CHILD DEVELOPMENT PERSPECTIVES

Developing Thoughts About What Might Have Been

Sarah R. Beck[1] and Kevin J. Riggs[2]

[1]University of Birmingham and [2]University of Hull

ABSTRACT—***Recent research has changed how developmental psychologists understand counterfactual thinking or thoughts of what might have been. Evidence suggests that counterfactual thinking develops over an extended period into at least middle childhood, depends on domain-general processes including executive function and language, and dissociates from counterfactual emotions such as regret. In this article, we review the developmental evidence that forms a critical but often-overlooked complement to the cognitive, social, and neuroscience literatures. We also highlight topics for further research, including spontaneous counterfactual thinking and counterfactual thinking in clinical settings.***

KEYWORDS—*counterfactual thinking; cognitive development; imagination; regret*

Much of intelligent thought involves speculating outside the here and now. Counterfactual thoughts compare what we know to be true with what might have been. We imagine how our lives would have been different had we chosen a different holiday destination, failed our high school exams, or accepted that invitation to dinner. Work on adult counterfactual thinking is well established (e.g., Epstude & Roese, 2008; Mandel, Hilton, & Catellani, 2005) and research on the neuroscience of counterfactual emotions is expanding rapidly (e.g., Nicolle, Bach, Driver, & Dolan, 2011). Knowing how counterfactual thinking develops is critical if we are to understand fully the cognitive processes that underpin both its acquisition and use by adults, and children's decision making, causal reasoning, and moral judgments.

Sarah R. Beck, School of Psychology, University of Birmingham, United Kingdom and Kevin J. Riggs, Department of Psychology, University of Hull, United Kingdom.

Correspondence concerning this article should be addressed to Sarah R. Beck, School of Psychology, University of Birmingham, Edgbaston, Birmingham B15 2TT, United Kingdom; e-mail: s.r.beck@bham.ac.uk.

DOI: 10.1111/cdep.12082

In this review, we focus on *real-world counterfactuals*—thoughts about how past events could have been different, which is how social scientists tend to think of counterfactuals (e.g., Epstude & Roese, 2008). Some philosophers favor a broader use of the word that terms all thoughts about alternatives to the here and now as counterfactual, including, for example, thinking about future, pretend, or fictional worlds (e.g., Woodward, 2011). Real-world counterfactuals are central to the practical business of learning from our past mistakes (Epstude & Roese, 2008) and support certain emotions, such as regret. Moreover, real-world counterfactuals put specific and additional demands on children's cognitive development compared to future, pretend, and fictional worlds (cf. Weisberg & Gopnik, 2013), and we explore that evidence here.

THE DEVELOPMENT OF COUNTERFACTUAL THINKING

Harris, German, and Mills (1996) made the first claim of children's counterfactual thinking. Children heard a story in which Carol walks across a clean floor wearing dirty shoes. They were asked: "What if Carol had taken her shoes off. Would the floor be dirty?" Three-year-olds gave the correct counterfactual answer ("no") in most of the trials. Riggs, Peterson, Robinson, and Mitchell (1998) ascribed this ability to 4-year-olds and suggested it underpinned understanding of false belief. Although these findings suggest that children can reason with premises that are known to be false to answer a counterfactual question, more recent research (discussed later) suggests this does not reflect adult-like counterfactual thinking, but is rather the first of several necessary developments needed to reach this goal.

An important second development is relating the imagined counterfactual world to the known world. Children come to appreciate that at a specific point in the past, two possible worlds diverged because of a single causal event. Thus, children need to understand the causal relation between a specific past event and its subsequent outcome, and understand that had that specific past event been different, another outcome would have ensued (the counterfactual). For adults, this distinguishes real-world counterfactual thinking from other thoughts about

Child Development Perspectives

alternatives to the here and now: For example, "I can daydream about winning the lottery without relating this to reality. But if I fail to buy a ticket 1 week and 'my' numbers come up, there's an all-too-salient relation between the real and counterfactual worlds."

Children find relating the two possible worlds challenging. In one study, children found questions requiring thinking about the actual and counterfactual possible consequences of a single causal event more difficult than the counterfactual conditional questions posed by Harris and Riggs (Beck, Robinson, Carroll, & Apperly, 2006). In Beck et al.'s (2006) task, a mouse took one of two paths to one of two end points. Three- to six-year-olds found it relatively difficult to answer the question, "Could he have gone anywhere else?"—that is, to acknowledge two possible scenarios. A subsequent study (Beck & Guthrie, 2011) explored children's interpretation of the word *almost*. When we consider what almost happened, we also think about two possible worlds. For example, describing that a horse almost fell draws attention to the fact that it did not fall (reality) yet could have fallen (counterfactual). Not until children are 5 years old do they interpret reliably this counterfactual use of *almost* (Beck & Guthrie, 2011). An earlier study (Harris, 1997) suggested that 2½-year-olds could do this, but the recent study suggests these were false positives.

