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Developing intuitions about free will between ages four and six

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ABSTRACT

Our folk psychology includes intuitions about free will; we believe that our intentional acts are choices and that, when such actions are not constrained, we are free to act otherwise. In a series of five experiments, we ask children about their own and others' freedom of choice and about the physical and mental circumstances that place limitations on that freedom. We begin with three experiments establishing a basis for this understanding at age four. We find that 4-year-olds endorse their own and others' ability to "do otherwise" only when they or others are free to choose a course of action, but not when others' actions are physically impossible (Experiment 1), their own actions are physically constrained (Experiment 2), and their own actions are epistemically constrained (Experiment 3). We then examine developmental changes in children's understanding of actions and alternatives that lead to more adult-like free will intuitions. Across two experiments, 6-year-olds, but not 4-year-olds, endorse another person's (Experiment 4) or their own (Experiment 5) freedom to act against stated desires. These age-related changes suggest relationships between a belief in free will and other cognitive and conceptual developments in theory of mind, self-control and self-awareness that take place in early childhood.

1. Introduction

Our folk psychology includes intuitions about free will; in particular, we believe that our intentional acts are choices and that, when such actions are not constrained, we are free to act otherwise. The ability to "act otherwise", and the idea of alternative possible actions more generally, is also at the core of many philosophical definitions of free will. Studies have shown that our adult intuitions about free will are grounded in folk-psychological theories; in particular our understanding of choice, agency, intentionality, social responsibility, and morality (Dweck & Molden, 2008; Guglielmo, Monroe, & Malle, 2009; Haggard & Tsakiris, 2009; Kushnir, 2012; Monroe & Malle, 2010; Nichols & Knobe, 2008; Pizarro & Helzer, 2010; Vohs & Schooler, 2008; Wegner, 2002; Wellman & Miller, 2008). Other studies reveal that folk-psychological intuitions about free will and relatedly freedom of action are universal – everybody has some intuitions about freedom – but that these beliefs are also subject to important individual and cultural variation (Iyengar & Lepper, 1999; Miller, Das, & Chakravarthy, 2011; Paulhus & Carey, 2011; Pronin & Kugler, 2010; Sarkissian et al., 2010; Savani, Markus, Naidu, Kumar, & Berlia, 2010).

Given the now large body of research on how adults understand and reason about free will, it is surprising how little we know about the origins of these ideas in childhood. We know almost nothing about when or how young children first come to think of actions as freely

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enacted, and whether free will plays a role in children's early understanding of themselves and other people.

Of course, we do know that young children, like adults, have folk theories that predict and explain human behavior (Gopnik & Meltzoff, 1997; Gopnik & Wellman, 1992). Quite early in development, they are able to distinguish between various unseen causes of human actions, be they internal or external, psychological, biological or physical (Gelman & Wellman, 1991; Gergely & Csibra, 2003; Inagaki & Hatano, 1999; Kalish, 1996; Meltzoff, 1995; Woodward, 2009). But understanding that action is *caused* does not necessarily lead clearly or smoothly to understanding that action can be *free*, indeed there may be some tension between the two. Moreover, young children's theories of the mind and action arguably look very different from those of adults in many respects (Gopnik & Meltzoff, 1997; Kalish & Shiverick, 2004; Rhodes & Gelman, 2009; Wellman, 2012). Thus, even if children demonstrate early intuitions about free will, those intuitions may be very different from ours.

The question of whether someone "could have done otherwise" is central to free will intuitions because, as philosophers and psychologists have pointed out, having options plays a critical role in our adult understanding of free will. Indeed, much of the variability in adult beliefs about free will reflects individual and cultural differences in how we reason about *not* having options; the conditions – both external and internal – that place constraints on our ability to act freely (Baumeister, Mele, & Vohs, 2010; Chernyak, Kushnir, Sullivan, & Wang, 2013; Guglielmo et al., 2009; Kitayama, Snibbe, Markus, & Suzuki, 2004; Pöhlmann, Carranza, Hannover, & Iyengar, 2007; Savani et al., 2010). Thus, for adult intuitions about free will, notions of freedom and constraint are complementary – we reason about one by considering the other. A person is free to do otherwise in so far as alternative actions are possible and not constrained. These complementary ideas serve as a guide for our methods of questioning young children.

Beginning in infancy, children at least sometimes seem to have some ideas about possibility and constraint that are specific to the actions and psychological motivations of agents. Studies show that infants expect agents to perform different actions to achieve their goals when they are free versus when they are constrained. For example, they expect an agent to reach around barriers (i.e. constraints) to obtain an object but then to change his action in order to reach directly for the object when a barrier is removed (Brandone & Wellman, 2009; Gergely & Csibra, 2003; Phillips & Wellman, 2005). They also interpret actions differently when agents are unwilling to act (a choice) versus unable to act (not a choice; Behne, Carpenter, Call, & Tomasello, 2005). Other studies show that infants in their second year have some concept of choice even in the absence of any visible constraints. They appreciate that certain actions of psychological agents reflect subjective, individual preferences and desires (Fawcett & Markson, 2010; Graham, Stock, & Henderson, 2006; Repacholi & Gopnik, 1997) and that choices (actions which could have been otherwise) reveal those desires (Kushnir, Xu, & Wellman, 2010; Ma & Xu, 2011).

By preschool age, children link changes in psychological motivations to changes in behavior, with sensitivity to both possibility for and constraints on action. For example, Schult and Wellman (1997) told preschoolers a story about a character that engaged in some habitual activity (i.e. always drinking milk every day) but one day wanted to do something different (i.e. drink juice). Children correctly reasoned that changing desires would cause changes to habitual activities if they were physically possible (in the milk/juice example) but not if they would result in actions that were physically impossible (i.e. always jumping up and down, but one day wanting to stay up in the air). Browne and Woolley (2004) found that older preschoolers explain violations of physically possible action (e.g. walking on the ceiling) and also violations of mentally possible action (e.g. turning on the TV with one's mind) by appealing to magic as a cause, but use ordinary causal principles – desires, in particular – to explain violations of social norms which do not render actions impossible (e.g. wearing pajamas at a grocery store). Sobel (2004) showed that, when children were asked to generate alternatives for physically and psychologically possible acts (using the phrase "What can she do different?") they could come up with plausible alternative actions that were both possible and domain appropriate.

In one study explicitly focused on the understanding of free will, Nichols (2004) asked preschool and early school-age children questions about the alternative actions of agents and objects. He showed 4- to 6-year-old children a scenario in which an experimenter either stuck his hand inside a box (touching its bottom) or dropped a ball inside. Children were asked, "after the lid was open, did I [the ball] have to touch the bottom, or could I [it] have done something else instead?" Children said that the experimenter, but not the ball, could have done something else. Nichols' (2004) study demonstrated that young children respond appropriately to questions intended to distinguish between possibility and constraint. However, as his contrasting conditions involved alternatives for human versus object actions, children's responses could have simply reflected their early understanding of the agent/object distinction (e.g. Meltzoff, 1995; Spelke, Breinlinger, Macomber, & Jacobson, 1992) rather than the free/not-free distinction. That is, children could have responded correctly based on the presence of a psychological agent, rather than by understanding that, for this agent, the situation (freely reaching into a box) allows an alternative action, although another situation (for example, being physically forced to reach inside the box) may not. This latter question – whether young children reason appropriately about the ability of *agents* to do otherwise – is the focal contrast in our experiments.

