mid-sized Canadian city in Southwestern Ontario. Demographic information was not formally collected, but the region is predominantly middle-class, and approximately 79% of residents in this region are White, with Chinese and South Asians as the most visible minorities. This research, submitted under the name, “Social Understanding in Children” (ORE#30395), received ethics clearance through the University of Waterloo’s Research Ethics Board.

Materials and procedure. All materials were shown on a laptop computer. Children were told a story about a girl who could win either a regular or a special balloon. See Figure 1 for the story and script. The girl stood before ten closed boxes that each contained a balloon (the balloons were not visible). The girl could choose one of the boxes and win the balloon inside. She chose a box and received a regular balloon. Next, she was shown the balloons in the remaining boxes. Children were asked how the girl felt about getting the regular balloon, and responded using a 7-point happy face scale, ranging from extremely happy to extremely sad.

After children rated the girl’s happiness, they were asked whether she could have easily gotten a special balloon, with their responses recorded as either “yes” or “no”. We asked the close counterfactual question in this way as this phrasing has been used to assess counterfactual reasoning with adults in other studies (e.g., Teigen 1995, 1997).

Children saw the story in one of two between-subjects conditions. In the Mostly Special condition, there were eight special balloons and two regular balloons (80% chance of getting a special balloon). In the Mostly Regular condition, there were eight regular balloons and two

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special balloons (20% chance of getting a special balloon). The scripts were identical across conditions.

Experiment 1

Here's a girl and she can win a balloon. She might win this kind of *regular* balloon or she might win this kind of *special* balloon. Here's how the girl can win a balloon.

Do you see these boxes? Each box has a balloon in it. The girl gets to choose a box and she gets whichever kind of balloon is in the box she chooses.

The girl chooses this box. Look, she got this balloon. Let's show the girl what balloons are in the other boxes.

When the girl sees this, how does she feel about the balloon that she got?

Could the girl have easily gotten a special balloon?

Experiment 2

Here are some balloons. There are *special star* balloons and there are *regular round* balloons.

Each balloon is hidden in a box. And look, here's a girl. She can win a balloon. Here's how the girl can win a balloon. The girl gets to choose a box and she gets whichever kind of balloon is in the box she chooses. The girl does not know which balloon is in each box. *Does the girl know which balloon is in each box?*

The girl chooses this box. Look, she got this balloon. Let's show the girl what balloons are in the other boxes.

When the girl sees this, how does she feel about the balloon that she got?

Did the girl almost get a special balloon?

Experiment 3

Here's a girl and she can win a balloon. She might win this kind of *regular* balloon or she might win this kind of *special* balloon. Here's how the girl can win a balloon.

Do you see these boxes? Each box has a balloon in it. The girl gets to choose a box and she gets whichever kind of balloon is in the box she chooses.

The girl chooses this box. Look, she got this balloon. Let's show the girl what balloons are in the other boxes.

When the girl sees this, how does she feel about the balloon that she got?

Could the girl have easily gotten a special balloon?

OR

Did the girl almost get a special balloon?

Figure 1. Slides and scripts for Experiments 1-3. The star and heart balloons are the special balloons and the round balloons are the regular balloons.

Results and Discussion

The analyses in all experiments used Generalized Estimating Equations models (GEEs); ordinal logistic for happiness ratings and binary logistic for counterfactual questions. In Experiments 1-3, age in months was mean-centred and entered as a covariate. Table 1 lists the factors entered into each model and all significant and marginal effects.

We first looked at children's happiness ratings. There was a significant main effect of age, $Wald\ X^2(1) = 19.51, p < .001$, no main effect of distribution, $Wald\ X^2(1) = 1.88, p = .170$, and a significant age-by-distribution interaction, $Wald\ X^2(1) = 12.18, p < .001$; see Figure 2. To follow up on this interaction, we tested each age group separately and found that 6-year-olds rated the girl as significantly happier in the Mostly Regular condition than in the Mostly Special condition, $Wald\ X^2(1) = 13.34, p < .001$. Five-year-olds did not show differences between the two conditions, $Wald\ X^2(1) = 1.51, p = .218$, and 4-year-olds rated the girl as significantly happier in the Mostly Special condition than in the Mostly Regular condition, $Wald\ X^2(1) = 4.51, p = .034$. We also tested each condition separately. In the Mostly Special condition, with age, children rated the girl as less happy to receive a regular balloon, $Wald\ X^2(1) = 26.88, p < .001$; in the Mostly Regular condition, age did not affect their happiness ratings, $Wald\ X^2(1) = 0.63, p = .429$.