Two other studies also emphasize the importance of the relation between the counterfactual and the real world by finding a difference in difficulty when children had to take what happened into account to generate the counterfactual compared to when they could ignore what had gone before. Both 3- to 4-year-olds (Perner, Sprung, & Steinkogler, 2004) and 5- to 6-year-olds (Rafetseder, Cristi-Vargas, & Perner, 2010) found the former more difficult to answer correctly than the latter.

In yet another study (Rafetseder, Schwitalla, & Perner, 2013), younger children used basic conditional reasoning and general knowledge to engage in reasoning that countered the facts, but the authors denied that this amounts to full-fledged counterfactual reasoning. Children heard scenarios (based on Harris et al., 1996) in which Carol *and* John make dirty footprints on a floor. Children performed less optimally when they had to judge that the floor would still be dirty if (only) Carol had removed her shoes than when they had to judge the scenario with only one person. According to these authors, the mistake children made was not to generate the *nearest possible world* (see Lewis, 1973), that is, one that requires the fewest changes from the actual world. Rather, children used basic conditional reasoning to jump to the conclusion that with dirty shoes taken off, no muddy footprints exist. Based on tasks like this, Rafetseder et al. (2013) argue that adult-like counterfactual reasoning does not typically emerge until early adolescence (after 12 years). However, we think it likely that these tasks make additional reasoning demands in terms of informational complexity and that in middle childhood, children can relate the real and counterfactual possibilities (see other studies described earlier). Despite our disagreement over the end point, we agree with Rafetseder and Perner that counterfactual thinking develops over a prolonged period.

COUNTERFACTUAL EMOTIONS

We see a third development in counterfactual thinking in research on children's counterfactual emotions, in particular, regret and relief—although other counterfactual emotions exist, including shame and guilt. We experience regret when our actions give rise to a reality that is less desirable than it could have been, for example, when a student stays out late the night before an exam that she fails. Relief is the complement to this, where reality is more desirable than it could have been. Regret and relief result from the comparison between actual and counterfactual possibilities.

Studies of counterfactual emotions typically involve children choosing between two boxes and receiving the reward contained in the box they choose. Then they learn what was in the unchosen box: a more desirable prize in regret trials (e.g., eight stickers compared to two), or a less desirable prize in relief trials (e.g., zero stickers compared to two). Children are judged to feel regret if they rate themselves as less happy when they learn what was in the unchosen box than they felt before learning the contents (e.g., Weisberg & Beck, 2010). Relief is shown when children rate themselves as more happy. Do these tasks really measure counterfactual emotions or do they measure just a reality-based emotion, such as frustration that the more desirable prize eludes them? Observing that children are less likely to rate themselves as less happy if their choice of box was determined by overt chance (the throw of a die) rather than their own choice (Weisberg & Beck, 2012) supports the idea that their feelings are genuine counterfactual emotions.

We do not yet know when children first experience counterfactual emotions. In one study, 4- and 5-year-olds experienced regret (Weisberg & Beck, 2010, 2012), in another, 6-year-olds, but not younger children, experienced regret (O'Connor, McCormack, & Feeney, 2011), and in one study, children did not feel regret until around 9 years (Rafetseder & Perner, 2012). Moreover, children can experience a delay between experiencing counterfactual emotions and attributing them to others (Weisberg & Beck, 2010; see also Guttentag & Ferrell, 2004). Although evidence is limited, it hints that experiencing and understanding relief lag behind experiencing regret, at least in some contexts (Guttentag & Ferrell, 2004; Weisberg & Beck, 2012).

Adults experience counterfactual emotions when they reflect on what could have happened in the past, but the relation of counterfactuals to reality is complicated by the fact that adults also anticipate counterfactual emotions (Zeelenberg & Pieters, 2007). For example, I might avoid a novel dish of the day in my favorite restaurant, opting instead for my trusted staple, because I know I will regret the risky choice if it turns out to be

disappointing. Although evidence is limited, anticipated regret, with its associated demands in thinking about many possible futures, develops later than counterfactual emotions in the present (Guttentag & Ferrell, 2008; McCormack & Feeney, in press).