Since younger children have some understanding of possibility and of constraints on action they may have an initial understanding of the possibility of alternative actions and of the constraints on those alternatives. Such an understanding is, at the least, a prerequisite for a full understanding of free will. However, no prior study has systematically asked the "can do otherwise" question while contrasting actions that afford choice and actions that pose various constraints on choice. So, children's understanding of choice and free will is essentially

unexplored. Additionally, no study has investigated whether children's intuitions about choice and free will are similar for their own actions and for the actions of other people. We might imagine that first-person experiences of agency could accelerate intuitions of free will, or conversely, that illusions associated with first-person agency might undermine the concept. Finally, choices can be constrained not only in physical but also in psychological ways. An understanding of constraints on possibility that are psychological, rather than physical (and thus can *only* constrain psychological agents, and not also physical objects), is largely unaddressed by prior research and is of particular importance to our central question. Thus, it would be interesting to know if children treat physical and psychological constraints differently.

Across multiple studies we asked individual children about the ability to do otherwise in the absence and presence of constraints on physical possibility, and also in the absence and presence of two kinds of potential constraints on psychological possibility. The first kind of psychological constraint was epistemic – involving limitations based on what we perceive, believe or know. In our everyday conception, we believe that many choices are not possible because of our own or others' knowledge or ignorance. Arguments from ignorance are common in related discussions of responsibility as well. If the Queen in Hamlet knows that there is poison in the cup then she has chosen to commit suicide and is responsible for doing so. If not, then she did not make that choice freely (and directors often choose one interpretation rather than the other).

The second kind of psychological constraint was motivational; we questioned children about potential limitations created by personal desires. As adults we believe that our free choice may be impossible because of physical or epistemic constraints but we do not feel that our desires render choice impossible–even if we really want to do something we can choose to do otherwise. It is not difficult to find examples of this separation in adult folk psychological reasoning. In a weak version of this separation, we believe that we have the freedom to make choices that are equally desirable – for example, choosing to eat one of our two favorite foods, or choosing to study at one of two equally ranked Universities. We also believe in a stronger version of this idea – that is, we believe we can exercise our free choice even when our options are *not* equally desirable. This actually involves two complementary beliefs: that we can freely choose to perform *undesired* actions, and also that we can freely choose to *inhibit* desired actions. For example, to successfully lose weight, dieters must believe that they can choose to eat healthy food (even if they don't like it) and also that they can resist the temptation to eat unhealthy foods (even their favorite ones).

In these cases we might describe the situation by saying that we have alternative desires – like the desire to lose weight or to eat one food rather than another – and having free will involves selecting among those desires. More profoundly, however, as adults we also have the intuition that we have ultimate autonomy – that we can simply decide on a course of action regardless of our other desires. Either way, both descriptions suggest that it is the possibility of performing alternative actions, regardless of desires, that ultimately constitutes free choice. In fact, we have the intuition that it is possible to act freely in a perverse way, that is, to act against our own desires and interests. Indeed, in a novel like "Crime and Punishment" the protagonist expressly acts in a perverse way just in order to prove his freedom of will.

This intuition of autonomy is also closely related to our judgments of responsibility and blame. While we would mitigate blame for someone who was unable to make an alternative choice because of limits on physical or epistemic possibility, say a driver whose car lost control of its brakes or a driver who failed to see a pedestrian dart into the road, we would not mitigate blame simply because the agent had a strong desire to perform the action, a driver, say who really wanted both to drink and drive, or had a deep hatred of pedestrians.

In sum, in the following experiments, we asked children about the ability to engage in alternative courses of action – to do otherwise – in the presence or absence of various constraints. This included asking children about both physical and especially psychological circumstances that might place limitations on possibilities for action and, consequently, on the ability to choose freely. We also take up the important question of whether children's third-person intuitions about other people's choices are similar to or different from their first-person intuitions about their own choices. Finally, we asked whether there are age-related changes in children's reasoning about possibility, choice and constraint. In particular, we examined developmental changes in children's endorsement of the freedom to engage in actions that directly conflict with their desires.

As implied in this background, all of our experiments rely on posing focal questions about actions and possible alternative actions to children 3–6 years of age. In essence we asked children, "did the agent have to do that or could he/she have done something else?" in various linguistic forms. Our methods did not rely exclusively on the words "choose" and "choice" (as in, "Did he she choose to do that or did he/she have no choice?"). At first we began with could-have/have-to wordings (Experiments 1–3) without direct reference to choice and choosing, in part because preliminary examination of children's own speech shows that they very rarely ever used the terms *choose*, *choice*, or *chose*. However, they frequently speak in terms of *could have*, *need to*, and *have to*. Specifically, we examined 2328 CHILDES (MacWhinney, 2000) transcripts from children aged 36–84 months (3–7 years), encompassing 1,891,573 child utterances (Bååth, 2010). These transcripts yielded a total of only 84 child utterances with the words *choose*, *choice*, or *chose*. The exact same transcripts yielded 3127 child utterances using the phrases *could have*, *have to*, and *need to* (including variations like *hafta and coulda*) and many tens of thousands of utterances using *can*, *need* and *must*. In experiments 4–5, we added direct reference to choice ("Can she *choose to* do X") in the alternative action questions, and also included a replication of the questions in Experiment 1 to verify that changes to the linguistic form did not itself change the overall pattern of responses.

In our focal Choice Questions, alternatives were explicitly presented either for past choices ("Did you have to do X, or could you have done Y?") or future choices ("Can you

choose to do X, or do you have to do Y?"). Studies have shown that by age four, children possess the requisite skills to understand the structure of these types of questions, as applied to physical and psychological events (Beck, Robinson, Carroll, & Apperly, 2006; Harris, German, & Mills, 1996; Riggs, Peterson, Robinson, & Mitchell, 1998; Sobel, 2004). Moreover, not only do children use terms like *could have* and *have to* in their speech at least from 3 years on, there is evidence that, by age four, children understand and use modal verbs such as "can" and "could" for denoting permission, obligation, intention, willingness, and ability (Papafragou, 1998) – all of the requisite meanings invoked in our questions about alternative action possibilities and constraints on choice.

By using similar question wordings across the different types of constraints, and by always contrasting questions about free actions with questions about constrained actions within each experiment and within participants, we can show that children's responses did not simply reflect language difficulties. If children respond differently to the same "Could you do otherwise?" question in physical and psychological contexts, or when the question refers to a possible or impossible action, that shows that they are not simply responding to the form or language of the question.

2. Experiment 1: The ability to "do otherwise" and physical (im)possibility

In an initial study we focused on physically possible and physical impossible alternative actions and asked children about other peoples' actions. Four-year-olds heard two stories – one about a character who desired to perform a *possible* action and one about a character who desired to perform an *impossible* action. The stories were adapted from Schult and Wellman's (1997) study of children's psychological, biological, and physical explanations for human actions. For example, in one story pair, a character, Mary, is standing on a stool. She either expresses a possible desire to "step off the stool and come down to the ground" or an impossible desire to "step off the stool and float in the air and never come down." Schult and Wellman (1997) followed these stories with open-ended questions designed to prompt for explanations about the character's successful and unsuccessful actions. Four-year-olds could generally appropriately determine whether actions were physically or psychologically caused – children generally explained possible actions by referring to psychological causes, and impossible actions by referring to physical causes.