Next, we looked at children's responses to the counterfactual question. There was a significant main effect of age, $Wald\ X^2(1) = 4.05, p = .044$, no main effect of distribution, $Wald\ X^2(1) = 0.62, p = .431$, and a significant age-by-distribution interaction, $Wald\ X^2(1) = 4.09, p = .043$; see Figure 2. We tested each age group separately and found that 4-, 5-, and 6-year-olds' responses did not significantly differ between the two conditions, $Wald\ X^2(1) = 0.34, p = .558$, $Wald\ X^2(1) = 0.45, p = .503$, $Wald\ X^2(1) = 2.10, p = .147$, respectively. We also tested each

condition separately, and found that in the Mostly Regular condition, with age, children were less likely to say the girl could have easily gotten a special balloon, $Wald\ X^2(1) = 7.69, p = .006$; in the Mostly Special condition, age did not affect their judgment, $Wald\ X^2(1) = 0.00, p = .993$.

At age 4, children inferred that the girl would be happier when she learns that most of the remaining boxes contained special balloons. Although seemingly counterintuitive, our youngest children may have inferred that the girl is happy because there were overall many special balloons – more special balloons means more happiness. Previous studies have reported similar findings in older children aged 5 and 7 (Guttentag & Ferrell, 2004; McCloy & Strange, 2007). Our older children did not rely on this strategy for their emotion ratings, and by age 6, children inferred the girl would feel sadder about winning a regular balloon when she could have easily won a more attractive one (i.e., compared with when this counterfactual alternative was not close). This finding suggests that children might use counterfactuals to infer others' emotions earlier than previously thought.

However, when directly asked the counterfactual question, even 6-year-olds were insensitive to the difference in closeness between conditions. Perhaps children struggled with our specific question. We asked children whether the girl “could have easily” won a special balloon. In earlier work showing that 5-year-olds can consider close counterfactuals, children were instead asked about whether a counterfactual alternative “almost” happened (Beck & Guthrie, 2011), which may be easier for them to understand. So in the next experiment, we adopted this wording for our counterfactual question.

We also wondered if younger children would succeed if the chronology of the story was changed. Information about the initial odds of winning a special balloon was only provided after it already became evident that this outcome did not occur to reduce the likelihood that children

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could rely on prior beliefs in their emotion judgements. However, this is a somewhat unusual sequence of events and young children might find it difficult to follow. We examined these possibilities in Experiment 2. That is, we changed the close counterfactual question to be more similar to previous child studies and changed the chronology of the story.

Table 1

Factors and Effects from each GEE Analysis

Experiment	Test Question	Factors	Effects	Wald X^2	<i>df</i>	<i>p</i>
1	happiness	distribution	age	19.51	1	<.001
			age*distribution	12.18	1	<.001
	counterfactual	distribution	age	4.05	1	.044
			age*distribution	4.09	1	.043
2	happiness	distribution	age	12.45	1	<.001
			distribution	2.93	1	.087
	counterfactual	distribution	age	4.55	1	.033
			age*distribution	6.83	1	.009
3	happiness	distribution	distribution	12.23	1	<.001
			distribution	14.92	1	<.001
	counterfactual	distribution	age*distribution	7.59	1	.006
			question-type	13.82	1	<.001
4	happiness	distribution	age*question-type	9.92	1	.002
			distribution	72.84	1	<.001
	counterfactual	distribution	distribution	177.77	1	<.001
			question-type	3.16	1	.076

Note. In all experiments, distribution was either Mostly Special or Mostly Regular; in Experiments 3 and 4, question-type was either “could the girl have easily gotten” or “did the girl almost get” a special balloon.

Figure 2. Children's happiness ratings (top row) and counterfactual responses (bottom row) in Experiments 1-3. Happiness ratings ranged from -3 (extremely sad) to 3 (extremely happy). Colored bands show 95% confidence intervals; points are jittered to avoid over-plotting.

