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The Effect of Moral and Statistical Norm Violations in Children's Counterfactual Reasoning

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Abstract

Counterfactual reasoning involves thinking about how reality could have been different. Adults show remarkable consistency in the counterfactual possibilities they imagine. For example, they tend to imagine counterfactuals that undo immoral actions. However, it remains unclear whether this link between morality and the counterfactual imagination is an inherent cognitive feature, present from early childhood. To elucidate this relation, we tested 191 4- to-11-year-olds across two studies. In Study 1, children heard stories in which a moral norm-violating and a moral norm-conforming character together bring about a negative outcome. When asked what could have happened differently, children changed the moral norm-violating part of reality over other parts with increasing age. In Study 2, we examined whether this effect is unique to moral norm violations or extends to statistical norm violations. Children began mutating moral norm violations earlier than statistical norm violations, suggesting morality influences counterfactual thinking earlier than statistical norms.

Keywords: counterfactuals; imagination; norm violation; morality.

Introduction

People often imagine how past events could have been different by altering aspects of reality (Byrne, 2016). This way of thinking—counterfactual thinking— has effects on learning (Epstude & Roese, 2008), decision-making (Zeelenberg & Pieters, 2007), moral judgments (Markman et al., 2008; Branscombe et al., 1996) and emotional experience (Beck et al., 2014). A prominent finding from counterfactual studies is that some kinds of counterfactual alternatives are more readily available than others, such that different people tend to envision the same kinds of counterfactual alternatives in response to events (Byrne, 2016; Byrne, 2017). For example, they mutate unexpected events over expected ones (Kahneman & Tversky, 1982), controllable events over uncontrollable ones (Girotto et al., 1991), events including action over those which do not include action (Byrne & McEleney, 2000), or the most recent event in a chain of events (Byrne, et al., 2000). These patterns, or biases, in adults' counterfactual thinking have been termed "fault lines of reality" and appear with consistency across individual and tasks (for a review, see Byrne, 2016).

Another key factor that influences the availability of counterfactuals is morality (Byrne, 2017)—normative evaluations of whether an action is permissible or considerations as to whether an action is morally right or good (for a review, see Malle, 2021). For example, McCloy and Byrne (2000) presented adult participants with a series of causal events leading to a negative outcome. Consider Alan, who, on his way to buy a stereo from a stereo shop, detours to a tobacconist to buy cigarettes and to the post office to post a letter. He does not arrive at the stereo shop in time before the stereos sell out. When asked how things could have been different so he could have bought a stereo, adults mutated what they deemed to be a socially inappropriate event (i.e., stopping to buy cigarettes) more often than the socially appropriate event (i.e., stopping to post a letter).

Moreover, Hitchcock and Knobe (2009) have proposed that *prescriptive* norm violations—disobeying a rule dictated by a group or institution that one ought to follow—play a role in counterfactual imagination by prompting people to envision a hypothetical world where no violations took place. In their "pen vignette" study, participants are introduced to a rule within a university department: administrative assistants are permitted to take pens from a receptionist's desk, whereas faculty members are not. Participants are then told that an administrative assistant and a faculty member each take a pen at the same time, leading the reception desk to run out of pens. Even though the two characters jointly caused the pen supply to run out, participants judged that the faculty member was the cause of there being no pens left. Hitchcock and Knobe (2009) argued that participants primarily think about a counterfactual world free of any prescriptive moral norm violations (e.g., a world where the faculty member had not taken a pen) to form their causal judgments, compared to other possible alternatives (e.g., a world where the administrative assistant had not taken a pen).

A later study by Phillips and colleagues (2015) supported Hitchcock and Knobe's (2009) claim and showed that moral judgments also affect the relevance of counterfactual alternatives people consider. For instance, participants were presented with a story in which a captain faces the risk of his ship sinking due to a large storm. In a morally neutral condition, participants were informed that the captain threw cargo overboard to lighten the ship and return home safely and were then asked to judge the relevance of the counterfactual world where the captain had not thrown the cargo. In a morally bad condition, participants were informed that the captain threw his wife overboard and were then asked to judge the relevance of the counterfactual world where the captain had not thrown his wife. Participants judged the latter counterfactual that did not involve an overboard wife more

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relevant to imagine compared to those who encountered the cargo-throwing scenario.

