Title

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Authors

Flanagan, Teresa
Kushnir, Tamar

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Individual differences in fluency with idea generation predict children's beliefs in their own free will

Teresa Flanagan (tmf87@cornell.edu)
Department of Human Development, Cornell University, 116 Reservoir Ave,
Ithaca, NY 14853 USA

Tamar Kushnir (tk397@cornell.edu)
Department of Human Development, Cornell University, 116 Reservoir Ave,
Ithaca, NY 14853 USA

Abstract

The ability to imagine alternative possibilities plays a crucial role in everyday cognitive functioning beginning in early childhood. Across two studies, we ask whether individual differences in young children's (Mean Age = 5.01; SD = 0.78 Range = 2) fluency in generating alternative possibilities relates to a particular type of social-cognitive counterfactual judgment, namely children's belief in the possibility to "act otherwise" when actions go against stated strong desires (i.e. "free will"). We found that the fluency of generating ideas was a consistent individual difference that held regardless of domain. We also found that individual children's fluency predicted judgments of free will for themselves (Study 2) but not for others (Study 1). Our findings raise new questions about how counterfactual thinking enables children to overcome psychological barriers to self-control, and how stimulating the imagination facilitates developing cognitions that rely on it.

Keywords: counterfactual thinking, free will, social cognition, modal cognition

Introduction

The ability to imagine alternative possibilities is ubiquitous in human cognition. Broadly, it is invoked in all types of modal thinking: how we imagine counterfactually what could have been in the past, hypothetically what might be in the future, and normatively what should or ought to be (Lewis, 1973; Balke & Pearl, 1994; Woodward & Hitchcock, 2003). Imagining possibilities is a critical cognitive skill underlying our memory for past events (Schacter et al., 2015), ability to plan for the future (Baumeister, Vohs, & Oettingen, 2016), our moral judgments (Phillips & Cushman, 2017; Phillips, Luguri, & Knobe, 2015), and our causal cognition (Engle & Walker, 2018). Moreover, this type of thinking is governed by a common cognitive and neural architecture (De Brigard et al., 2013). Recently, researchers have claimed that it plays a role in a host of psychological processes that develop in early childhood, including future thinking (Atance & Meltzoff, 2005), causal inference (Walker & Gopnik, 2013; Engle & Walker, 2018), imaginary play (Taylor et al, 2018; Weisberg & Sobel, 2012), self-regulation (White et al., 2017), and social and moral judgment (Kushnir, 2018).

Separate from this, there has been a long research tradition focused on ability to imagine alternative possibilities as a stable individual difference, relating it to differences in creativity and intelligence. Most of this work utilizes a classic method developed by Guilford (1967) in which people are asked to generate many unique alternative possible uses for a common object (e.g. a tissue). Conservatively, these tasks capture individual differences in verbal fluency, performance on these "idea generation" paradigms also relates to individual differences in creativity and intelligence (Wallach & Kogan, 1965; Nusbaum & Silva, 2011). There is recent evidence that modified versions of tasks such as Gilford's capture stable individual differences in children as well, even when controlling for age and verbal IQ (Taylor et al., 2018).

To date, however, no studies have linked individual differences in "idea generation", either in adults or children, to the types of cognitions that have been hypothesized to rely on modal thinking. Here we explore one such link: we examine whether individual differences in the ability to generate alternative ideas relate to a particular social-cognitive skill that relies on counterfactual thinking – children's judgment of their own and others' freedom of choice.

Counterfactual thinking has been argued to be the basis of folk intuitions of freedom of choice (i.e. "free will", Alquist et al., 2015; Nichols, 2011). Studies show that when adults make free will judgments, they consider whether or not there were alternative choices available (Feldman, Baumeister, & Wong, 2014). Children's early developing intuitions about free will are also based on the ability to represent alternative possibilities. For example, infants are more impatient with an agent when the agent is unwilling to act (they understand that a possible alternative is available) than when the agent is unable to act (they understand that no possible alternative is available, Behne et al., 2005). Preschoolers can answer explicit questions about whether an agent can and can't do otherwise when actions are possible, impossible, or limited by social and moral considerations (Nichols, 2004; Schult & Wellman, 1977; Shtulman & Phillips, 2008). As part of this ability, children generate explanations about what alternative actions are available if an agent chooses to "do otherwise."

