

The Temporal Order Effect in Children's Counterfactual Thinking

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Abstract

When adults think about how an outcome could have turned out differently, they tend to undo the events leading up to the outcome in regular ways. Consider a game in which two players could win a prize if they picked the same color card. The first picks black and the second picks red and so they lose. The temporal order effect refers to the tendency to think the players would have won if the second player had picked black. Adults also judge that the second player will feel more guilt and will be blamed more by the first player. We describe the results of an experiment on the temporal order effect in children's counterfactual thoughts. The experiment shows that children aged six and eight years exhibited the standard temporal order effect when they thought about what might have been, but they differed in their judgments of guilt and blame. We discuss the implications of the findings for understanding the development of mental representations.

Counterfactual Thinking

When people think about what might have been, they often imagine how a situation could have turned out differently (see Byrne, 2002 for a review). For example, if you miss the bus and are late for an important appointment, you might think that you would have been on time if you had avoided the rush hour traffic or if you had taken the train. These sorts of imaginative thoughts - *counterfactual* thoughts - are pervasive in adult mental life (e.g., Kahneman & Tversky, 1982). They play an integral part in higher level cognition such as deductive reasoning (e.g., Johnson-Laird & Byrne, 1991).

The function of counterfactual thoughts may be preparatory: they help people to learn from past mistakes and to prepare for the future (Markman, Gavanski, Sherman & McMullen, 1993; Roese, 1994). When people think about how a situation could have turned out differently, they mentally compare the factual situation to an imagined one. The comparison may help them to understand the causes of the events and to learn how to avoid similar outcomes in the future. Another function of counterfactual thoughts may be affective: they contribute to the experience of emotions such as regret, guilt, relief, surprise and hope as well as to social judgments such as responsibility and blame (e.g., Roese & Olson, 1995). The suggestion is that the experience of an emotion such as regret or guilt is amplified by the comparison of the way a situation

turned out and the way it could have turned out differently (Kahneman & Tversky, 1982).

There are systematic similarities in how adults mentally 'undo' aspects of their mental representation of a factual situation, when they think about how an outcome could have turned out differently (e.g., Kahneman & Miller, 1986). For example, adults show a tendency to mentally undo events that are exceptional rather than routine (Kahneman & Tversky, 1982). They are more likely to undo actions rather than inactions, at least in some situations (e.g., Byrne & McEleney, 2000; Gilovich & Medvec, 1995). They tend to undo the first cause in a causal chain rather than subsequent causes (e.g., Wells, Taylor & Turtle, 1987), but they tend to undo the most recent event rather than an earlier one in a sequence of independent events (e.g., Byrne, Segura, Culhane, Tasso & Berrocal, 2000; Miller & Gunasegaram, 1990; Walsh & Byrne, 2004). The mutability of aspects of the mental representation of the factual situation depends upon the ease with which people can think of alternatives (e.g., Byrne, 2005).

Our interest in this paper is in the development of counterfactual thinking in children. In the experiment we report we focus on the tendency to mentally undo the more recent event in a sequence of independent events. We first describe the temporal order effect in adult's counterfactual thoughts, and then we outline an experiment on the effect in children's counterfactual thoughts.

The Temporal Order Effect

When adults were asked to think about a student who fails an examination and to imagine how they, as students, might have passed, they wished that different examination questions had been set when they believed the questions had been set after they had prepared for the examination, whereas they wished that their preparation had been different when they believed that the questions had been set before their preparation (Miller & Gunasegaram, 1990). When adults are asked to think about how a basketball team might have performed better in a league of ten games, they mentally undid the 10th basketball game in which the team was defeated, irrespective of how the team performed in the nine games prior to the defeat (Sherman & McConnell, 1996). The tendency may play a role in many everyday situations, such as the propensity for athletic teams to feature their fastest

runner last in a relay race and the common aversion blackjack players have to playing on the last box (Miller & Gunasegaram, 1990; Kahneman & Miller, 1986). Consider the following scenario (from Byrne et al. 2000, p. 280): Imagine two individuals (John and Michael) who are offered the following very attractive proposition. Each individual is given a shuffled deck of cards, and each one picks a card from his own deck. If the two cards they pick are of the same color (i.e., both from black suits or both from red suits), each individual wins £1,000. However, if the two cards are not the same color, neither individual wins anything. John goes first and picks a red card from his deck; Michael goes next and picks a black card from his deck. Thus the outcome is that neither individual wins anything.