These findings indicate that morality affects the counterfactual alternative adults consider (McCloy & Byrne 2000; for a review, see Byrne, 2017) and influences which counterfactual alternatives adults deem worth considering (Kominsky & Phillips, 2019; Phillips et al., 2015).

Conversely, morality is also susceptible to being affected by the counterfactual possibilities people consider. Studies with adults and children suggest that counterfactuals influence morality both in forming new moral evaluations (Gautam et al., 2023; Wong et al., 2023) and in changing existing moral standards (Genç & Nyhout, 2024; Markman et al., 2008). For instance, in a recent study by Genç and Nyhout (2024), 5-6-year-olds learned about the experience of a new child at a school, who was excluded by some other children. In an alternative condition, participants were presented with a counterfactual world where the other children included the child. Compared to children in a control condition, children who were prompted to imagine how things could have been better judged the social exclusion treatment worse.

In adults, the relation between counterfactual and moral reasoning appears to be bidirectional. While existing work suggests that the counterfactual possibilities children consider affect their moral judgments, we do not know whether moral considerations constrain the counterfactual possibilities children consider from early in development. Does the tendency to mutate moral norm violations characterize counterfactual reasoning from the outset, or are these patterns learned over time? Understanding whether, when, and how moral considerations constrain counterfactual thinking can provide insight into the development of moral cognition, causal reasoning, and decision making.

In the current studies, we examined whether and when in development children show a tendency to change morally inappropriate factors (vs. morally appropriate ones) when imagining how a negative situation could have been avoided.

The Current Studies

In Study 1, we hypothesized that children would more likely change moral norm-violating aspects of reality compared to other aspects and that this tendency would increase with age. To test this hypothesis, we adapted the "pen vignette" study by Hitchcock and Knobe (2009) for children and created another similar vignette. Participants were presented with two stories in which a moral norm-violating and a moral norm-conforming character jointly brought about a slightly negative outcome, and children were then asked to imagine how this negative outcome could have been altered.

Although no study, to our knowledge, has examined the effect of morality on children's counterfactual reasoning, there are few studies looking at when children begin showing other counterfactual thinking biases such as the controllability bias (Nyhout & Ganea, 2020) and temporal order bias (Payir & Guttentag, 2019; Byrne & Meehan, 2005). To determine the target age range for the current study, we took into consideration both these previous studies and the studies on the development of counterfactual imagination. Since the current literature provides evidence that children as young as 4 years might engage in counterfactual reasoning (Harris et al., 1996; Nyhout & Ganea, 2019) and children as young as 5 show biases in their counterfactual imagination (Nyhout & Ganea, 2020), we decided to include children from the age of 4.

In Study 2, we looked at whether moral violations have a unique effect on counterfactual imagination, or if norm violations more generally influence the counterfactual alternative children consider.

Study 1: Method

Participants

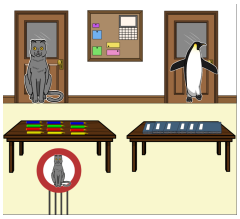
The final dataset included 96 children aged 4.00 to 9.99 years (M_{age}= 83.8 months, SD= 20.3, 55 females, 189 trials), with at least 15 children per age. Children in our final sample were 81.2% White, 13.5% Mixed-Multiple ethnicity, and 5.2% Asian ethnic groups. An additional 10 children were tested but excluded for the following reasons, as per our pre-registered exclusion criteria: having a developmental disorder (n= 6), parental interference (n= 2), unwillingness to answer test questions (n= 2). Children resided in the UK and had to be exposed to English at least 50% of the time since birth. Parents were asked to confirm their child understood and spoke English fluently and did not have any developmental concerns. The method, predictions, and main analysis were pre-registered.