Experiment 2

The story was similar to Experiment 1, except children saw the array of balloons at the beginning and were told that the girl did not know which balloons were in each box. Also, instead of asking whether the girl *could have easily* gotten a special balloon, we asked whether the girl *almost* got a special balloon. Lastly, because only the oldest children correctly inferred the girl's happiness in Experiment 1, we tested only 5- and 6-year-olds in the following experiments.

Methods

Participants. We tested 125 5-6-year-olds ($M = 6;0$; range = 5;0 – 6;11; 67 girls); 60 5-year-olds ($M = 5;6$; range = 5;0 – 5;11; 39 girls), and 65 6-year-olds ($M = 6;5$; range = 6;0 – 6;11; 28 girls). Four additional 5-year-olds were tested but excluded for failing the comprehension question three times ($n = 3$) or for having already completed Experiment 1 ($n = 1$). We aimed to test 60 children per between-subjects condition, with equal numbers of children per age-in-years randomly assigned to each condition. However, we accidentally tested five extra 6-year-olds. Thus, we ended up with 63 children in the Mostly Special condition and 62 children in the Mostly Regular condition.

Materials and procedure. The materials, procedure, and design were similar to those in Experiment 1. See Figure 1 for the story and script. In this experiment, however, children saw the balloons at the beginning of the story, and were told that the girl did not know which balloons were in each box. They were asked a comprehension question to confirm they understood this. We also changed the counterfactual question so that it asked whether the girl almost got a special balloon. Children were again tested in either the Mostly Special or the Mostly Regular condition.

Results and Discussion

We first looked at children's happiness ratings. There was a significant main effect of age, $Wald X^2(1) = 12.45, p < .001$, where younger children rated the girl as happier about receiving a regular balloon than older children did; see Figure 2. There was no effect of distribution, $Wald X^2(1) = 2.93, p = .087$, and no age-by-distribution interaction, $Wald X^2(1) = 0.03, p = .857$.

Next, we looked at children’s responses to the counterfactual question. There was a significant main effect of age, $Wald X^2(1) = 4.55, p = .033$, no main effect of distribution, $Wald X^2(1) = 2.64, p = .104$, and a significant age-by-distribution interaction, $Wald X^2(1) = 6.83, p = .009$; see Figure 2. We tested each age group separately and found that 6-year-olds were more likely to say the girl almost got a special balloon in the Mostly Regular condition than in the Mostly Special condition, $Wald X^2(1) = 3.99, p = .046$, while 5-year-olds’ responses did not significantly differ between these conditions, $Wald X^2(1) = 0.11, p = .739$.¹ We also tested each condition separately. In the Mostly Regular condition, with age, children were more likely to say the girl almost got a special balloon, $Wald X^2(1) = 9.54, p = .002$; in the Mostly Special condition, age did not affect their judgment, $Wald X^2(1) = 0.14, p = .707$.

In sum, children were insensitive to close counterfactuals when inferring emotions, and did not appropriately differentiate between conditions when answering the counterfactual question. In fact, to the extent that children were sensitive to the difference between conditions for the counterfactual question, it was opposite to expectations. Surprisingly, 6-year-olds were more likely to say that the girl “almost” got a special balloon when this was *less* likely. We are uncertain about what caused this result, but here is one speculation: Although the regular balloon chosen by the girl was next to a special one in both conditions, this might have seemed more remarkable or luckier in the condition where there were just a few special balloons. So in that condition, the low odds of winning a special balloon might have accentuated the closeness of choosing an adjacent balloon.

¹ For 6-year-olds, we had to run this follow-up analysis using a negative binomial distribution because using a binary logistic distribution led to the Hessian matrix being violated. We observed comparable results when we analyzed the data using a Mann-Whitney test ($p = .044$).

Regardless, children's difficulties in this experiment suggest that rather than benefitting children, showing the distribution and locations of balloons in advance hurt their performance. Children may have had difficulty suppressing their knowledge of the balloons' locations when inferring the girl's emotions. If they thought she knew where the balloons were located, they might have thought she chose the regular balloon on purpose, which would affect their emotion inferences. This difficulty is consistent with findings that children, sometimes including 6-year-olds, have difficulty ignoring their privileged knowledge when attributing emotions to others (Bradmetz & Schneider, 1999; de Rosnay et al., 2004; Harris et al., 1989; Ronfard & Harris, 2014).