In sum, counterfactual thinking and experiencing counterfactual emotions are neither trivial matters for young children nor do they develop early. Rather, adult-like counterfactual thinking appears sometime after the preschool years and depends on a number of necessary earlier developments, including reasoning with information that is known to be false, relating the real and counterfactual possibilities, and comparing them in a way that results in counterfactual emotions. Next, we consider factors that may contribute to these developments.

FACTORS AFFECTING COUNTERFACTUAL THINKING

Executive processes—inhibition (the ability to ignore interfering cognitions that are irrelevant to a task goal), working memory (the ability to hold information in mind that is relevant to a goal), and attentional flexibility (the ability to switch between mental sets)—underpin these three developments in counterfactual thinking. The relation between executive processes and counterfactual thinking is perhaps unsurprising. To reason with information that is known to be false, we need to resist reasoning with what we know to be true (inhibition). To relate both the counterfactual and the real world requires holding them in mind (working memory). And to make comparisons requires switching between them (attentional flexibility). Children's inhibitory control predicts their ability to answer counterfactual questions of the type used by Riggs et al. (1998; Beck, Riggs, & Gorniak, 2009; see Beck, Carroll, Brunsdon, & Gryg, 2011, for experimental evidence). Attentional flexibility predicts children's experience of regret (Burns, Riggs, & Beck, 2012). And working memory predicts counterfactual generation (Guajardo, Parker, & Turley-Ames, 2009), although we lack firm evidence that working memory is involved in relating the counterfactual and real possibilities.

In addition to executive functions, other factors may play a role in the development of counterfactual thinking. One possibility is language: In one study, receptive vocabulary was related to conditional reasoning with information known to be false (Beck et al., 2009). Language per se may be *necessary* for counterfactual thought and thus counterfactual thinking may be a uniquely human ability. However, rhesus monkeys represent hypothetical outcomes of unchosen behaviors (e.g., Abe & Lee, 2011), although whether this suggests real-world counterfactual thought is unclear. Alternatively, children might need to understand specific grammatical constructions (such as the subjunctive) to think counterfactually. Furthermore, most studies on counterfactual thinking in humans rely heavily on language to conduct the task. However, recent studies on regret may offer ways to test the proposed relation between counterfactuals and language because they do not require subjunctive questioning (e.g., Weisberg & Beck, 2010). For example, children are simply asked to rate "How do you feel about choosing your card now?"

A different factor that may influence counterfactual reasoning is domain-specific knowledge (Sobel, 2011). A child's ability to think about possibilities and counterfactuals may differ depending on his or her causal knowledge in the relevant domain. For example, children answer more questions correctly when asked counterfactual questions about desire than when asked about surprise, which may reflect children's greater understanding of desire.

Counterfactual thinking may be influenced by conceptual change in children's thinking about time (McCormack & Hoerl, 2008). McCormack and colleagues argue that between the ages of 3 and 5 years, children's understanding of time moves from being event based to being event independent. This means that children come to appreciate that different events could slot into a particular time point. Developmental changes in temporal concepts and in executive function may occur in parallel, and although both are necessary for counterfactual thinking, neither depends on the other. Or changes in executive function may be necessary to support the structural changes needed to think about time as independent of events.

LOOKING AHEAD

Our theoretical view is of many developments (reasoning with false information, relating possible worlds, and comparing them) underpinned by domain-general executive processes. Other factors may also contribute to the development of counterfactual thinking, such as the understanding of temporal concepts, language, and domain-specific knowledge. This rich account of children's counterfactual thinking should inform other research in cognitive development where an understanding of counterfactual thinking is deemed important, such as causal understanding (Frosch, McCormack, Lagnado, & Burns, 2012) and decision making (O'Connor, McCormack, & Feeny, 2012). Furthermore, our account offers a framework for thinking about the complexities of counterfactual thinking to inform neuroscience and cognitive and social research in adults. We have much to gain by seeing counterfactual thinking as relying on numerous processes and developments rather than being unitary: Different brain areas are likely to be implicated in hitherto-neglected processes, and we may deepen our understanding of those areas already implicated (e.g., the orbito-frontal cortex, anterior cingulate cortex, and hippocampus) by investigating their specific processing demands.

Adults engage spontaneously in counterfactual thinking, but it is unknown at what age and under which circumstances children do so. We have some preliminary ideas based on children's understanding of the word *almost* and their experience of regret, but in these studies, children are prompted to engage in counterfactual thought by the experimental setup. We know that children can talk about hypothetical worlds (e.g., Kuczaj & Daly,

1979) from 4 years of age, but when do they make spontaneous counterfactual speculations of the type that play on the minds of adults? Do children spontaneously generate their own counterfactuals as soon as they have the reasoning competence? When does counterfactual thinking become automatic? Once children generate counterfactuals spontaneously, do they necessarily experience counterfactual emotions or is further development needed? Answering these questions is critical for understanding how this reasoning occurs beyond the laboratory.