Children's beliefs about free will also undergo important developmental changes, changes that may be linked to their counterfactual thinking. For example, 6-year-olds are more likely to endorse the free will to act against desires than 4-year-olds (Kushnir et al., 2015). Furthermore, older children

are more likely than younger children to endorse the freedom to act against moral and social norms (Chernyak et al., 2013; Chernyak, Kushnir, & Wellman, 2010). Moreover, younger children have difficulty distinguishing improbable from impermissible events more generally (Lane et al., 2016; Shtulman & Carey, 2007; Shtulman & Phillips, 2008). Together these studies suggest that a domain-general cognitive mechanism is responsible for the developmental shift.

One intriguing possibility is that the ability to *fluently generate ideas* about possible alternative actions underlies children's judgments of free will. That is, in order to make judgments of free will (or possibility more generally) children are attempting to imagine any situations in which an action could be different, and, if they can think of one or more such situations readily and easily, they answer in the affirmative. For example, a child may be able to easily imagine how yummy crackers could be inedible for all sorts of reasons, thus they answer that one can choose not to eat them. Anecdotally, this hypothesis has some support from the post-hoc justifications that children come up with following the initial yes/no judgment. The large majority of their justifications are imagined alternative scenarios (i.e. "because some crackers aren't good for you" Kushnir et al, 2015). Under this model, individual differences in free will judgments should relate to individual differences with a facility for idea generation.

To test this, we conducted two studies using the third person (Study 1) and first-person (Study 2) versions of the free will questions from Kushnir et al. (2015). Overall, we hypothesized that children's free will judgments would replicate prior work, such that there would be some variability in children's free will beliefs, and also age-related changes. Like prior work, we expect lower free will beliefs (and more variability) for first-person question (Study 2) than for third-person (Study 1).

We also measured children's ability to generate alternative possibilities using a battery of idea generation tasks. Our tasks had a structure modeled after standard creativity task (e.g. "uncommon uses task" Milgram & Milgram, 1976; Wallach & Kogan, 1965) with some notable differences. First, we scored children on idea fluency only. That is, we did not compare each idea to the sample-wide list of ideas to score its originality. Fluency was captured by coding for number of unique ideas listed a child gives for a particular question.

Second, we asked children to list as many alternative possibilities they could think of in each of three different domains – Physical, Fantastical, and Social/Psychological. The Physical question was adapted from Guilford (1967) and asked about alternative uses for a tissue. The Fantastical questions were adapted from Taylor et al. (2018) asking children to imagine what the world would be like if certain laws of our world were changed (ability to walk on walls, people have tails). We added to these our own set of Social/Psychological questions which asked children to come up with ways to help a sad friend feel better (social) or make themselves feel better when they are sad (psychological).

Including a range of idea generation tasks across these domains allowed us to explore the generality of the relationships: we were able to check whether children who generate a lot of ideas in one domain also do so in others. Moreover, Since children's free will beliefs are part of their developing social-cognition, our addition of questions which explore children's social and psychological idea generation allowed us to check whether social/psychological ideas are specifically related to free will beliefs over and above other types of ideas.

Study 1

Method

Participants A total of 43 4–6-year-olds (M_{age} = 5.07, SD_{age} = 0.80, N_{female} = 23) were recruited at a science museum in a small city in the northeastern United States.