Alternatively, the finding could be taken to suggest that 6-year-olds' responses in Experiment 1 do not replicate. To address these possibilities, we conducted a further study using the original design in which the participant does not know the initial odds of winning a special balloon. We attempted to make the task easier for children by providing two cues to the closeness of the counterfactual alternative of winning a special balloon. In addition to manipulating probability across the two conditions, we also manipulated spatial proximity. This next experiment also used both close counterfactual questions – half the children were asked whether the girl *could have easily* gotten a special balloon and the other half were asked whether the girl *almost* got a special balloon.

Experiment 3

Children saw a character choose one of ten closed boxes and learn the distribution of the balloons after she had already won a regular one. In this experiment, we also manipulated the position of the special and regular balloons. In the Mostly Special condition, the girl had a high

chance and was physically very close to winning a special balloon. In the Mostly Regular condition, the girl had a low chance and was physically far from winning a special balloon.

Methods

Participants. We tested 120 5-6-year-olds ($M = 5;11$; range = 5;0 – 6;11; 55 girls). There were 60 5-year-olds ($M = 5;4$; range = 5;0 – 5;11; 27 girls), and 60 6-year-olds ($M = 6;6$; range = 6;0 – 6;11; 28 girls), with equal numbers of children per age-in-years randomly assigned to each between-subjects condition.

Materials and procedure. The experiment used a 2 x 2 design in which distribution (Mostly Special, Mostly Regular) was manipulated within subjects (order counterbalanced across children) and question-type (easily, almost) was manipulated between subjects. Children each heard two stories. See Figure 1 for a sample of the stories and script. In both stories, a character (girl in story 1, boy in story 2) chose one of ten closed boxes and received a regular balloon. The character was then shown the balloons in the remaining boxes, and children were asked how the character felt about getting the regular balloon. Next, children were either asked whether the character *could have easily* gotten a special balloon, or whether the character *almost* got a special balloon.

The difference between this experiment and the previous experiments is the *position* of each balloon in the distribution. In the previous experiments, in both conditions, the regular balloon that the girl received was flanked by one regular balloon and one special balloon. In this experiment, the regular balloon that the girl received was flanked by two special balloons in the Mostly Special condition, and two regular balloons in the Mostly Regular condition. This could potentially make the happiness and counterfactual questions easier to answer.

Results and Discussion

We first looked at children's happiness ratings. There was a significant main effect of distribution, $Wald X^2(1) = 12.23, p < .001$, where children rated the character as happier about receiving a regular balloon in the Mostly Regular condition than in the Mostly Special condition; see Figure 2. There was no main effect of age, $Wald X^2(1) = 0.78, p = .376$, and no age-by-distribution interaction, $Wald X^2(1) = 0.78, p = .376$.

Next, we looked at children's responses to the counterfactual questions; see Figure 2. There was a significant main effect of distribution, $Wald X^2(1) = 14.92, p < .001$, as children were overall more likely to say "yes" in the Mostly Special condition than in the Mostly Regular condition (i.e., said the character could have easily gotten or almost got the special balloon), but no main effect of age, $Wald X^2(1) = 0.002, p = .969$. There was also a significant age-by-distribution interaction, $Wald X^2(1) = 7.59, p = .006$. This resulted from 6-year-olds being more likely to say "yes" in the Mostly Special condition than in the Mostly Regular condition, $Wald X^2(1) = 15.22, p < .001$, and 5-year-olds not responding differently between the two conditions, $Wald X^2(1) = 1.97, p = .161$. However, we did not observe significant effects of age in either condition when they were examined separately, though the effect of age in the Mostly Regular condition approached significance: Mostly Special condition, $Wald X^2(1) = 0.04, p = .834$; Mostly Regular condition, $Wald X^2(1) = 3.70, p = .054$.