Adults' counterfactual thinking is susceptible to various biases. They engage in more counterfactual thinking when people act rather than fail to act, or when counterfactual worlds seem close rather than distant (e.g., "I almost caught the plane or I missed it by two hours"). Researchers have begun to investigate these biases in children (Meehan & Byrne, 2005; Weisberg & Beck, 2012), but we have yet to understand their origins. A developmental perspective offers a unique opportunity to understand how biases appear: Do they result from intrinsic differences in how we process counterfactuals or are they learned?

Research on children's regret is limited because the tasks used involve arbitrary choices about chance events. Arguably, true regret results from events where people make informed choices. Developmental researchers should create appropriate paradigms to resolve this discrepancy as a way to inform our understanding of the development of children's decision making.

Counterfactual thinking may be implicated in a range of clinical disorders, including depression (Markman & Miller, 2006) and autism (Beeger, Terwogt, Lunenburg, & Stegge, 2009). If many developments in counterfactual thinking are underpinned by different executive processes, researchers should explore subtle differences in counterfactual thinking in such disorders.

Developmental psychology offers insight into the fact that counterfactual thinking is a complex ability with a protracted development and is supported by a number of domain-general executive processes. By attending to these complexities, researchers will gain a rich understanding of counterfactual thinking.

REFERENCES

Abe, H., & Lee, D. (2011). Distributed coding of actual and hypothetical outcomes in the orbital and dorsolateral prefrontal cortex. *Neuron*, *70*, 731–741 doi:10.1016/j.neuron.2011.03.026.

Beck, S. R., Carroll, D. J., Brunsdon, V. E. A., & Gryg, C. K. (2011). Supporting children's counterfactual thinking with alternative modes of responding. *Journal of Experimental Child Psychology*, *108*, 190–202 doi:10.1016/j.jecp.2010.07.009.

Beck, S. R., & Guthrie, C. (2011). Almost thinking counterfactually: Children's understanding of close counterfactuals. *Child Development*, *82*, 1189–1198. doi:10.1111/j.1467-8624.2011.01590.x

Beck, S. R., Riggs, K. J., & Gorniak, S. L. (2009). Relating developments in children's counterfactual thinking and executive functions. *Thinking and Reasoning*, *15*, 337–354. doi:10.1080/13546780903135904

Beck, S. R., Robinson, E. J., Carroll, D. J., & Apperly, I. A. (2006). Children's thinking about counterfactuals and future hypotheticals as possibilities. *Child Development*, *77*, 413–426. doi:10.1111/j.1467-8624.2006.00879.x

Beeger, S., Terwogt, M. M., Lunenburg, P., & Stegge, H. (2009). Additive and subtractive counterfactual reasoning of children with high-functioning autism spectrum disorders. *Journal of Autism and Developmental Disorders*, *39*, 1593–1597. doi:10.1007/s10803-009-0774-8

Burns, P., Riggs, K. J., & Beck, S. R. (2012). Executive control and the experience of regret. *Journal of Experimental Child Psychology*, *111*, 501–515. doi:10.1016/j.jecp.2011.10.003.

Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review*, *12*, 168–192. doi:10.1177/1088868308316091.

Frosch, C. A., McCormack, T., Lagnado, D. A., & Burns, P. (2012). Are causal structure and intervention judgments inextricably linked? A developmental study. *Cognitive Science*, *36*, 261–285. doi:10.1111/j.1551-6709.2011.01208.x

Guajardo, N. R., Parker, J., & Turley-Ames, K. J. (2009). Associations among false belief understanding, counterfactual reasoning, and executive function. *British Journal of Developmental Psychology*, *29*, 681–702. doi:10.1348/026151008X357886.

Guttentag, R., & Ferrell, J. (2004). Reality compared with its alternatives: Age differences in judgments of regret and relief. *Developmental Psychology*, *40*, 764–775. doi:10.1037/0012-1649.40.5.764.

Guttentag, R., & Ferrell, J. (2008). Children's understanding of anticipatory regret and disappointment. *Cognition and Emotion*, *22*, 815–832. doi:10.1080/02699930701541542.

Harris, P. L. (1997). On realizing what might have happened instead. *Polish Quarterly of Developmental Psychology*, *3*, 161–176 doi:10.1016/S0010-0277(96)00715-9.