Procedure Children were interviewed individually in a quiet room at a museum. The procedure began with the free will questions, adapted from Kushnir et al. (2015). Two Action questions (one about food and one about activity) asked children to judge whether an agent could "choose to" act against or whether they "have to" act in accordance with the stated desire (e.g. "Even though she does not like the cracker, can she just *choose to* eat the cracker or does she *have to not* eat the cracker?"). Two Inhibition questions (one about food and one about activity) asked children to judge whether an agent could choose to *not* act (i.e. inhibit action) or whether they have to act on a stated strong desire (e.g. "Even though she wants to know about the box, can she just *choose not to* look into the box or does she *have to* look into the box"). Note that the free will questions offer children a forced choice between a stated action (e.g. eating a yummy cookie) and a general possibility of acting otherwise without explicitly stating any alternative actions. Question order was counterbalanced. Order of the options within the question ("choose to" vs "have to") was counterbalanced. There were also two Control questions, Simple free action (e.g. "Can she step off a chair?") and Physically Impossible action (e.g. "Can she run through a wall?"). The majority of children (86%) answered these control questions correctly, ensuring children understood and could follow the form of the target questions about acting against desires.

After the free will questions, children completed the idea generation task battery. This began with a warm-up question about uncommon uses for a pen ("Besides [drawing/writing] can you think of some things to do with [pen]?") that was used to familiarize children with the question format and idea probes ("what else?"). Following the warm-up, the idea generation task battery consisted of three question types in a latin-square counterbalanced order:

Physical (one, Gilford 1967): Children were asked for the common use of, and then ideas for uncommon uses of, a tissue ("Can you think of some things you can do with it besides [common use]?").

Fantastical (two, Taylor et al, 2018): Children were asked to "imagine what if we all woke up tomorrow and every person [had a tail/could walk on walls]. What would the world be like if we all [had tails/could walk on walls]?"

Social/Psychological (one third-person, one first-person). Children were asked to think of ways to make a friend /themselves happy when the friend/they themselves are sad. (e.g. "Imagine that one day [your friend/you] [was/are] very sad and didn't want to play at all. What things could you do to make [your friend/yourself] feel better and want to play again?).

For each question, children were encouraged using the probe "what else?" to keep generating ideas until they chose to stop (e.g. saying they had no more ideas). Children also participated in a storytelling task at the end of the procedure, but those results are not reported here.

Coding For the free will task, children received a score of 0-2 for each story type, Action and Inhibition (2 meaning they said "choose to" for both food and activity questions). Two coders independently scored each response. A Cohen's k indicated agreement between the two coders for each question (κs > .83, *ps* < .0005). Discrepancies were resolved through discussion.

For the idea generation tasks, the number of unique responses were recorded for each question. Uniqueness was defined as any difference from previous responses (e.g. "we could wag our tails" versus "we could bounce on our tails"). Two coders were trained on the coding scheme. A Cohen's k indicated agreement between the two coders for each question (κs > .867, *ps* < .0005). Discrepancies were resolved through discussion.

Results

Free Will A repeated measures ANCOVA with Question Type (Action vs Inhibition) as a within-groups factor and age as a covariate found a marginal main effect of Question Type ($F(1) = 3.17$, $p = .083$) and a marginal age effect ($F(1) = 3.097$, $p = .086$) and no interaction. Replicating past work, children's free will scores were higher for Action ($M = 1.45$, $SD = 0.78$) than in Inhibition ($M = 1.13$, $SD = 0.82$; $t(39) = 2.177$, $p = .036$). In addition, scores were significantly above chance for Action ($t(39) = 3.636$, $p = .001$) but not Inhibition ($t(41) = .927$, $p = .359$). We found a significant positive correlation between age and Inhibition score ($r = .376$, $p = .014$), but not age and Action score ($r = .088$, $p = .590$).