Design and Procedure

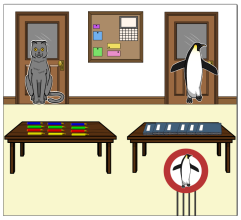
Each participant was presented with two storybooks with static images (pencil and football). The presentation order of the stories was fully counterbalanced. The structure of both stories was the same: first, a rule was introduced at a school (football match) and then a moral norm-violating and a moral norm-conforming character jointly brought about a negative outcome that meant that a teacher (referee) could not take a pencil (apple). (See excerpt script for the "Pencil" story in *Figure 1*).

Children were first asked a *control question* to check their understanding of reality ("Did the teacher/referee take a pencil/apple?") followed by a *counterfactual test question* ("What could have happened differently so the teacher/referee could have had a pencil/apple?"). For children who generated more than one alternative, we included only their first answer in the analysis. Lastly, they were asked a *moral norm control question* to be ensure that they understood the norm in the story ("Which student was allowed to take a pencil from the desk?"). Responses to trials in which children failed the moral norm control question were excluded from analysis (n= 3).

1) At this school, there is a Cats class and a Penguins class. There are always pencils and notebooks for the children. But there is a rule about who is allowed to take a pencil or take a notebook from the desks.



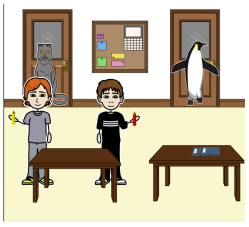
2) Only students in the Cats class are allowed to take pencils from the desk.



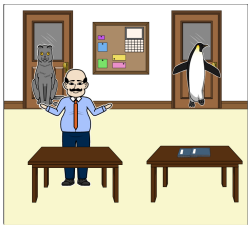
3) Only students in the Penguins class are allowed to take notebooks from the desk.

[*Children were then asked which class is allowed to take pencils and which class is allowed to take notebooks and then the story continued. All children answered correctly*].

4) This is Oliver from the Cats class. This is Freddie from the Penguins class.



5) One day, Oliver and Freddie come to the desk at the same time. Both Oliver and Freddie take a pencil from the desk.



6) Then, a teacher needs a pencil. But there are no pencils left. So, the teacher does not take a pencil.

Figure 1: Sample script for the "Pencil" story with example images.

Coding

Children's answers were recorded verbatim by the experimenter after each question. The entire dataset was coded by two independent coders for each of four categories. Disagreements were resolved after discussion.

(1) *Changes norm-violation:* Whether children changed the norm violating aspect of the stories (scored as 1; e.g., "if the penguin student did not take a pencil") over other aspects (scored 0; e.g., "the teacher should get there first") after they were asked how the outcome could have been avoided (e.g., a world where the teacher had had a pencil).

(2) *Context:* Whether children's answers were in-context (i.e., included elements from the scenes of the stories), out-of-context (i.e., included elements outside of what was explicitly stipulated in the stories, e.g., "buy some more from the shop"), or uncodable (e.g., "I do not know").

(3) *Counterfactual alignment:* Whether children's answers were aligned with the counterfactual premise we asked them to imagine (e.g., a counterfactual world where the teacher could have had a pencil) or not (e.g., "the teacher could have a notebook").

(4) *Character focus:* Lastly, the focus of the alternatives children created was coded in the following categories based on which character's behaviour they changed: The teacher/referee, norm violating character, norm conforming character, both/either of the characters, others/uncodable/no alternative.

Coder agreement was high for all categories (κ = .90, .93, .92, .91, respectively).

Study 1: Results & Discussion

We ran generalized linear mixed models (GLMMs) with binomial error distribution to examine if children *changed the moral norm-violating* aspect of the stories over the other aspects as they get older. The unit of analysis was each trial, and our full model included age in months (mean-centered) as a predictor variable, story order (first vs. second) and story type (pencil vs. football) as control predictors, and the random intercept of participant ID. The full model improved the fit compared to the null model, which included story order and story type as control predictors, and the random intercept of participant ID ($\chi2(1) = 35.71$, $p < .001$). This suggests that children were more likely to change the moral norm-violating aspect of the story with increasing age (OR = 1.13, 95% CI [1.04, 1.22], z = 3.03, p = .002). When the full model was compared separately with reduced models without story type ($\chi2(1) = .03$, p = .859) and story order ($\chi2(1) = 1.39$, p = .239), it did not provide a better fit in either case, suggesting that there was no significant effect of story type (z = 0.18, p = .860) and story order (z = 1.15, p = .250). Figure 2 displays the relation between age (in months) and the tendency children showed to change the immoral aspect of the stories.