When adult participants are asked to undo the outcome, they tend to focus on the second event, that is, they tend to undo Michael's selection of a black card and imagine he selected a red card instead. In addition, they tend to judge that Michael, the second player, feels more guilt and that he will be blamed more by John (Miller & Gunasegaram, 1990). Both events are of chance, and logically, neither event should be considered more mutable, and neither individual should be more likely to blame the other or feel more guilt.

The temporal order effect may reflect fundamental properties of the nature of the mental representations that people construct (Byrne, 2005). People may understand the story about John and Michael by envisaging several possibilities. They tend to think about true possibilities (Johnson-Laird & Byrne, 2002) rather than false possibilities, and they tend to think of few possibilities, because of the constraints of working memory (Johnson-Laird & Byrne, 1991). They may mentally represent the facts, 'John picked red and Michael picked black and they lost', and they may think of only one of the several counterfactual possibilities, the one in which John picked red and Michael picked red. Their tendency to think of this possibility rather than others may indicate that the earlier events in the sequence are presupposed (Miller & Gunasegaram, 1990). Earlier events in a sequence act as a context or anchor against which subsequent events are interpreted. The presupposition of the earlier event (John picks red) can be countered by providing an explicit alternative (e.g., John picks black, there is a technical hitch in the game and he must pick again, this time John picks red), and the temporal order effect is eliminated when there is an explicit alternative (Byrne et al. 2000). The elimination of the temporal order effect when there is an alternative rules out the view that the temporal order effect occurs due to the availability of the more recent event to a backward search through the entries in working memory. It also rules out the view that the effect arises because people calculate the probabilities of a good outcome after each play (Spellman, 1997). The temporal order effect can even be reversed when people construct incomplete mental representations of the events (Walsh & Byrne, 2004). The result corroborates the theory that people create counterfactual alternatives by making minimal changes to their mental representation of reality (Byrne, 2005).

The temporal order effect is a robust phenomenon in adults' counterfactual thoughts. But little is known about the development of this tendency in children's thoughts about what might have been. Our aim in the experiment we report is to examine whether children also tend to focus on the more recent event in an independent sequence of events when they think about what might have been. We also examine the development of their judgments of emotions and social ascriptions. We consider the development of counterfactual thinking in children before we describe the experiment.

The Development of Counterfactual Thinking

Children begin to demonstrate the ability to think about a situation that was once possible but is so no longer during the pre-school years (e.g., German & Nichols, 2004; Harris, German & Mills, 1996). Children as young as 3 years can engage in counterfactual thinking to reach causal conclusions about how an outcome could have turned out differently (Harris et al. 1996). Pre-school children rarely produce unprovoked 'if only' counterfactual assertions (e.g., Kuczaj & Daly, 1979), but they can generate them upon request (e.g., Sobel, 2004). It is not yet clear how competent young children are in considering alternatives to reality (see Riggs, Petersen, Robinson, & Mitchell, 1998; Robinson & Beck, 2000). Nonetheless they appear to demonstrate the ability to represent not only what is true (the facts), but also what is temporarily supposed to be true (the counterfactual alternative).

By the age of 6 years, children begin to demonstrate the tendency to produce spontaneous counterfactual assertions (Kuczaj & Daly, 1979) and their understanding of guilt and regret also begins to emerge (Amsel, Robbins, Tumarkin, Janit, Foulkes, & Smalley, 2003; Guttentag & Ferrell, 2004; Harris, Olthof, Terwogt, & Hardman, 1987). But little is known about the relation between the development of counterfactual thoughts and the development of emotions such as guilt and regret (e.g., Amsel et al. 2003). For example, children aged 5, 7, and 9 years were asked to judge how another person would feel about the facts of a situation, (e.g., Susan had her usual choice of chocolate pudding for dessert and became ill, whereas Mary had chocolate pudding over her usual choice of vanilla pudding and became ill) in the light of information about a counterfactual alternative, (e.g., they would not have become ill if they had eaten the vanilla pudding instead.) The 7- and 9-year-old children made judgments that compared reality to its counterfactual alternative (e.g., Mary feels more regret than Susan because if she had chosen her usual dessert she would not have become ill), but the 5-year-olds did not (Guttentag & Ferrell, 2004).

We examined the temporal order effect in 6- and 8-year-old children (Meehan & Byrne, 2005). We predicted that children aged 6 and 8 years have the capacity to represent not only what is true (the facts), but what is temporarily supposed to be true (the counterfactual alternative). We expect that children tend to think about true possibilities rather than false possibilities and they tend to think about few possibilities due

to working memory limitations. Children understand the story described earlier about John and Michael picking black and red cards in a similar way to adults. They mentally represent the facts, John picked red and Michael picked black and they lost, and they mentally represent only one of several counterfactual possibilities, the one in which John picked red and Michael picked red. We predicted that children would tend to say the players could have won if only Michael had picked red, that is, they would exhibit the standard temporal order effect.