Note that it was not the aim of this prior study to investigate children's beliefs about choice and constraint. However, the contrast between possible and physically impossible human actions is appropriate to our question about children's understanding of the ability to "do otherwise". Unlike the contrast posed in Nichols, 2004 between agent and object actions, here we can consider constrained versus unconstrained actions of the same agent. And unlike Schult and Wellman, we took the additional step of asking how children reason about alternative actions and constraint. Thus after asking children whether a desired action was possible or impossible, we showed children the outcome of that action, and asked if the character could have done otherwise, contrasting (within-participants) a possible alternate choice with an impossible one.

Importantly, across both stories, the final outcome was matched – the character, regardless of her initial desire, ended up performing the same action (e.g. stepping off of the stool on to the ground). Children were asked the focal Choice Question in the form we described earlier: "Did she have to do X, or could she have just done Y?" In the *Possible Action* story, children were asked whether the character could have made a different, but possible choice (e.g. Y = staying on the stool). In the *Impossible Action* story, children were asked whether the character could have made an impossible choice (e.g. Y = floating in the air and never coming down).

Some prior research suggests that preschoolers judge that outcomes constrain desires (if he did that, that's what he wanted). Thus young children might similarly judge that outcomes constrain choices (if she did that, she couldn't do otherwise). In contrast, we predicted that children's responses to the Choice Question would depend on the nature of the action (that is, whether the action was possible or impossible), and not on either the character's initial desire (to go down or to float) nor on the final outcome. This would demonstrate that 4-year-old children not only distinguish between possible and impossible actions, but also distinguish between possible and impossible choices.

2.1. Method

2.1.1. Participants

Participants were 26 four- to five-year-olds (M = 4 years, 7 months; SD = 5.5 months) attending preschool in two small university towns. The sample was predominantly middle- and upper-middle class and reflected the diversity of the local population. Five additional participants were excluded from the analysis –due to non-compliance (n = 2) or experimenter error (n = 3).

2.1.2. Materials

Materials consisted of four stories and six colored drawings mounted on 8 × 11 cards. Each story was illustrated using three of the picture cards. As shown in Fig. 1, the first card was a picture of the main character (Either Mary or John) standing alone. The second card was a picture of the same character getting ready to perform an action. The third card was a picture showing the outcome of the action. In the outcome card the character's face was turned away so no emotional expression was depicted.

2.1.3. Procedure

Children were interviewed individually in a quiet room at their preschool. Each child heard two stories about two different characters, Mary and John. One was a *Possible Action Story* and one an *Impossible Action Story*. Fig. 1 shows the exact sequence of events. The two stories about Mary are used as examples. The other stories were about John, who either wanted to push a brick across the table (possible) or wanted to ooze his hand through a brick (impossible). If a child heard a possible story about Mary, then (s)he heard

	Possible Action Story	Impossible Action Story
Introduction	This is Mary. Mary is standing on a small stool.  	
Desired Action	I'll tell you what Mary wants to do. Mary wants to step off the stool and go right down to the ground.	I'll tell you what Mary wants to do. Mary wants to float in the air and never come down.
Possibility Question	Can Mary do that? Can she step off the stool and go right down to the ground?	Can Mary do that? Can she float in the air and never come down?
Explanation	How can she do that/Why can't she do that?	
Outcome Reveal	Let's see what happens. Mary steps off the stool and goes right down to the ground. 	
Choice Question	Did she have to do that, or could she have just stayed on the stool?	Did she have to do that, or could she have just floated in the air?

Fig. 1. Example of sequence of events for the Mary story (both possible and impossible versions), Experiment 1.

an impossible story about John, and visa versa. The order of stories (possible/impossible, Mary/John) was counterbalanced. The focal Choice Question followed each story, and had the following form: "Did John/Mary have to do that, or could s/he have just [alternate undesired but possible action/alternate desired but impossible action]?"

For each story, children were introduced to the story character, and then to his/her desired action. To make sure children distinguished between possible and impossible actions, we then asked a *Possibility Question* (e.g. "Can Mary do that? Can she [desired action]?"). Most children (24/26, 92%) answered both of these questions correctly. Of the remainder, 3 children said that John couldn't push the brick because it would fall of the table (2 children) or he wasn't strong enough (1 child). After prompting (e.g. "what if he pushed it just a little?") they also said it would be possible. Only two children insisted that the impossible actions were possible throughout.

Importantly, after the outcome was revealed children were asked the focal *Choice Question* (e.g. "Did she have to do that, or could she have just…?"). If a child did not answer one of the choice questions or said "I don't know" the question was repeated exactly as before. Children's responses were coded independently by the first author and a researcher blind to the hypothesis of the study. Responses to the Possibility Question and the Choice Question were coded as either *character constrained* (children said s(he) had to do what (s)he did) or *character free* (children said (s)he could have done the alternative). Agreement was 95% (Cohen's $K = .84$).

2.2. Results and discussion

Results did not differ based on whether the stories were about Mary or John for each story type (possible/impossible) thus we collapsed across characters for further analysis. For the Possible Stories, 18/26 (69%) of the children said that the action was a choice; that is, they said that the story character, having acted, could have done otherwise. In contrast, for the Impossible Stories, only 4/26 (15%) of the children said that the character could have done otherwise; instead 20/26 (77%) said that the character had to do what they did (2/26 did not make a judgment, but simply restated the action and outcome, e.g. "he moved it over there"). Across the two stories, 16/26 (62%) of the children said that *only* the character in the possible action story could have done otherwise, 6/26 (23%) did not say either could have, 2/26 (8%) said that both could have, and 2/26 (8%) children responded that only the character performing the impossible action could have done otherwise. This distribution differed from chance (*Chi square* (3, $N = 26$) = 19.00; $p < .001$). Crucially, children were significantly more likely to endorse the ability to do otherwise for the possible action story only rather than for the impossible action story only (McNemar's test, $p < .01$).

Children's consistently correct answers to the Possibility Questions replicate prior research in showing that they appropriately distinguished between possible and impossible actions. Beyond this however, their consistently correct answers to the Choice Questions demonstrated that they distinguished between cases where one can act

otherwise and cases where one cannot, suggesting a foundation for thinking about actions as choices.

3. Experiment 2: Agency, choice and physical possibility

Experiment 1 begins to show that preschool children distinguish possible choices from impossible ones, reasoning that a character could have done otherwise only when his/her alternate course of action was not constrained by physical laws such as gravity and solidity. A crucial extension of this sort of reasoning, especially relevant to our adult sense of free will, is our sense that our *own* actions are often freely chosen. Indeed in adults, free will is not just a tool for explaining human actions in others or in general; it is fundamental to our agentive experience. Simple actions, such as moving my hand across a surface, or lifting my finger to press a button, feel to us as if they are freely willed – not caused by external forces, but rather by "ourselves" (Blakemore & Frith, 2003; Haggard & Tsakiris, 2009; Wegner, 2002). In Experiments 2 and 3, we ask how children reason about choice as it applies to their own actions.