Further, there was a significant main effect of question-type, $Wald X^2(1) = 13.82, p < .001$, where children were overall more likely to say "yes" when asked whether the character almost got a special balloon. Although we collapsed across question-type when showing these results in Figure 2, we show the results split by question-type in the Supplementary Materials. There was also a significant age-by-question-type interaction, $Wald X^2(1) = 9.92, p = .002$. This

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resulted because 6-year-olds were more likely to say “yes” when asked whether the character almost got a special balloon than when asked whether the character could have easily gotten a special balloon, $Wald X^2(1) = 19.89, p < .001$, whereas 5-year-olds' responses did not differ between the two question-types, $Wald X^2(1) = 0.81, p = .369$. Also, when asked about whether the character could have easily gotten a special balloon, with age, children were less likely to say “yes”, $Wald X^2(1) = 5.14, p = .023$; when asked about whether the character almost got a special balloon, age did not affect their responses, $Wald X^2(1) = 2.57, p = .109$.

Finally, we looked at whether children's responses to the counterfactual questions corresponded with their happiness ratings. If children reason about close counterfactuals, they should judge that the girl almost (or could have easily) received a special balloon in the Mostly Special condition, but not in the Mostly Regular condition. Overall, 25 children showed this pattern, and 95 did not. We used a GEE model (ordinal logistic) to test whether this pattern of responding predicted whether children gave more positive emotion ratings in the Mostly Regular condition than in the Mostly Special condition. The model included distribution (Mostly Special, Mostly Regular) and whether children showed this pattern of close-counterfactual reasoning as factors. There was a significant main effect of distribution, $Wald X^2(1) = 4.89, p = .027$, and no main effect of pattern-type, $Wald X^2(1) = 3.45, p = .063$. There was also no distribution-by-pattern-type interaction, $Wald X^2(1) = 0.85, p = .357$, suggesting that children's happiness ratings did not differ based on how they responded to the counterfactual questions.

In sum, both 5- and 6-year-olds inferred the girl would feel sadder about winning a regular balloon in the condition where she was closer to winning a better one. Further, 6-year-olds also responded correctly to the close counterfactual questions. However, children's success in inferring emotions did not depend on their answering the close counterfactual question

correctly, suggesting that they may not use close counterfactuals to infer emotions. This raises the concern that even adults' close counterfactual reasoning might not correspond with their emotion predictions. We assessed this possibility in our final experiment.

Experiment 4

We tested adults using a similar design to Experiment 3. Our goal was to have a reference point with which to compare children's responses and to address the concern that previous studies on adults confounded close counterfactuals with prior beliefs (e.g., Mellers et al., 1997; van Dijk & van der Pligt, 1997).

Methods

Preregistration. This experiment was preregistered at <https://aspredicted.org/yi5mg.pdf>. The preregistration covered the number of participants, design, and analysis plan.

Participants. The experiment was successfully completed by 227 adults (mean age = 35 years; 74 females) recruited using Amazon Mechanical Turk. We chose this sample size because it was sufficient in previous experiments with similar designs (e.g., Doan et al., 2020). Participants received \$0.75 USD for their participation. We originally had 302 participants, but as per our preregistration, we excluded those who failed at least one of our two comprehension check questions or neglected to answer any of the test questions ($n = 75$).

Materials and procedure. The experiment used the same 2 x 2 design as Experiment 3: distribution (Mostly Special, Mostly Regular) was manipulated within subjects, and question-type (easily, almost) was manipulated between subjects. The stories were similar to those in Experiment 3, except the language of the script was changed to be more suitable for adults. The first page showed a girl in front of two balloons with the script, "Here's a girl. She can win a balloon. She might win a regular balloon (left) or she might win a special balloon (right)". The

second page showed the girl in front of ten closed boxes with the script, “The girl gets to choose a box and she’ll win whichever balloon is in the box she chooses”. The third page showed the girl receiving a regular balloon with the script, “The girl chooses this box and wins this balloon. Let’s show the girl what balloons are in the other boxes”. The fourth page showed the remaining balloons. The test question (“When the girl sees this, how does she feel about the balloon she won?”) appeared beneath the image, along with the same happy face scale used with children. Participants responded by clicking on one of the faces. Participants then saw a story about a boy with the other distribution. The counterfactual question for both stories was asked after participants had already seen and made happiness judgments for both distributions (e.g., “Here’s the girl and all of the balloons again. Could the girl have easily won a special balloon?” or “Here’s the girl and all of the balloons again. Did the girl almost win a special balloon?”). We left these counterfactual questions for the end of the procedure (i.e., rather than asking a counterfactual question after each story) because we were concerned that asking the counterfactual question after the first story might affect how adults approached the emotion judgment in the second story.