We also wished to examine children's emotion and social judgments. Adult's emotion and social judgments are often amplified by their counterfactual thoughts, that is, their judgments of guilt and blame often follow the same pattern as their 'if only' thoughts (e.g., Byrne et al, 2000). They think 'if only' most about the second player, and they also judge him to feel more guilt and to be blamed more by the first player. But dissociations between counterfactual thoughts and emotion and social judgments occur (e.g., Roese & Olson, 1995). Emotion and social judgments are sometimes based more closely on the facts of the situation rather than on the counterfactual alternatives (Walsh & Byrne, 2004). The calibration of emotion and social judgments to the mental representations of facts and counterfactual alternatives may follow a developmental pattern. Given the evidence that the understanding of guilt and regret appears to emerge around the age of 6 or 7 years, we expected to observe a difference between 6- and 8-year old children in the association of their 'if only' thoughts and their judgments of guilt and blame.

Experiment

Method

The aim of the experiment was to examine the temporal order effect in the 'if only' sentence completions and judgments of guilt and blame made by 6-year-olds and 8-year-olds. We adapted three scenarios from Byrne et al. (2000). The scenarios were about cards, marbles and coins and their structure was identical to those used by Byrne et al. (2000). Some aspects of the scenarios were modified for children, for instance the scenarios were enacted with the use of props and the protagonists involved were represented as puppets (see Meehan & Byrne, 2005, for further details). We adhered to the wording of the original scenarios as closely as possible but some wording was modified to be more accessible to children. For example, instead of the individuals winning £1,000, the children were told the puppets would win stickers if they met the winning conditions. A number of additional check questions were included to ensure that the children understood the objectives set out for the two puppets. For example, the children were asked about the winning conditions during the enactment of the games (e.g., 'Can you show me how they both can win?') and as a final check question (e.g., 'Can you remind me how the puppets both can win?').

Participants were asked to watch each game and to comment on how the puppets played each game. For example, for the scenario about the cards, the two puppets were introduced, with their names clearly marked on badges (e.g., 'Here are two puppets, Al and Bill, who are told about this great game') and the children were questioned about the identity of each puppet (e.g., 'Can you show me which puppet is which?'). The children were then informed of the objectives set out for the puppets in the following way:

Each puppet is given a pile of cards, and each one picks a card from his own pile. Can you see that there are only red and brown cards in each pile? Now, if the two cards they pick are the same color - so if both are brown or both are red - each puppet wins the prize. But if the two cards are not the same color, neither puppet wins anything. Al goes first and picks a brown card from his pile. Bill goes next and picks a red card from his pile. So, neither puppet wins anything.

Children's creation of counterfactual alternatives to the events was measured by a sentence completion task and a physical manipulation task. For the sentence completion task we introduced a third puppet named Oscar. The children were told that he was a friend of the two puppets and that he liked to wish that things could have been different for his friends. The children were asked to complete a counterfactual sentence in the following way: 'Oscar is going to whisper a wish in my ear about his friends and it's your job to guess how he finishes his wish. So Oscar just said that he wishes that Al and Bill could have won the prize. They could have won the prize if only one of them had picked a different colored card, so if... Can you guess how he finishes his wish?'. For the physical manipulation task the children were asked to indicate how the objects the puppets were playing with (e.g., the cards) would look if they had won the prize. Our measurement was based on the observation of which puppets' object the children moved: the object of the puppet who took his turn first (e.g., Al) or the object of the puppet who took his turn second (e.g., Bill). In both tasks we measured whether the responses made reference to the first or second events.

For the children's judgments of emotions and social ascriptions, they were asked to indicate which puppet felt more guilt and which puppet was blamed by the other. We adapted these two questions to include the puppets informing the experimenter that one of them felt guilty (e.g., 'One of these two puppets just said that they feel guilty about them not winning the prize. Which puppet do you think said that?') and that one of them blamed the other (e.g., 'One of these puppets just said that they really blame the other one for not winning the prize. Which puppet do you think said that?'). We also asked about who would feel worse (e.g., 'Which puppet do you think feels worse about them not winning the prize?').

The participants were 62 children. There were 33 6-year-olds (15 boys and 18 girls) and 29 8-year-olds (14 boys and 15 girls). All 62 participants received the three scenarios in a different random order.

Results

‘If only’ thoughts The temporal order effect was observed for both age groups in the sentence completion task and in the physical mutation task, and there were no differences between the two age groups, as Table 1 shows. Overall across the three scenarios, more children mentally undid the second event rather than the first event. The temporal order effect was observed for the 6-year-olds (64% vs. 25%) and the 8-year-olds (63.5% vs. 25%). The two age groups did not differ, $\chi^2(1, N = 165) = .001, p < .491$.