Developmental studies suggest that the experience of agency is present in early infancy, and coincides with the beginnings of motor control (Rochat & Striano, 2000; Sommerville, Woodward, & Needham, 2005; Watson & Ramey, 1972). Preschoolers can also distinguish between their own passive and active movements (Montgomery & Lightner, 2004), and distinguish inner, psychological causal forces from outside, physical ones (Gelman & Wellman, 1991; Inagaki & Hatano, 1999; Schult & Wellman, 1997).

However, again there are important differences between children's agentic appraisals and those of adults. For example, though preschool children readily identify their own causal agency, they often over-attribute agency to themselves over others. Preschool children often say they "meant to" or "tried to" do what they did, even when their actions are accidental (Shultz & Wells, 1985) or forced (Montgomery & Lightner, 2004). Preschoolers also interpret ambiguous causal evidence as a sign of their own agency (Kushnir & Gopnik, 2005; Kushnir, Wellman, & Gelman, 2009) and overinflate their contribution to collaborative activities (Foley & Ratner, 1998; Sommerville & Hammond, 2007). Against this backdrop of preschoolers often mis-appraising their own agency, an important question is whether and when intuitions of free will factor into children's appraisal of their own actions.

Biases of intentional agency or episodic memory, such as those described above, may lead to two types of errors in judgments of choice. On one hand, preschoolers might be overconfident that *all* of their intentional actions are freely chosen, including those that are physically constrained. On the other hand, they may feel constrained by the outcome of their intentional actions (by what they actually did) even when they were, in fact, free to choose.

In Experiment 2 we investigated both possibilities by again creating a within-participant contrast between a possible and a physically impossible action, but this time involving children's own experience of agency. We used a task in which children had to draw a series of shapes. In this task, children could experience their actions and also see the effects of their actions (the drawings). Each child drew two pictures. In the *Free Drawing* trial, children were asked to draw a dot. In the *Physically Constrained Drawing* trial, children were asked to draw a line, but the experimenter held their hand preventing its movement across the page, resulting in a dot. Thus, the outcome in each trial was the same (a dot), but the acts that produced that outcome were different (free vs. constrained). We asked children the same focal Choice Question after each trial: "could you have drawn the [alternate shape]?" and asked them to explain their response.

3.1. Method

3.1.1. Participants

Participants were 21 4-year-old children recruited from preschools in two university towns (M = 4 years, 9 months; SD = 5.8 months). The sample was predominantly middle- and upper-middle class and reflected the diversity of the local population.

3.1.2. Materials

Materials were a set of colored placemats, white pieces of paper (for drawing), a marker, and two predrawn shapes (a dot and a line).

3.1.3. Procedure

Children were interviewed individually in their preschool. The task was structured as a series of drawings on blank paper placed on colored placemats; placemat color was randomly selected. The focal Choice Question followed the sequence of events shown in Fig. 2 and took the following form: "Last time on the [name of color] mat, when I held [your hand/the paper] like this, could you have drawn the line?"

Fig. 2 shows a photograph of the set-up on each trial, as well as the exact language of the requests and questions. To begin, children saw two premade drawings of a dot and a line side by side (counterbalanced) and labeled each shape. Each child did both a *Free Drawing* and *Constrained Drawing*; eleven received the Free Drawing trial first. In the Free Drawing trial, children were asked to draw the dot. In the Constrained Drawing trial, children were asked to draw the line but were physically constrained to draw the dot. After asking children to restate the outcomes, the experimenter moved the colored mat aside and placed a new colored mat out to start the next drawing. Before drawing again, she asked the focal Choice Question. Responses were coded "yes" or "no" based on the first answer provided. Agreement between two coders (one hypothesis-blind) was 100% (Cohen's K = 1.00).

3.2. Results and discussion

Four-year-olds appropriately attributed the ability to act otherwise to themselves when their actions were free, and not when they were physically constrained. As shown in Fig. 3 (the blue[1] bars) children's responses to the Choice

[1] For interpretation of color in Fig. 3, the reader is referred to the web version of this article.

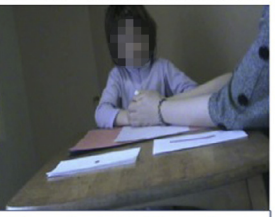
	Free Drawing	Physically Constrained Drawing
		
Drawing request	*"I'm going to hold the paper really hard so that it doesn't move. Can you draw the dot?*	*"I'm going to hold your hand really hard so that it doesn't move. Can you draw the line?*
Child draws	----------	
Outcome recall	*What did you try to draw?* (a dot) *What is this?* (a dot).	*What did you try to draw?* (a line) *What is this?* (a dot)
Choice Question	*Last time on the [name of color] mat, when I held the paper like this, could you have drawn the line?"*	*Last time on the [name of color] mat, when I held your hand like this, could you have drawn the line?"*
Explanation	*How could you do that/Why not?*	

Fig. 2. Sequence of events in each condition, Free Drawing and Constrained Drawing, Experiment 2.

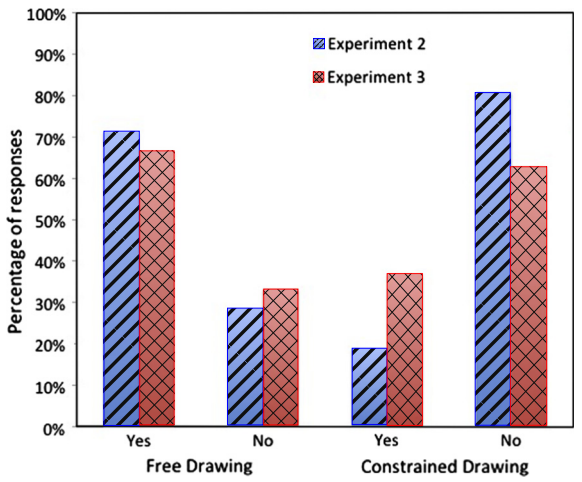


Fig. 3. Percentage of "yes" and "no" responses to the Choice Question ("Could you have drawn the [other shape]") across Experiments 2 and 3.

Question were significantly and appropriately different between Free Drawing and Constrained Drawing trials. In the Free Drawing trial, 15/21 (71%) of the children said that they could have drawn the line (Chi square (1, $N = 21$) = 3.86, $p = .05$). In the Constrained Drawing trial, only 4/21 (19%) of the children said they could have drawn the line (Chi square (1, $N = 21$) = 8.05, $p < .01$). Twelve children (57%) appropriately answered they could have acted differently on the free but not on the constrained trials, and only 1 (5%) answered the reverse (McNemar's $p < .01$). Thus, children judgments showed that they were not generally biased to match intentions and outcomes. Instead, as in Experiment 1, children distinguished between possible and impossible choices, though in this experiment they did so with respect to their own actions rather than the actions of others.

3.2.1. Explanations

Children's explanations provide further insight into these response patterns. The experimenter prompted for an explanation by saying, "How could you do that?" or "Why not?" depending on the answer the child gave to the Choice Question. We examined how these explanations differed according to children's judgments on the Choice Questions, that is their judgments of being constrained ("no") or free ("yes") as shown in Table 1. We separated these explanations into several categories also shown in Table 1: explanations referencing Task-Specific (Physical) Constraints (e.g. "*you held my hand*," "*I couldn't move*"), explanations referencing Psychological States ("*I didn't want to*," "*I know how to do it*"), and explanations which referenced Outcomes or Events that occurred ("*there is a dot there*," "*I drawed it*"). The final category contained Enactments of the alternative drawing (gestures illustrating the alternative action, at times preceded by a statement such as "*go like this*"). Agreement between two coders was 93% (Cohen's $K = .90$); disagreements were resolved through discussion.