Results and Discussion

We first looked at adults’ happiness ratings. There was a significant main effect of distribution, $Wald\ X^2(1) = 72.84, p < .001$, where they rated the character as happier about receiving a regular balloon in the Mostly Regular condition ($M = 0.28; SD = 1.38$) than in the Mostly Special condition ($M = -1.12; SD = 1.89$).

Next, we looked at adults’ responses to the counterfactual questions. There was a significant main effect of distribution, $Wald\ X^2(1) = 177.77, p < .001$, where they were more likely to respond “yes” in the Mostly Special condition (i.e., said the character could have easily

gotten or almost got the special balloon). There was no main effect of question-type, $Wald\ X^2(1) = 3.16, p = .076$, and no distribution-by-question-type interaction, $Wald\ X^2(1) = 1.09, p = .296$.

Finally, we looked at how adults’ responses to the counterfactual questions corresponded with their happiness ratings. Responses were coded in the same manner as in Experiment 3. Overall, 174 participants showed the expected pattern (“yes” in the Mostly Special condition and “no” in the Mostly Regular condition), and 53 did not. We conducted a GEE model (ordinal logistic) with distribution and pattern-type entered into the model as factors. There was a significant main effect of distribution, $Wald\ X^2(1) = 30.73, p < .001$, a significant main effect of pattern-type, $Wald\ X^2(1) = 14.13, p < .001$, and a distribution-by-pattern-type interaction, $Wald\ X^2(1) = 13.67, p < .001$. Participants who responded both “yes” in the Mostly Special condition and “no” in the Mostly Regular condition rated the character as happier about receiving a regular balloon in the Mostly Regular condition than in the Mostly Special condition, $Wald\ X^2(1) = 82.12, p < .001$. Participants who responded to the counterfactual questions in any other way showed no differences in happiness ratings between the two conditions, $Wald\ X^2(1) = 1.43, p = .231$.² Unlike children, adults’ emotion ratings corresponded with their close counterfactual responses, suggesting that they consider close counterfactual alternatives when inferring emotions.

General Discussion

We investigated young children’s ability to consider close counterfactual alternatives when inferring other people’s emotions. We first examined counterfactual closeness in connection with probability and found that 6-year-olds (but not younger children) recognized

² In our pre-registration, we reported that we would run the analysis for the happiness ratings using a paired-samples t-test (we report GEEs in the main text because they are more appropriate for this ordinal data). The results are essentially the same. See the Supplementary Materials for the pre-registered analyses.

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that a person would be less happy about receiving a regular prize when the prior probability of receiving a special prize was high rather than low. However, children did not show this understanding when they knew the odds of winning a special prize from the outset. We next examined counterfactual closeness in connection with probability and spatial proximity combined. Now 5- and 6-year-olds, and adults, recognized that the person would be less happy about winning a regular prize when the possibility of receiving a special prize was a close counterfactual alternative.

In each experiment, participants also responded to counterfactual questions about whether the alternative outcome of winning a special prize was close or far. In the first two experiments, children did not appropriately respond to these questions. They were no more likely to say the girl could easily have won a special balloon (or that she almost won one) when the prior probability of this alternative outcome was high rather than low. In the final experiments (where counterfactual closeness depended on both prior probabilities and spatial proximity), 6-year-olds (but not 5-year-olds) and adults responded appropriately. But whereas adults' responses to the close counterfactual questions predicted their emotion inferences, 6-year-olds' responses did not.

Together these findings provide conflicting evidence about whether children consider close counterfactuals when inferring emotions. The emotion ratings suggest that by age 5 or 6, children do consider close counterfactuals in these inferences – their emotion judgments were broadly in line with those of adults in classic studies connecting close counterfactuals and emotions (e.g., Johnson, 1986; Mellers et al., 1997; van Dijk & van der Pligt, 1997). At the same time, children's largely poor performance in response to the counterfactual questions provides reason to doubt this conclusion.