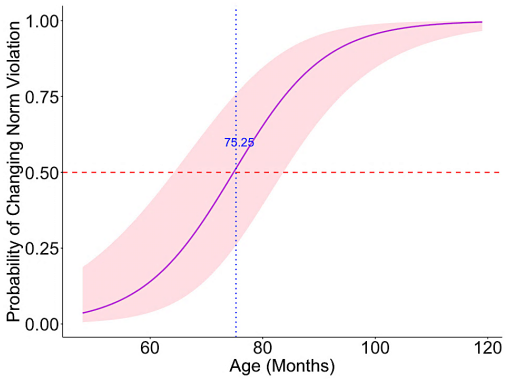


Figure 2: The figure shows how age in months (x-axis) predicts the probability of changing the moral norm violating aspect of the stories (y-axis). The shaded area represents 95% confidence interval. The red dashed line represents the chance level, and the point (75.25m, 6.27y) where it meets the blue dashed vertical line marks where the predicted probability begins to surpass chance level.

In 109 of the 189 valid trials (57.7%), participants replaced the moral norm-violating part of the stories with a moral norm-conforming counterpart. All 109 instances were *in-context* and *aligned with the counterfactual premise*. Children changed the behaviour of the norm-violating character in 107 of these 109 trials (98.2%) and altered the teacher (referee)'s behaviour in 2 trials (1.8%) to prevent the norm-violating character from taking a pencil (apple).

What did children who did not change the norm-violating aspect of the stories think about? While children did not change the moral norm violating aspect of the stories in 80 of 189 trials (42.3%), they still imagined a hypothetical world that was *aligned with the counterfactual premise* on 29 trials (15.3%, of all trials). Children changed the behaviour of the teacher(referee) in 8 trials (e.g., the referee should stay there first), the norm-conforming character in only 2 trials, both/either characters in 11 trials (e.g., if the other two took notebooks), and referred to situational factors in 8 trials (e.g., if there were more supplies). Responses on 5 trials included elements that were not explicitly mentioned in the stories (e.g., buy some more from the shop). Children's answers on the remaining 51 trials (27%, of all trials) were *not aligned* with the counterfactual premise we asked them to imagine (e.g., "The teacher could have had a notebook").

In sum, Study 1 found that from age 6 (75.25 months) onwards, morality begins to constrain the counterfactual alternatives children consider as they imagine a world without moral norm violations. Like adults, children viewed violations of moral rules as "fault lines" to be altered in counterfactual worlds with increasing age. Is this effect specific to *moral* norm violations or do children view the more general category of norm violations as targets for counterfactual intervention? Statistical norms—norms about the frequency of certain events, actions, or behaviours (Bear & Knobe, 2017)—also constrain adults' counterfactual imagination, much like moral norms (Kahneman & Miller, 1986). In Study 2, we examined whether statistical norm violations influence children's counterfactual imagination, using modified versions of the stories from Study 1.

Study 2

A study by Kahneman and Tversky (1982) showed that adults are more likely to change aspects of a situation that violate (compared to conform to) statistical norms when they imagine how things could have been different. In one well-known scenario, Mr. Jones leaves his office at his regular time but does not take his regular route. On his way home, he is killed in a car accident. Kahneman and Tversky (1982) found that participants were more likely to alter the statistical norm violating behaviour (the unusual route he took) compared to the norm-conforming behaviour (the time he left), stating that Mr. Jones would still be alive if only he had taken his regular route.