In Table 2, we illustrate the main patterns in explanations by using shading – dark gray cells indicate more frequent explanations, medium gray indicates less frequent, light gray even less, and so on. Judgments of free choice, across both the Free Drawing and Constrained Drawing trials, were generally followed by Enactments of how the alternate action could be performed; the dark gray cells show that enactments accounted for 47% (7/15) of explanations for "yes" responses in the Free Drawing trial, and 75% (3/4) in the Constrained Drawing trial. The remaining lightly shaded cell shows that a few (20%, 3/15) children who participated in the Constrained Drawing trial first explained their free choice by contrast (e.g. "*this time you weren't holding my hand*").

There were two main types of explanations for constraint, depending on the trial in which they occurred,

Table 1
Explanation categories (Experiments 2 and 3) and examples from each category.

Choice Question response	Explanation category and examples
"No" (Could not draw the [shape])	Task-specific constraints **Physical (Exp 2)**: *"you held my hand,"* *"I couldn't move."* **Mental (Exp 3)**: *"I couldn't see it,"* *"the paper was up,"* *"I didn't know what it was."* Outcomes and events *"there is a dot there,"* *"I drawed this instead of that."* *"you already drew it" (Exp 3)* Psychological States: *"I didn't want to"* *"I didn't know you were gonna draw it"* *"I tried it"* I don't know/Other/No response
"Yes" (Could draw the [shape])	Enactments: *"like this" (gestures drawing a line)* Task-specific Constraints (from previous trial) *"you didn't hold my hand"* *"you weren't helping me"* Outcomes and events *"you told to do the dot" (Exp 2)* *"you told me to draw something different" (Exp 3)* Psychological States: *"I wanted to"* *"I know how to do it"* I don't know/Other/No response

both shown in Table 2 in dark gray. Following "no" responses in the Constrained Drawing trial, 13/17 children (76.5%) clearly and predominantly referenced the appropriate Task-Specific (Physical) Constraint. Following "no" responses in the free drawing trial, 6/6 (100%) children explained their responses by referencing the Outcomes and Events that had occurred. Thus, if a child judged herself unable to do otherwise in the free Drawing trial, this seemed to reflect an undue focus on the action outcome. This is notable in that it may suggests a possible inverse relationship between a nascent understanding of choice and the sorts of intention-outcome matching errors found in previous research.

4. Experiment 3: Agency, choice and epistemic possibility

Experiment 2 demonstrates that 4-year-olds appropriately attributed the ability to do otherwise when their own actions were free, and not when they were constrained. Second, their attribution of their own ability to choose was not generally biased by observing outcomes; most children never stated that they had to draw the dot simply because that is what they did. Instead, in the Free Drawing trial children typically demonstrated through enactments that they could easily have done something else. In the Physically Constrained Drawing trial they appropriately explained the outcome by referencing the physical constraints.

These results, together with the results of Experiment 1, suggest that preschooler's beginning intuitions about choice – about alternative actions and constraints on action – are similar for their own actions and for the actions of others. It is still possible, however, that 4-year-olds have a narrow understanding of situational constraints on choice; they may only distinguish between freedom and *physical* possibility. Alternatively, they could have a crucial and more general understanding that their freedom can be limited by other, more intangible, psychological constraints as well. For their own actions in particular, a further, important test of children's understanding of choice would be to see if they reason appropriately about constraints that limit psychological possibility. Thus, in Experiment 3 we turn to this issue.

We began by again utilizing the drawing situations explored in Experiment 2. This time we established a

Table 2
Percentages (and proportions) of explanations falling into each category by trial type (Free Drawing or Physically/Mentally Constrained Drawing) and response to the Choice Question (No or Yes).

Choice Question Response	Explanation Category	Experiment 2: Percent (proportion) of explanations within response type		Experiment 3: percent (proportion) of explanations within response type	
		Free Drawing	Physically Constrained Drawing	Free Drawing	Mentally Constrained Drawing
"No" (Could not draw the [shape])	Task-Specific Constraints	-	77 (13/17)	-	29 (5/17)
	Outcomes and events	100 (6/6)	18 (3/17)	34 (3/9)	29 (5/17)
	Psychological States	-	-	67 (6/9)	12 (2/17)
	I don't know/Other/No response	-	6 (1/17)	-	35 (6/17)
"Yes" (Could draw the [shape])	Enactments	47 (7/15)	75 (3/4)	67 (12/18)	80 (8/10)
	Task-specific Constraints	20 (3/15)	-	-	-
	Outcomes and events	7 (1/15)	-	11 (2/18)	10 (1/10)
	Psychological States	13 (2/15)	-	6 (1/18)	-
	I don't know/Other/No response	13 (2/15)	25 (1/4)	17 (3/18)	10 (1/10)

set-up in which both the experimenter and the child drew an object. The children were told to "draw something different" from the experimenter, and were then asked if they could have done otherwise, that is, if they could have drawn the same thing as the experimenter. In one condition of this experiment, however, we hid the experimenters drawing behind an occluder. This meant that the child could not have chosen to draw the same thing as the experimenter, since the child could not see what the experimenter had drawn, just as in the physical case the child could not have chosen to remain in the air.

We focused on this psychological constraint because past research shows that preschoolers understand the epistemic relation between seeing and knowing (Kushnir, Wellman, & Gelman, 2008; Nurmsoo & Robinson, 2009; Wellman & Liu, 2004) thus setting the stage for us to ask whether children understand that limits on knowledge can lead to limits on choice. Provided that 4-year-olds' intuitions about choice might be based on understandings of psychological possibility, rather than being specific to physical possibility, we expect results similar to those of Experiment 1 and especially Experiment 2.

Experiment 3 had the same basic set-up as Experiment 2; there were two trials counterbalanced within subjects, *Free Drawing* and *Constrained Drawing*. In the *Free Drawing* trial, the experimenter drew a shape in full view of the child. In the *Constrained Drawing* trial, the experimenter drew a shape which was hidden behind an occluder, thus restricting the child's visual access to the drawing. Importantly, this time we did not physically control the outcome across trials, we simply told children to "draw something different" from the experimenter. Critically, this meant that children had the same experience of freely drawing across both Free and Constrained trials. Indeed, each drawing made by the child was truly their own creation – some were simple shapes, some were faces, houses, etc. The difference was that, on the Constrained drawing trial, the experimenter kept her picture hidden from the child behind an occluder, and revealed it only after the child had completed her drawing (and before asking the choice question). The choice question was now "could you have drawn (the experimenters shape)" with the implication that this would have been the result of an intentional choice to copy the experimenter rather than an accident. The alternative was either epistemically possible (visible at the time of drawing) or impossible (hidden behind the occluder at the time of drawing).

4.1. Method

4.1.1. Participants

Participants were 27 4-year-old children (M = 4 years; 6 months; SD = 4.9 months) recruited from preschools in a small university town and a large city. The sample was predominantly middle- and upper-middle class and reflected the diversity of the local population.

4.1.2. Materials

Materials were a set of colored placemats, white pieces of paper (for drawing), a marker, a black occluder, and a doll and a drawer with a toy dog inside (purpose described below).