Idea Generation Table 1 shows the descriptive statistics for each idea generation task as well as the correlations between them. The results point to group-level and individual consistency across domains. On the group level, a repeated measures ANCOVA with Question Type (Physical vs Fantastical_Tails vs Fantastical_Walls vs Social vs Psychological vs Total) and age as a covariate found no effect of Question Type ($F(1) = 2.58$, $p = .117$), no effect of age ($F(1)=.013$, $p = .911$), and no interaction. Also, the number of unique ideas generated was positively correlated across domains (*ps* < .05); children who generated more in one domain tending to generate more in another.

Relationship between Free will beliefs and Fluency Children received a score of 0-4 for total free will judgments (combined Action and Inhibition scores). Total free will score did not significantly correlate with any of the idea generation scores separately or total idea generation score (see Table 1).

Table 1: Relationships between idea generation questions across domains in Study 1. Relationship between idea generation and third-person free will judgments included in final row.

	Physical	Fantastical Tails	Fantastical Walls	Soc/Psych third-person	Soc/psych first-person	Total number of ideas generated
Physical ($M = 4.73$, $SD = 4.62$)	-	.500**	.571***	.728***	.382*	
Fantastical Tails ($M = 4.70$, $SD = 5.06$)	-	-	.367*	.365*	.645***	
Fantastical Walls ($M = 4.28$, $SD = 3.83$)	-	-	-	.410**	.374*	
Social/psychological third-person ($M = 4.29$, $SD = 5.44$)	-	-	-	-	.420**	
Social/psychological first-person ($M = 2.79$, $SD = 2.55$)	-	-	-	-	-	
Third-person Free Will	.075	.037	.144	-.112	-.060	.032

*p<.05; **p<.01, ***p<.001

Discussion

In this study, we examined children's third-person free will judgments, children's ability to fluently generate alternative possibilities, and the relationship between two. Patterns of children's free will judgment by age and type of question (action vs inhibition) mirrored past work. Children generated an average of 4-5 ideas per domain (with the exception of first-person social/psychological ideas). Idea generation was consistent across Physical, Fantastical, and Social/Psychological domains, both at the group level and at the individual level. Our findings of cross-domain consistency in idea generation suggest that these tasks, if properly validated (e.g. by controlling for verbal IQ, see Taylor et al, 2018), could be used to measure fluency in children.

We did not find significant relationships between idea generation scores and third-person free will judgments. One reason could be that there was not enough variability in free will judgments, which were relatively high in this study even for the youngest children.

More substantively, taking this third-person view may facilitate children's reasoning about possible actions in itself, and thus our third-person task may not be demanding enough to demonstrate the role of individual differences. Recent work has shown that, like adults, children are subject to such "psychological distance" effects when reasoning about possibility, choice, and future desires (Bowman-Smith, Shtulman & Friedman, 2018; Lee & Atance, 2016; Kushnir et al, 2015). Relatedly, taking a third-personal view on actions can facilitate higher-cognitions required for immediate (White & Carlson, 2015) and future-oriented (Atance, Louw & Clayton, 2015) self-regulation. In Study 2 we explore whether fluency has more predictive power in explaining individual differences in children's beliefs about their ability to act against and inhibit desires which they have expressed for themselves, rather than those given for another person.

Study 2

Method

Participants A total of 28 4-6-year-olds (M_{age} = 4.93, SD_{age} = 0.77, N_{female} = 19) were recruited at a science museum in a small city in the northeastern United States. Data collection is still ongoing and preliminary results are reported.

Procedure Children were interviewed individually in a quiet room at a museum. The procedure consisted of the first-person free will questions followed by the idea generation task battery in a counterbalanced order.

The free will task was similar to Study 1, but the questions first asked children to think of their own desires (e.g. "think of a [food you really like]/[something you really like to do]" and then referenced the child's response rather than the desires of someone else (e.g. "If *you* really wanted to [eat/do X], could *you* just choose to…"). Question order was counterbalanced. Order of the answer choices within the question ("choose to" vs "have to") was counterbalanced. The two Control questions had the same form as in Study 1. A majority of responses to these control questions (82%) were correct. A Cohen's k indicated agreement between the two coders for each question (κs > .82, *ps* < .0005). Disagreements were resolved through discussion.