One interpretation of the findings, then, is that children did *not* use close counterfactuals to infer emotions; perhaps children do not use close counterfactuals this way until age 7 (e.g., Weisberg & Beck, 2010). To be viable, though, this account needs to specify how else children in our experiment could have inferred emotions. We do not see a plausible alternative. For example, it might seem that children could have inferred the girl's emotions by considering her prior beliefs and expectations (e.g., Asaba et al., 2019; Lara et al., 2019; Wellman & Bartsch, 1988; also see Wu & Schulz, 2018). But this is unlikely because in Experiments 1 and 3, children had no information about the girl's prior beliefs (i.e., the distribution of balloons was revealed *after* the girl had already won a regular one).³ It might also seem that children could have inferred emotions by using the distribution of balloons as a standard of comparison (Cadotte et al., 1987; also see Doan et al., 2020). For example, when most balloons are special, winning a special balloon may be viewed as the standard outcome. Receiving a regular balloon is disappointing because it falls short of this standard. But this cannot explain why children's judgments should be sensitive to the spatial arrangements of the regular and special balloons, and it appears that children were sensitive to this factor (i.e., 5-year-olds performed better when counterfactual closeness depended on spatial proximity and probability together, compared with when it depended on probability alone).

We instead favor an account holding that children *do* use close counterfactuals to infer emotions, but that our participants had difficulty understanding and responding to the counterfactual questions. A hint that children might have difficulty understanding these questions is the finding that whereas 6-year-olds in Experiment 3 gave differing responses depending on

³ Further, the findings from Experiment 2 suggest that information about prior beliefs interfered with performance. When children saw the distribution and locations of the balloons at the beginning, they had difficulty ignoring their privileged knowledge and did not rate the girl's emotions differently between conditions (for related findings, see Bradmetz & Schneider, 1999; de Rosnay et al., 2004; Harris et al., 1989; Ronfard & Harris, 2014).

which counterfactual question they were asked, adults in Experiment 4 (who responded to the same scenarios) gave similar responses regardless of which question was asked. Several factors could have made the questions difficult for children. For example, the “easily could have” question is somewhat figurative, and children might have had difficulty understanding it; no previous research had used this question with children. Previous work has found that 5-year-olds do understand counterfactual questions about what “almost happened” (Beck & Guthrie, 2011). But children might need to see contrasting events to successfully understand this kind of question (i.e., Beck and Guthrie’s experiment did provide such a contrast). Our participants may also have struggled because the counterfactual questions were asked *after* the question about the girl’s emotion. Perhaps they would have found the counterfactual questions easier if these had been asked immediately after the scenario. So we suspect that with procedural changes, children’s responses to counterfactual questions might predict their emotion ratings.

Our primary interest in conducting this research was examining children’s use of close counterfactuals when inferring emotions. As discussed, though, counterfactual closeness depends on many factors, including probability, spatial proximity, and numerical proximity. Our first experiments manipulated closeness via probability alone, and our later experiments manipulated it alongside spatial proximity. Differences between children’s responses in Experiments 1 and 3 suggest that children could be more sensitive to spatial proximity than probability as a cue to counterfactual closeness, and that spatial proximity may precede probability as a cue to counterfactual closeness. However, these conclusions are tentative at best. Adequately investigating it will require a single experiment that separately manipulates both factors (i.e., rather than making informal comparisons across experiments). It is also possible that future research might reveal deeper differences between these determinants of counterfactual closeness.

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Indeed, it is even possible that probability-based and spatially-based closeness could turn out to be different kinds of counterfactual closeness. Returning to our counterfactual questions, while it might be appropriate to say that an outcome with a high prior probability “could have easily happened”, it might be less appropriate to say it “almost happened” (i.e., even though both phrases express that a counterfactual outcome is close).

In summary, we found that by age 5 or 6, children recognize that another person will be sadder about an outcome if a better outcome could easily have occurred, rather than if a better outcome could not have easily occurred. These emotion judgments contrast with children's judgments in earlier work, which suggested that before age 7, children do not consider counterfactual possibilities when inferring emotions (e.g., Amsel & Smalley, 2000; Beck & Crilly, 2009; Guttentag & Ferrell, 2004). In our experiments, children largely had difficulty directly stating whether the better outcome was a close counterfactual, even when they were successful in these emotion inferences. Although further work is needed, we suspect that difficulty understanding these counterfactual questions masked children's reasoning about close counterfactuals.

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