A similar pattern occurs for the physical manipulation. The temporal order effect was observed for the 6-year-olds (69% vs. 31%) and the 8-year-olds (73% vs. 27%). The two age groups did not differ, $\chi^2(1, N = 186) = .524, p < .143$ (for further details see Meehan and Byrne, 2005).

These findings suggest that children as young as 6 years create counterfactual alternatives to reality by mentally changing the same aspects of a factual situation as adults. Children, like adults may mentally represent only true possibilities, and they may mentally represent few possibilities due to working memory constraints. These findings are consistent with the suggestion that children as young as 6 years have the capacity to represent both what is true and what is false but temporarily supposed to be true.

Table 1: Percentages of mutations of the first event and the second for the sentence completion task and the physical manipulation task.

	6-year-olds	8-year-olds
<i>Sentence completion</i>		
Second	64	63.5
First	25	25
<i>Physical manipulation</i>		
Second	69	73
First	31	27

Guilt and Blame Judgments of emotions and social ascriptions differ for 6-year-olds and 8-year-olds. As Table 2 shows, 8-year-olds ascribed guilt to the second puppet rather than the first (66% vs. 34%). But 6-year-olds ascribed guilt equally to the two puppets (46% vs. 53%). The two age groups differed reliably, $\chi^2(1, N = 185) = 13.87, p < .000$.

Likewise, 8-year-olds judged that the first puppet would blame the second more than the second would blame the first (69% vs. 31%). But 6-year-olds judged that the first puppet would blame the second as often as they judged that the second would blame the first (48% vs. 52%). The two age groups differed reliably, $\chi^2(1, N = 186) = 7.97, p < .005$.

The children’s judgments of who would feel worse for not winning show a similar pattern for 6-year-olds and 8-year-olds. Eight-year-olds judged that the second puppet would feel worse rather than the first puppet (75% vs. 25%). 6-year-

olds also judged that the second puppet would feel worse rather than the first puppet (61% vs. 35%). Nonetheless the two age groups differed reliably, $\chi^2(1, N = 182) = 2.81, p < .047$.

Table 2: The percentages of emotion and social judgments

	6-year-olds	8-year-olds
<i>Guilt</i>		
Second	46	66
First	53	34
<i>Blame</i>		
Second	52	69
First	48	31
<i>Worse</i>		
Second	61	75
First	35	25

The experiment shows that the standard temporal order effect is observed for 8-year-old children in their ‘if only’ thoughts and in their judgments of emotions and social ascriptions. The 8-year-olds show a consistent pattern in their ‘if only’ sentence stem completions, their physical manipulations, and their judgments of guilt, blame, and who feels worse. Their responses are similar to adults’ responses. The finding suggests that by the age of 8 years, children create counterfactual alternatives by changing aspects of their mental representation of the factual situation in the same way that adults do when they think about how an outcome could have been different.

The experiment shows a dissociation between the ‘if only’ thoughts and the judgments of emotions and social ascriptions for 6-year-old children. The 6-year-olds exhibit the standard temporal order effect for their ‘if only’ sentence stem completions and their physical manipulations, and their judgment of who feels worse. But their judgments of guilt and blame show no temporal order effect. These findings suggest at the age of 6 years, children create counterfactual alternatives by changing aspects of their mental representation of the factual situation in ways that have not yet developed to be entirely similar to adults. When 6-year-old children think about counterfactual situations, they appear to be able to mentally represent both the facts and the counterfactual possibility. However when they make emotion and social judgments they may be limited in how their mental representation of the counterfactual alternative influences their representation of the facts, perhaps due to working memory constraints (see Meehan & Byrne, 2005). Children’s understanding of guilt and blame in counterfactual thinking does not emerge simultaneously with their understanding of who feels worse, or with their mental and physical mutations.

Conclusions

Children, like adults, display systematic similarities in their mutations of factual situations when they think about how an outcome could have turned out differently. Their emotion and social judgments follow a developmental pattern. In the experiment reported here, 6- and 8-year-olds exhibit the standard temporal order effect in their mutations of the factual situation, that is, they more readily undo the second event than the first event in an independent sequence of events. We suggest that the temporal order effect in 6- and 8-year-olds' mental mutations of factual situations shows that they have the capacity to represent not only what is true (the facts) but also what is temporarily supposed to be true (the counterfactual alternative). The experiment also shows that the standard temporal order effect occurs for 8-year-olds' emotion and social judgments for guilt, blame and who feels worse, but the temporal order effect does not occur for 6-year-olds' judgments of guilt and blame. The dissociation between 'if only' thoughts and emotion and social judgements for six year olds may indicate that their creation of counterfactual alternatives has not yet fully developed.