After the free will questions, children completed the idea generation task battery, exactly as in Study 1. Coding followed the same procedure as in Study 1. Two coders were trained on the coding scheme. A Cohen's k indicated agreement between the two coders for each question (κs > .815, *ps* < .0005). Disagreements were resolved through discussion.

Results

Free Will A repeated measures ANCOVA with Question Type (Action vs Inhibition) as a within-subjects factor and age as a covariate found no effect of question type ($F(1)$ = .151, p = .701), no effect of age ($F(1)$ = .151, p = .701), and no interaction. In addition to not being different from each other or correlated with age, children's free will scores were significantly below chance for Action (M = 0.64, SD = 0.70; $t(25)$ = -2.132, p = .043) but not Inhibition (M = 0.96, SD = 0.89; $t(25)$ = -.225; p = .824). We further confirmed that rates of "choose to" responses were low by comparing to responses in Study 1. T-tests of overall "choose to" scores showed that they were significantly lower in Study 2 than in Study 1 (Study 1: M = 2.58, SD = 1.299, Study 2, M = 1.60, SD = 1.354; $t(63)$ = 2.897, p = .005).

Idea Generation Table 2 shows the descriptive statistics for each idea generation task as well as the correlations between them. As in Study 1, the results point to group-level and individual consistency across domains. On the group level, a repeated measures ANCOVA with Question Type (Physical vs Fantastical_Tails vs Fantastical_Walls vs Social vs Psychological vs Total) and age as a covariate found no effect of Question Type ($F(1)$ = .137, p = .715), no effect of age ($F(1)$ = 2.450, p = .132), and no interaction. Also, we found correlations between the tasks, not all approached significance. However, a 2 (Study: Study 1 vs Study 2, between subjects) x 6 (Question: Physical vs Fantastical_Tails vs Fantastical_Walls vs Social vs Psychological vs Total, within subjects) ANCOVA controlling for age revealed a marginal effect of Study ($F(1)$ = 3.157, p = .081), no main effect of Question ($F(1)$ = 1.778, p = .187), and no interaction.

Relationship between Free will beliefs and Fluency Children received a score of 0-4 for total free will judgments. Total free will score was significantly correlated with the number of ideas generated in the Fantastical Tails task (r = .493, p = .020). Total free will score was also significantly correlated with the number of ideas generated across all tasks (r = .428, p = .047). (see Table 2).

Discussion

In this study, we examined children's first-person free will judgments, children's fluency with generating alternative possibilities, and the relationship between the two. Children's first-person free will judgments were lower and more variable than children's third-person free will judgments, replicating past findings and supporting the idea that psychological distance facilitates children's ability to think about alternative possible actions.

As in Study 1, idea generation was consistent across Physical, Fantastical, and Social/Psychological domains at the group level and to a large extent at the individual level. Though our second sample was smaller, we again found reliable individual differences in counterfactual fluency using this measure.

Importantly, children's fluency predicted their judgments that they could possibly choose to act against their own most and least desired foods and activities. This relationship suggests that facility in generating multiple alternative possibilities might contribute to children's free will beliefs. Implications of this are discussed further below.

General Discussion

In this project, we examined whether individual differences in the ability to generate multiple alterative possibilities in an idea generation task relate to children's first-person or third-person free will judgments. We conducted two studies that measured a child's third-person or first-person free will judgments and their ability to fluently generate alternative possibilities. Overall, we found consistency in children's fluency across domains and we found that children's first-person free will judgments relate to overall fluency across domains and fluency within one of the fantasy domains.