In Study 2, we presented two characters: one who conformed to and one who violated their past patterns of behaviour. We hypothesized that (1) children would be more likely to change the statistical norm violating part of reality over other parts of reality with increasing age and (2) the counterfactual effect of agent-level statistical norm violation would emerge later than that of moral norm violation.

Although moral norm violations are unexpected (Kahneman & Miller, 1986) and occur less frequently than statistical norm violations, participants often judge them as unacceptable (Malle, 2021) and even impossible in both childhood (Shtulman & Phillips, 2018) and adulthood (Phillips & Cushman, 2017). These features might make moral norm violations more salient or viable targets for counterfactual intervention. Therefore, our latter hypothesis builds on the premise that moral acceptability and the perceived possibility of reality affect children's imagination by intuitively prompting them to imagine a more morally acceptable and possible hypothetical world.

Given that children began to change the moral norm-violating aspects of reality in their counterfactuals around the age of 6-7 and the prediction that statistical norm violations might only begin to constrain counterfactual reasoning somewhat later, we included 6 years as our lower end of the age range and extended the upper end to 11 years.

Study 2: Method

Participants

The final dataset included 95 children aged between 6.00 and 11.99 years (M_{age}= 107 months, SD = 20, 54 females, 184 trials), with at least 15 children per age as pre-registered. An additional 8 children were tested but excluded for the following reasons as per our pre-registered exclusion criteria: having a developmental disorder (n=7), experimenter error (n= 1). Most of the children were tested in local schools so we were not able to collect their demographic data. The method, predictions, and main analysis were pre-registered.

Design and Procedure

Each participant was presented with modified versions of storybooks we used in Study 1, replacing moral norm violations with statistical norm violations. Unlike Study 1, participants were explicitly told that *all* children are allowed to take whatever they want from the desks. Then, we introduced two characters who each make a consistent selection every day (e.g., always taking a pencil/notebook). At the end, one character repeats their past behaviour (e.g., taking a pencil) as usual and the other deviates from their repeated past behaviour to make the opposite choice (e.g., taking a pencil when they usually take a notebook). The rest of the story followed the same structure and script as in Study 1, with both characters ultimately taking the same object (pencil/apple), leaving none for the teacher/referee (Figure 3).

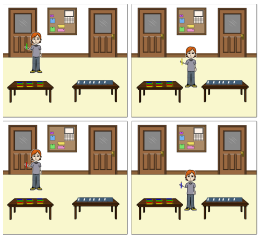
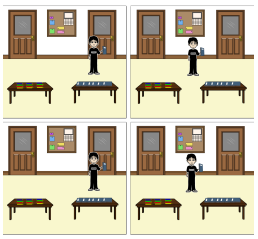
 1) This is Oliver, and he always takes a pencil every time he passes the desk. Let's see what Oliver takes for the rest of the week.	 2) This is Freddie, and he always takes a notebook every time he passes the desk. Let's see what Freddie takes for the rest of the week.

Figure 3: Variation on presented norm in Study 2

Stories were presented in counterbalanced order, and only children's first responses were included in the analysis. As in Study 1, we asked a control question to check understanding of reality ("Did the teacher/referee take a pencil/apple?"), followed by a counterfactual test question ("What could have happened differently so the teacher/referee could have had a pencil/apple?"). We also asked a statistical norm check question ("At the beginning, which kid always took a pencil from the desk?") and excluded trials where children failed this question from our analyses (N = 6). Coding took place as in Study 1 with the same four coding categories**.** Coding agreement was κ = .96, 61, .95, .98 for the categories of *changes norm violation, context, counterfactual alignment, and character focus, respectively*.