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References

- Amsel, E., Robbins, M., Tumarkin, T., Janit, A., Foulkes, S., & Smalley, J.D. (2003). The card not chosen: The development of judgments of regret in self and others. Manuscript submitted for publication.
- Byrne, R.M.J. (2002). Mental models and counterfactual thoughts about what might have been. *Trends in Cognitive Sciences*, 6, 426-431.
- Byrne, R.M.J. (2005). *The Rational Imagination: How People Create Alternatives to Reality*. Cambridge, MA: MIT Press.
- Byrne, R.M.J. & McEleney, A. (2000). Counterfactual thinking about actions and failures to act. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26, 1318-1331.
- Byrne, R.M.J., Segura, S., Culhane, R., Tasso, A., & Berrocal, P. (2000). The temporality effect in counterfactual thinking about what might have been. *Memory & Cognition*, 28, 264-281.
- Gilovich, T., & Medvec, V.H. (1995). The experience of regret: What, when and why. *Psychological Review*, 102, 379-395.
- Guttentag, R., & Ferrell, J. (2004). Reality compared with its alternatives: Age differences in judgments of regret and relief. *Developmental Psychology*, 40, 764-775.
- Harris, P.L., German, T.P., & Mills, P. (1996). Children's use of counterfactual thinking in causal reasoning. *Cognition*, 61, 233-259.
- Harris, P.L., Olthof, T., Terwogt, M.M., & Hardman, C.E. (1987). Children's knowledge of the situations that provoke them. *International Journal of Behavioral Development*, 10, 319-343.
- Johnson-Laird, P. N. & Byrne, R. M. J. (1991). *Deduction*. Hove, UK: Erlbaum.
- Johnson-Laird, P.N., & Byrne, R.M.J. (2002). Conditionals: a theory of meaning, pragmatics, and inferences. *Psychological Review*, 109, 646-678.
- Kahneman, D., & Miller, D.T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review*, 93, 136-153.
- Kahneman, D., & Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgments under certainty: Heuristics and biases* (pp. 201-208). New York: Cambridge University Press.
- Kuczaj, S.A., & Daly, M.J. (1979). The development of hypothetical reference in the speech of young children. *Child Language*, 6, 563-579.
- Landman, J. (1987). Regret and elation following action and inaction: Affective responses to positive versus negative outcomes. *Personality & Social Psychology Bulletin*, 13, 542-536.
- Markman, K.D., Gavanski, I., Sherman, S.J., & McMullen, M.N. (1993). The mental simulation of better or worse possible worlds. *Journal of Experimental Social Psychology*, 29, 87-109.
- Meehan, J.E. & Byrne, R.M.J. (2005). The temporal order and action effects in children's counterfactual thoughts. *Manuscript in preparation*.
- Miller, D.T., & Gunasegaram, S. (1990). Temporal order and the perceived mutability of events: implications for blame assignment. *Journal of Personality and Social Psychology*, 59, 1111-1118.
- Riggs, K.J., Petersen, D.M., Robinson, E.J., & Mitchell, P. (1998). Are errors in false belief tasks symptomatic of a broader difficulty with counterfactuality? *Cognitive Development*, 13, 73-90.
- Robinson, E.J., & Beck, S. (2000). What is difficult about counterfactual reasoning? In P. Mitchell & K. Riggs (Eds.), *Children's reasoning and the mind* (pp. 191 -120). Hove U.K: Psychology Press.
- Roese, N.J., (1994). The functional basis of counterfactual thinking. *Journal of Personality & Social Psychology*, 66, 805-818.
- Roese, N.J. & Olson, J.M. (1995). Counterfactual thinking: A critical overview. In N.J. Roese and J.M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 1-59). Mahwah, N.J: Lawrence Erlbaum Associates.

- Spellman, B.A. (1997). Crediting causality. *Journal of Experimental Psychology: General*, 126, 323-348.
- Sherman, S.J., & McConnell, A.R. (1996). The role of counterfactual thinking in reasoning. *Applied Cognitive Psychology*, 10, S113-S124.
- Sobel, D.M. (2004). Exploring the coherence of young children's explanatory abilities: evidence from generating counterfactuals. *British Journal of Developmental Psychology*, 22, 27-58.
- Walsh, C.R., & Byrne, R.M.J. (2004). Counterfactual thinking: The temporal order effect. *Memory & Cognition*, 32, 369-378.