4.1.3. Procedure

The procedure began with a warm-up introducing the idea of epistemic constraints; a version of the knowledge access task taken from the Theory-of-Mind Scale (Wellman & Liu, 2004). Children saw a drawer whose contents were hidden and were asked to guess what was inside. The experimenter then opened the drawer, revealing a toy dog. The experimenter closed the drawer and introduced a doll who, "has never ever seen inside this drawer." Children were asked: "Does she know what's in the drawer?" and "Has she seen inside the drawer?" Corrective feedback was not provided, but the majority (23/27, 85%) of children answered both questions correctly.

Fig. 4 shows a photograph of the set-up and procedure of each trial (note that the occluder was always present, but placed differently depending on the trial), and also describes the exact language that was used. The focal Choice Question was phrased similarly to Experiment 2, but made reference to the shape drawn by the experimenter ("Last time on the [blue] mat, when I held the paper like this, could you have drawn the [experimenter's shape]?"). The sequence of events began with the experimenter drawing a line or a circle (counterbalanced) and then asking the child to "draw something different." In the Constrained Drawing trial the experimenter then revealed her drawing so that it was visible for the remainder of the questions. Children's responses to the Choice Questions were coded based on their first answer. Agreement between two coders (one hypothesis blind) was 100% (Cohen's K = 1.00).

4.2. Results and discussion

All children drew something different from the adult in the Free Drawing trial, showing they clearly understood the instructions. No child coincidentally drew what the adult drew behind the occluder in the Constrained Drawing trial.

Children's responses to the Choice Question parallel the results of Experiment 2 (see Fig. 3, red bars). In the Free Drawing trial the majority of children (18/27; 67%) said that they could have drawn the alternate, visible shape whereas in the Constrained Drawing trial, only 10/27 (37%) of the children said that they could have drawn the alternate, hidden shape. Crucially, across both trials, 10/27 (37%) of the children appropriately answered they could have acted differently on the free but not on the constrained trials, and only 2/27 (7%) answered the reverse a significant difference (McNemar's $p < .05$) just as in Experiment 2.[2]

4.2.1. Explanations

Children's explanations were classified as in Experiment 2 (see Table 1), except that the Task-Specific Constraint was

[2] The pattern was consistent, but marginal when considering only the subset of 23 children who passed the seeing/knowing warm-up questions, 8 vs 2, McNemar's p = .1).

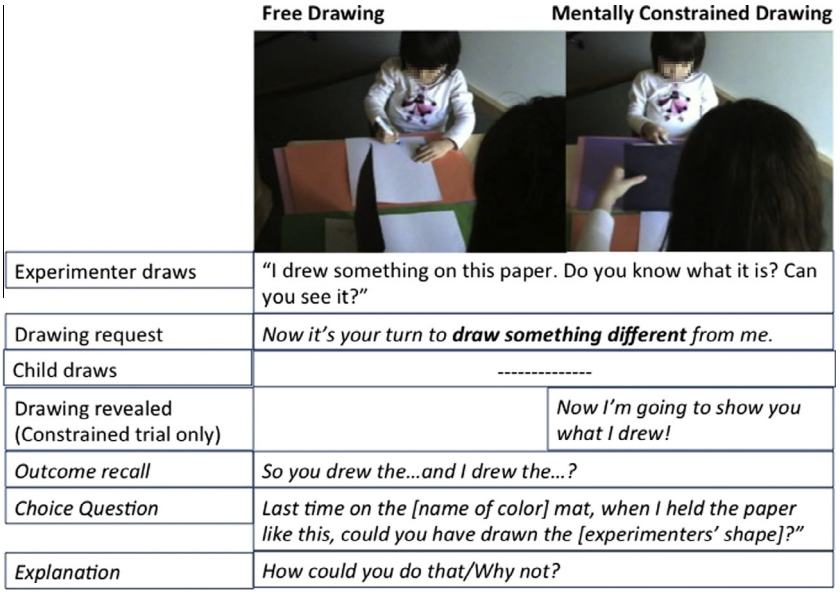


Fig. 4. Sequence of events in each condition, Free Drawing and Constrained Drawing, Experiment 3.

mental–epistemic–rather than physical. Importantly, Epistemic Constraint explanations referred to knowing (or not knowing) *about* the drawing and were kept distinct from references to knowing *how* to draw (the latter were included in Psychological State explanations). Also, since the procedure involved asking children to "draw something different," explanations that referred to this stated instruction were included in the category Outcomes and Events. Agreement between two coders was 85%; Cohen's $K = .81$.

Table 2 shows the explanations separated by children's response to the Choice Question on each trial. Again, shading represents the frequency of explanations within each category. As in Experiment 2, children's explanations accorded most closely with their judgments (that they could have done otherwise or not) rather than their situation (actually unconstrained or constrained). Children mainly explained having a choice by Enactments; 67% (12/18) in the Free Drawing trial, and 80% (8/10) in the Constrained Drawing trial, paralleling their explanations for choice in Experiment 2 and shaded in dark gray.

However, in the current experiment, children were not as adept at referencing the appropriate task-specific constraint on their knowledge. The dark gray cells show that explanations to negative responses were slightly different than in Experiment 2. First, most of the children who felt constrained on the Free Drawing (6/9; 67%) trial referenced other psychological constraints. Also, 5/17 (29%) of the children who appropriately judged their action as epistemically constrained in the Constrained Drawing trial referenced the appropriate Task-Specific (Epistemic) Constraint, and 5/17 (29%) referenced Outcomes and Events. Two lightly shaded cells show that an additional 12% (2/17) referred to other Psychological States, and 33% (6/17) offered no explanation. Thus children were able to identify the presence of some psychological constraint, but seemed to have difficulty explaining exactly what this psychological constraint was.

5. Experiment 4: Choosing to act against desires

The results of Experiments 1 through 3 show that 4-year-old children can use their knowledge of possible and impossible actions to reason about the ability to "do otherwise," suggesting they have the conceptual foundations for understanding choice and constraints on choice. When actions were unconstrained and alternatives were possible, children judged both others and themselves to be free to have done otherwise. Likewise, when actions were physically or mentally constrained and alternatives were impossible, children appropriately stated that they (or another) could not have done otherwise. Importantly, children treated the physical and mental events presented to them in the first three experiments as equivalent in the sense that they all represented constraints that limited the possibility of alternative actions. This demonstrates important developmental antecedents of our adult concepts of choice and free will; such adult concepts may be founded on an early understanding of when physical and psychological constraints on the ability to act otherwise apply or do not.

However, as we noted at the start, an additional component of our adult free will intuitions involves our freedom to act either in accord with or against our own desires. At what point do children share this intuition? In children's earliest folk-psychological theories, performing an action in the face of alternative actions *implies* desire. For example, infants who witness a person consistently choosing one of two objects infer that the person desires the chosen object, and not the other (Woodward, 1998, and see Luo & Baillargeon, 2007 for no effect when there is no visible alternative). Also, when toddlers see others making

different choices than they themselves would make – preferring broccoli over crackers, or boring toys over fun toys – they infer that others must have different desires than they themselves have (Fawcett & Markson, 2010; Repacholi & Gopnik, 1997). Additionally, when they observe a non-random set of actions indicating the choice of one object over another, infants and preschoolers infer a preference for that object (Kushnir et al., 2010; Ma & Xu, 2011). In studies with preschoolers, including those mentioned previously (Browne & Woolley, 2004; Schult & Wellman, 1997; Sobel, 2004), changes to habitual actions are primarily framed as a change to a story character's desire (e.g. "Now he *wants* it to be different") and when asked, children consistently explain voluntary actions in terms of the agent's desires (Hickling & Wellman, 2001; Schult & Wellman, 1997). The fact that children understand desires at such an early age, might suggest that they also share our intuitions about the relation between desires and choices, just as early understanding of knowledge access might lead them to understand the relation between epistemic states and choices.