Study 2: Results & Discussion

We ran generalized linear mixed models (GLMMs) with binomial error distribution to examine whether children were more likely to change the *statistical norm-violating* aspect of the stories rather than other aspects with increasing age. The unit of analysis was each trial, and our full model included age in months (mean-centered) as a predictor variable, story order (first vs. second) and story type (pencil vs. football) as control variables, and the random intercept of participant ID. The full model provided a better fit compared to the null model which included story order and story type as control variables, and the random intercept of participant ID ($\chi 2(1) = 6.03$, $p = .014$). This suggests that children were more likely to change the statistical norm violating aspect of the story with age (OR = 1.06, 95% CI [1.00, 1.11], z = 2.06, $p = .039$). The comparison of the full model with the reduced models without story type ($\chi 2(1) = 1.57$, $p = .211$) and story order ($\chi 2(1) = 4.94$, $p = .026$) showed that there was no significant effect of story type (z = 1.24, $p = .217$) but there was an effect of story order (OR = .35, 95% CI [.13, .93], z = -2.12, $p = .034$). Children were more likely to alter the statistical norm-violating aspect on the story presented first compared to the story presented second. Figure 4 displays the relation between age (in months) and the tendency children showed to change the statistical norm violation aspect of the stories, presented by story order.

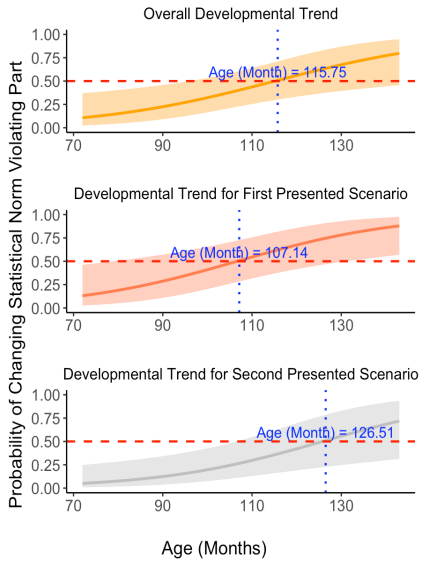


Figure 4: The figure shows how age in months (x-axis) predicts the probability of changing statistical norm violating aspect of the stories (y-axis) for each story order and demonstrated the overall developmental trend. The shaded areas represent 95% confidence intervals. The red dashed lines represent the chance level, and their intersection with the blue vertical lines shows at what age the predicted probability meets and first surpasses the chance level, at 107.14m (8.92y) months for the first story, 126.51m (10.54y) for the second story, and 115.75m (9.65y) combining across stories.

On 80 of 184 trials (43.5%), participants replaced the statistical norm-violating part of the stories with a norm-conforming counterpart. All 80 instances were *in-context*, *aligned with the counterfactual premise*, and the behaviour of the *statistical norm-violating character* was changed.

What did children who did not change the statistical norm-violating aspect of the stories think? On 66 trials (35.9%, of 184 trials), participants still imagined a hypothetical world which was *aligned with counterfactual premise* but did not change the statistical norm-violating aspect of the stories. Instead, they changed the behaviour of the teacher(referee) in 12 trials (e.g., "The teacher could go to another classroom and ask to borrow a pencil)", the norm-conforming character in 13 trials (e.g., "Because Oliver had so many pencils he could have had a notebook"), both/either characters in 33 trials (e.g., "If Oliver and Freddie had taken a notebook"), and referred to situational factors in 8 trials (e.g., "There should have been more pencils"). Seven of these 66 trials included elements that were *not in-context* (e.g., "The teacher could have gone to a shop"). Children's answers on the remaining 38 trials (20.7% of 184) were *not aligned* with the counterfactual premise (e.g., "The teacher could have had a notebook").

In sum, Study 2 examined whether the effect we observed of moral norm violations on the possibilities children imagine in Study 1 is unique to moral norm violations, or whether there is a general effect of norm violations on the counterfactuals children consider, as suggested by Kahneman and Miller's (1986) norm theory in adults' reasoning. Our findings indicate that even the performance of the oldest group in Study 2 was at chance level, suggesting that the effect of statistical norm violations emerges later than that of moral norm violations (see Figure 5).