Harris, P. L., German, T. P., & Mills, P. (1996). Children's use of counterfactual-thinking in causal reasoning. *Cognition*, *61*, 233–259.

Kuczaj, S. A., II, & Daly, M. J. (1979). The development of hypothetical reference in the speech of young children. *Journal of Child Language*, *6*, 563–579 doi:10.1017/S0305000900002543.

Lewis, D. (1973). *Counterfactuals*. Cambridge, MA: Harvard University Press.

Mandel, D., Hilton, D., & Catellani, P. (2005). *The psychology of counterfactual thinking*. London, UK: Routledge.

Markman, K. D., & Miller, A. K. (2006). Depression, control, and counterfactual thinking: Functional for whom? *Journal of Social and Clinical Psychology*, *25*, 210–227 doi:10.1521/jscp.2006.25.2.210.

McCormack, T., & Feeney, A. (in press). The development of the experience and anticipation of regret. *Cognition and Emotion*.

McCormack, T., & Hoerl, C. (2008). Temporal decentering and the development of temporal concepts. *Language Learning*, *58*(Suppl. 1), 89–113. doi:10.1111/j.1467-9922.2008.00464.x

Meehan, J. E., & Byrne, R. M. J. (2005). Children's counterfactual thinking: The temporal order effect. In B. G. Bara, L. Barsalou, & M. Bucciarelli (Eds.), *27th annual conference of the Cognitive Science Society* (pp. 1467–1473). Mahwah, NJ: Erlbaum.

Nicolle, A., Bach, D. R., Driver, J., & Dolan, R. J. (2011). A role for the striatum in regret-related choice repetition. *Journal of Cognitive Neuroscience*, *23*, 845–856. doi:10.1162/jocn.2010.21510

O'Connor, E., McCormack, T., & Feeney, A. (2011). The development of regret. *Journal of Experimental Child Psychology*, *111*, 120–127. doi:10.1016/j.jecp.2011.07.002

O'Connor, E., McCormack, T., & Feeny, A. (2012). Do children who experience regret make better decisions? A developmental study of

the behavioral consequences of regret. *Child Development*, *111*, 120–127. 10.1111/cdev.12253

Perner, J., Sprung, M., & Steinkogler, B. (2004). Counterfactual conditionals and false belief: A developmental dissociation. *Cognitive Development*, *19*, 179–201. doi:10.1016/j.cogdev.2003.12.001

Rafetseder, E., Cristi-Vargas, R., & Perner, J. (2010). Counterfactual reasoning: Developing a sense of "nearest possible world" *Child Development*, *81*, 376–389. doi:10.1111/j.1467-8624.2009.01401.x

Rafetseder, E., & Perner, J. (2012). When the alternative would have been better: Counterfactual reasoning and the emergence of regret. *Cognition and Emotion*, *26*, 800–819. doi:10.1080/02699931-.2011.619744

Rafetseder, E., Schwitalla, M., & Perner, J. (2013). Counterfactual reasoning: From childhood to adulthood. *Journal of Experimental Child Psychology*, *114*, 389–404. doi:10.1016/j.jecp.2012.10.010

Riggs, K. J., Peterson, 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. 10.1016/S0885-2014(98)90021-1

Sobel, D. M. (2011). Domain-specific causal knowledge and children's reasoning about possibility. In C. Hoerl, T. McCormack, & S. R. Beck (Eds.), *Understanding counterfactuals, understanding causation* (pp. 123–146). Oxford, UK: Oxford University Press.

Weisberg, D. P., & Beck, S. R. (2010). Children's thinking about their own and others' regret and relief. *Journal of Experimental Child Psychology*, *106*, 184–191. doi:10.1016/j.jecp.2010.02.005

Weisberg, D. P., & Beck, S. R. (2012). The development of children's regret and relief. *Cognition and Emotion*, *26*, 820–835. doi:10.1080/02699931.2011.621933

Weisberg, D. S., & Gopnik, A. (2013). Pretense, counterfactuals, and Bayesian causal models: Why what is not real really matters. *Cognitive Science*, *37*, 1368–1381. doi:10.1111/cogs.12069

Woodward, J. (2011). Psychological studies of causal and counterfactual reasoning. In C. Hoerl, T. McCormack, & S. R. Beck (Eds.), *Understanding counterfactuals, understanding causation* (pp. 123–146). Oxford, UK: Oxford University Press.

Zeelenberg, M., & Pieters, R. (2007). A theory of regret regulation 1.0. *Journal of Consumer Psychology*, *17*, 3–18. doi:10.1207/s15327663jcp1701_3