However, in our adult folk psychology, desires work differently than epistemic states like knowing. For example, in Experiment 3, children's visual access was blocked by external means. This created a very simple mental constraint, one that the child could not herself thwart. Desires, by contrast, are *internally* generated, and thus can be thwarted, if an agent both understands and believes in her ability to contravene them.

Do young children, unlike adults, initially view desire as a mental constraint on choice, inferring that if a person wants something he will necessarily choose it, and *cannot* act otherwise? Alternatively, do they have more adult-like intuitions about free will, including the intuition that you can always choose to act against your own desires? To investigate these issues in Experiment 4 we expanded our age range to include 6-year-olds along with 4-year-olds. We chose this age for two reasons. First, by age six children have advanced in their ability to flexibly switch between multiple perspectives (Munakata, Snyder, & Chatham, 2012; Zelazo, 2004) and show increasing sophistication in counterfactual reasoning (Rafetseder & Perner, 2010). These cognitive changes may relate to the ability to consider multiple (and perhaps even conflicting) mental states, which in turn would allow children to reason more flexibly about the relation between desire and choice.

Second, six-year-olds have much better self-regulatory abilities than four-year-olds. The ability to regulate or inhibit their desires might provide children with the sorts of experience necessary to reason about regulating or inhibiting desires in self and others. Either or both of these factors could co-occur with conceptual changes in the way children think about desires in relation to choice.

Our focal questions centered around whether a story character could choose to act against his/her desire, or whether the outcome was unavoidable because the character's desire constitutes a forceful constraint ("Can she choose to do X (the undesirable action) or does she have to do Y?" (the desirable one)). Two *Action Stories* involved choosing to do something undesirable, and two *Inhibition Stories* involved choosing *not* to do something desirable. The focal Choice Questions here involved a hypothetical future act rather than a past action, and thus remained neutral as to whether the character actually achieved the stated desire. We did not have a priori reasons to expect that this focus on future actions would influence children's judgments about physical possibility, but as a check we included two stories about physically impossible actions using the same question structure. We also used the linguistic contrast choose to/have to rather than could have/have to. This allowed us to test whether we would replicate the basic finding of Experiment 1 with this different question wording and temporal structure.

As in the earlier experiments, we looked for additional insight into children's reasoning about choice and constraint through their explanations. In this, we were guided by two ideas grounded in philosophical thinking about free will. The first idea is that choosing to follow desires or to act against them can itself be thought of as a desire (an alternate desire, or, perhaps, a "second order" desire, e.g. Bratman, 1987). The second, related idea involves thinking about autonomy, agency, or selfhood – a notion that the ultimate responsibility for choice exists independently of any particular motivational force that pulls on us. These ideas have not just philosophical but also psychological significance: they are central to adults' beliefs about our free will to regulate and control our desires (e.g. Dweck & Molden, 2008; Ryan & Deci, 2006).

If children, like adults, believe that they can choose to act against their desires, they might also justify those choices by referring to alternate desires or to personal autonomy. If instead they respond that their choices are constrained, they might justify that belief by explicitly referring to the constraining force of desires, indicating that their conception of free will is indeed different from that of adults.

5.1. Method

5.1.1. Participants

Sixteen 4-year-olds (M = 4 years, 7 months, SD = 3.1 months) and eighteen 6-year-olds (M = 6 years, 6 months; SD = 3.6 months) participated. The sample was predominantly middle- and upper-middle class and reflected the diversity of the local population.

5.1.2. Materials

Materials consisted of a Playmobil doll ("Carrie"), an index card with the drawing of a door for the closet, an index card with a drawing of a closed box, and two small pieces of paper, one as a pretend cracker and the other as a pretend piece of cereal.

5.1.3. Procedure

Children were interviewed individually in their preschool or in a local science museum. The procedure consisted of a warm-up phase and a test phase. The focal choice question contrasted "choose to" with "have to" or "choose not to" with "have to not" depending on the type of question, Action or Inhibition. The order of choose/have options was counterbalanced across participants. The Action stories involved choosing to act toward an

undesirable outcome, so the question (for example) was: "Does she *have to* [leave the cereal there], or could she just *choose to* [eat it anyway even though she doesn't like it?]" The Inhibition stories involved choosing to inhibit a desired action, so the question (for example) was: Could she just *choose* not to [eat the cracker], or does she *have* to [eat it because she likes it?]." Fig. 5 outlines the procedures.

5.1.4. Warm-up phase

The experimenter began by telling children that they were going to play a pretend game and make believe some things together. Children were then introduced to a doll character (named either Carrie or Bobby, matched for child's gender). The experimenter then asked 4 warm-up questions which were designed to get children to talk about choices and about limitations on choice (i.e. possible and impossible actions), and also acted as a control to ensure that children would sometimes say that agents could choose to perform an action. Each question began, "If [doll's name/] really wanted to, could s/he just choose to…"

(1) Possible actions: stick out one's tongue, jump up and down.
(2) Impossible actions*:* Turn invisible, run faster than a train.

Twenty-six out of 34 children (76%, 12 4-year-olds and 14 six-year-olds) answered all four questions correctly, 7/34 (21%, 3 4-year-olds and 4 six-year-olds) answered three correctly, and 1/34 (2%, a 4-year-old) answered two correctly. There were no differences between 4- and 6-year-olds on the average number of correct responses to the warm-up questions (4-year-olds: $M = 3.69$, $SD = 0.60$; 6-year-olds: $M = 3.78$, $SD = 0.43$; $t(32) = 0.51$, *ns*) and total number of correct responses was above chance for each item (binomial tests, $p < .001$). Thus, children were generally able to distinguish between possible and impossible actions on the warm-up questions. On the few occasions in which children answered incorrectly they were encouraged and prompted until they provided the correct answer. For example, if a child said that they could run faster than a train, the experimenter asked, "how about faster than an airplane? A rocketship?"

5.1.5. Test phase

Children heard about the doll character going on "a series of adventures." The items mentioned in the adventures were pictured on cardstock. There were six total stories:

(1) Physically Impossible Stories: float in midair, ooze through a wall.
(2) Action Stories (food/activity): eat yucky cereal, look in a scary closet.
(3) Inhibition Stories (food/activity): not eat tasty cracker, not look in a curious box.