Children's first-person free will judgments were also related specifically to one of our fantasy idea-generation tasks – imagining a world where everyone has tails. It is worth noting that we did not find comparable correlations between free will beliefs and social-psychological idea generation (e.g. ideas for making a friend happy when she is sad). This suggestive result (based as it is on a small sample) requires further study, but parallels links found in recent work by White et al. (2017) showing that pretending to be a superhero or other fantasy character has advantages for self-regulation. Together with this work, our results raise interesting questions about whether fantasy or pretense, rather than general theory-of mind abilities, might present unique advantages to children's developing ability to overcome struggles of will power and self-control.

Evidence of our hypothesized relationship between children's first-person free will judgments and their overall fluency is both correlational and preliminary, thus examining causal links is question for future research. Establishing causal links will have implications for understanding the mechanisms by which children's imaginations help them overcome psychological barriers in their self-beliefs.

One potential mechanism is a direct pathway from idea generation to judgments of choice and possibility. To explore this further would require experimentally limiting or enhancing idea generation in children and then exploring downstream effects on free will judgments. Other potential causal mechanisms are more indirect, via a third factor (or set of factors) that is responsible for both imaginative idea generation and judgments of free will. Language development is one candidate causal influence on both;

Table 2: Relationships between idea generation questions across domains in Study 2. Relationship between idea generation and first-person free will judgments included in final row.

	Physical	Fantastical Tails	Fantastical Walls	Soc/Psych third-person	Soc/psych first-person	Total number of ideas generated
Physical (M = 3.42, SD = 2.75)	-	.207	.684***	.448*	.354^{+}	
Fantastical Tails (M = 3.04, SD = 2.16)	-	-	.389^{+}	.185	.049	
Fantastical Walls (M = 3.38, SD = 3.35)	-	-	-	.544**	.285	
Social/psychological third-person (M = 2.77, SD = 1.90)	-	-	-	-	.266	
Social/psychological first-person (M = 1.73, SD = 1.69)	-	-	-	-	-	
First-person Free Will	.211	.493*	.356	-.108	.259	.428*

$^{+}$p<.1, *p<.05; **p<.01, ***p<.001

ideational fluency is known to be correlated with verbal ability, a fact which is supported in our study by intercorrelations between ability to generate ideas across physical, fantastical, and social/psychological domains. Social-cognitive skills are also correlated with language development (e.g. Astington & Jenkins, 1999; Carlson & Moses, 20001). Additional work is needed to investigate what influence, if any, developing verbal abilities have on the link between the two.

Perhaps a more interesting possibility is that one specific aspect of language development, semantic fluency, plays an important causal role. Indeed, semantic fluency tasks which require a child to list as many examples from a category in a specified amount of time (Kave, Kigel, & Kocvha, 2008) bear a resemblance to idea generation tasks such as the UUT: both require the child to have enough knowledge to explore a space of possibilities within a specified category. But idea generation tasks also go beyond semantic fluency because they require extending and conceptually re-combining familiar ideas and concepts in novel ways (e.g. other uses for a tissue). Conceptual re-combination additionally require other cognitive facilities like cognitive flexibility and, in first-personal cases, knowledge that is episodic or autobiographical (Schacter & Addis, 2007). We therefore don't believe it is likely that semantic fluency alone explains the link between idea generation and free will judgments, but this is a question that is beyond the scope of our data to address.

Despite recent agreement that the ability to imagine alternative possibilities is an important cognitive skill, few studies have examined how individual differences in modal cognition play a role in the ordinary judgments that rely on it. Perhaps capturing these differences can help explain variability and developmental changes in judgments of possibility (Shtulman & Carey, 2007; Lane et al, 2016), episodic future thinking (Atance & Melzoff, 2005, Atance et al, 2015) and counterfactual/hypothetical reasoning (Beck, Robinson, Carroll & Apperly, 2006) and causal inference (Walker & Gopnik, 2014). The approach outlined here could also be used to explore whether cultivating an ease with imagining new ideas could help children master basic (but difficult) social, cognitive and self-regulatory tasks.

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