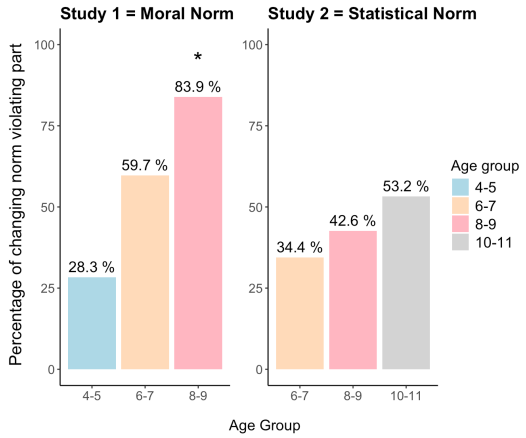


Figure 5: Proportion of trials in which participants changed the norm violating part of the reality over other parts across Study 1 and Study 2 for age groups. The age group marked with an asterisk indicates that participants were more likely than chance to undo the norm violation according to pairwise comparison against chance level (0.5) based on GLMMs including age variable as categorical.

We also found a story order effect, suggesting that children were more likely to change the statistical norm-violating aspect on the story presented first compared to the story presented second. A possible reason for this order effect might be the weakened perceived salience of statistical norm violation. After hearing the first story involving a statistical norm violation (e.g., the child who always takes a notebook takes a pencil), participants could have come to expect deviations from past behavioural statistical norms on the task, rendering the second violation less surprising and salient, and less likely to constrain the counterfactual possibilities imagined. In contrast, we did not detect a significant story order effect in Study 1, which could be related to children's tendency to judge moral norm violations as highly unusual or—in some cases—even impossible (Shtulman & Phillips, 2018). As such, one moral norm violation was not enough to normalize norm violations in Study 1.

General Discussion

Across two studies with children aged from 4 to 11, we examined the counterfactual possibilities children imagine, looking at when they begin altering moral and statistical norm violations in their counterfactual reasoning. Study 1 revealed that children preferentially altered moral norm violations when imagining how events could have been different with increasing age. This pattern appears around age 6 and shows consistency by age 8, aligning with prior evidence that children can reason counterfactually by this age on vignette tasks like those used in the current study (Nyhout et al., 2019; O'Connor et al, 2012; Rafetseder et al., 2010; Rafetseder et al., 2021). Study 2 extended our investigation to statistical norm violations, showing that even 11 –year old children do not show a consistent tendency to undo such violations in their counterfactual imagination. Together, these findings suggest that moral norm violations are particularly potent subjects or "fault lines" for counterfactual interventions.

Substantial work with adults (Byrne, 2016) and emerging work with children (Nyhout & Ganea, 2020; Payir & Guttentag, 2019) have identified common fault lines in counterfactual thinking. Our findings contribute to this growing literature, indicating that moral violations constitute a particularly robust fault line, which may be a more inherent feature of counterfactual thought compared to other types of norm violations.

The later emergence of statistical norm violations as counterfactual fault lines raises important theoretical questions. Does this developmental gap arise because these violations represent fundamentally different kinds of fault lines or because their salience differs? Given that our stimuli were closely matched across studies (and violation types), the observed pattern likely reflects a unique effect of morality on counterfactual thinking. While both types of violations are exceptional, immoral actions are particularly difficult for individuals to accept as possible (Phillips & Cushman, 2017). Moreover, past research suggests that, by age 5, children show stronger emotional and behavioral responses to moral norm violations than to other norm violations (Hardecker et al., 2016), indicating that they perceive moral violations as more serious.

It is worth noting that our stimuli involved relatively mild violations, as is typical in developmental research, involving arbitrary prescriptive norms. Had we used more extreme moral violation stimuli (e.g., in which one character hurts another), we might expect the moral fault line to affect the possibilities children consider at an earlier age. In follow-up studies, we are examining this possibility, as well as whether other types of norm violations, such as social norm violations (e.g., deviating from group conventions), influence counterfactual reasoning similarly.

These studies demonstrate that children preferentially consider moral norm violations when generating counterfactual alternatives as they get older, while statistical norm violations influence counterfactual reasoning later in development. These findings highlight the early and robust influence of morality on children's imaginative reasoning and align with prior research that children use counterfactuals to make moral evaluations (Genç & Nyhout, 2024; Wong et al., 2023), reinforcing the bidirectional relationship between morality and counterfactual reasoning in childhood, as in adulthood.

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