As outlined in Fig. 5, for each story, the experimenter would tell the child about the doll's undesirable or desired action, then asked whether the doll could choose to go against his/her desires (*Choice Question*). The order of the stories was randomized except that the physically impossible desires were always presented as the third and fifth

	Action Stories (Food Example)	**Inhibition Stories (Food Example)**	**Physically Impossible Stories**
Introduction	This is a cracker. Sally sees the cracker and she doesn't like it. Sally thinks the cracker tastes yucky.	This is a piece of cereal. Sally sees the cereal and she likes it. Sally thinks the cereal tastes good.	Every time Sally jumps up, she always comes back down. Now she wants it different. She wants to just float in the air, not touching anything. She doesn't ever want to come down.
Choice Question: (note: order of choose to/have to randomized)	Does she *have to* leave the cracker there, or could she just *choose* to eat it anyway even though she doesn't like it?	Does she *have to* eat it because she likes it or could she just *choose* not to eat the cereal?	Does Sally *have to* come back down, or can she just *choose* to float in the air?
Explanation Prompt:	How could she do that/Why not?**		

Fig. 5. Example of sequence of events for Experiment 4. The Action and Inhibition Food stories are shown. The other two stories not shown involved similar questions about a liked/disliked activity.

Table 3
Average number of "choose to" responses (max 2) in Experiment 4 in each age group.

	4-year-olds ($N = 16$)		6-year-olds ($N = 18$)		Age difference
	M (SE)	Difference from chance	M (SE)	Diff from chance	
Physically Impossible Stories	.18 (.08)	$t(15) = -8.06$ $p < .001$	.06 (.08)	$t(16) = -16.00$ $p < .001$	Ns
Action Stories	1.31 (.22)	Ns	1.47 (.21)	$t(17) = 2.70$ $p = .015$	Ns
Inhibition Stories	.81 (.20)	Ns	1.77 (.19)	$t(17) = 5.10$ $p < .001$	$t(32) = 3.59$ $p = .001$

trials. Children's first response ("have to" or "choose to") was recorded. Following each Choice Question, children were asked to explain their response.

5.2. Results and discussion

Results did not differ between the two Physically Impossible Stories, the two Action Stories, or the two Inhibition Stories (McNemar's tests, *ns*), thus judgments were combined across stories of the same type for further analysis. Children received a score of 0–2 for each story type, with 2 meaning that they said "choose to" for both stories. A 2 (Age: 4 vs 6, between subjects) × 3 (Story Type: Action, vs. Inhibition vs. Physically Impossible, within subjects) MANOVA on the average number of "choose to" responses showed a main effect of Age ($F(1,31) = 4.65$, $p < .05$) a main effect of Story Type ($F(2,62) = 35.11$, $p < .001$) and an Age X Story Type interaction ($F(2,62) = 5.55$, $p < .01$).[3] The means and standard errors for each Story Type by Age are shown in Table 3, as well as comparisons to chance performance and comparisons between ages. We next conducted two additional analyses to further investigate the cell differences.

5.2.1. Differences between Impossibility and Desire

To initially confirm that children appropriately responded to the type of choice question used in this study ("did she have to X or could she just chose to Y"?), we examined their responses to Physically Impossible stories: as expected "choose to" responses were significantly below chance for the Physically Impossible actions, and there were no differences between age groups (4-year-olds: $M = .18$ out of 2, SE = .1, $t(15) = 8.06$, $p < .001$; 6-year-olds: $M = .06$ out of 2, SE = .06, $t(15) = 16.00$, $p < .001$). This replicates the pattern of results found in Experiment 1, and extends our Experiment 1 findings to judgments of future rather than past actions and to questions that use the word "choose".

Next, we compared children's judgments when the story character's choice was impossible (Physically Impossible Stories) to each story type in which choices were possible but against the characters' stated desires (Action and Inhibition Stories, respectively). Pairwise comparisons between Physically Impossible stories and Action versus Inhibition stories showed that children were significantly more likely to say "choose to" in response to stories referencing desire as a constraint than in response to stories referencing physical impossibility, both for 4-year-olds—Physical Impossibility vs. Action, $t(15) = 4.39$, $p = .001$, Physical Impossibility vs. Inhibition, $t(15) = 2.18$, $p < .05$—and for 6-year-olds: Physical Impossibility vs. Action, $t(16) = 7.32$, $p < .001$, Physical Impossibility vs. Inhibition, $t(15) = 10.25$, $p < .001$). These results suggest that both 4- and 6-year olds do not think internal desires are as constraining as physical constraints; their responses suggest that they at least sometimes allow for the possibility of actions that decidedly go against stated desires.

5.2.2. Differences between Action and Inhibition stories, by age

Despite this commonality across the two ages, however, we also found important differences between older and younger children's judgments of choice. In particular, younger children were significantly more likely to say that the agent could not choose to inhibit her desires, but had to act on them. A 2 Age (4 vs. 6, between subjects) × 2 Story Type (Action vs. Inhibition, within subjects) MANOVA on the total number of "choose to" responses yielded a main effect of Age ($F(1,32) = 6.75$, $p < .05$) and an Age X Story Type interaction ($F(1,32) = 4.88$, $p < .05$). To interpret the results, we compared the mean number of "choose to" responses between age groups, and also compared the mean number of "choose to" responses to chance for each age group. The results of these comparisons are shown in Table 3. There were no significant age differences in the proportion of children's "choose to" responses to Action Stories, the 6-year-olds were not significantly more likely than the 4-year-olds to say that a character could choose to do something *undesirable*, although only 6-year-olds responded above chance. In contrast, there were significant age differences in children's "choose to" responses to the Inhibition Stories; 6-year-olds were significantly more likely than 4-year-olds to endorse the character's ability to inhibit an expressed desire for a favorite food and activity, and also did so at above chance levels.

In sum, 6-year-olds were significantly above chance in judging that an agent could choose to act against her desires in both inhibition and action cases, while 4 –year-olds were no better than chance in either case. Furthermore, there was a significant age effect for the inhibition stories.

[3] When considering the subset of 33 children who answered at least 3 of the 4 warm up questions correctly, both main effects and the interaction remain significant. When considering only the subset of 26 children who answered all four warm-up questions correctly, there was no main effect of Age ($F(1,24) = 1.3$, *ns*), but there remained a main effect of Story Type ($F(2,48) = 28.66$, $p < .001$) and marginal Age X Story Type interaction ($F(2,48) = 3.12$, $p = .053$).

Table 4
Explanation categories for Action and Inhibition Stories in Experiments 4 and 5, with examples from each category. Also shown are the percentages (and proportions) of each type of explanation broken down by response to the Choice Question (Have to/Choose to).

Choice Question response	Explanation category	Experiment 4 examples	Experiment 5 examples
"Have to"	External constraints: References to external conditions influencing the initial action	*"it's scary"*	*"it's too boring"*
		"crackers are good"	*"it's good for you"*
	Internal Constraints: References to desires or internal states influencing the initial action	*"she's too scared to open it"*	*"I don't like the taste"*
		"she thinks it tastes good/bad"	*"I like to jump and it's my favorite thing to do"*
		"she has to if she likes it"	
	I don't know/Other/No response		
"Choose to"	Alternate external conditions: References to physical, social, or biological conditions that could lead to an alternate action	*"it won't bite her"*	*"it has a lot of sugar"*
		"when we get boxes there is always something fun inside"	*"my mom won't let me"*
		"if she's too full"	*"I have something else to do"*
			"you can run out of energy"
	Alternate internal motivations: References to desires or internal psychological states that could lead to an alternate action	*"she might not want to"*	*"I might not want to play with them, I can play something else"*
		"she might be curious next time."	*"in case you don't want to"*
		"some people like cereal and some people don't"	*"sometimes I like it sometimes I don't"*
	Autonomy:	*"you can do whatever you want to"*	*"you can choose and umm you get to do whatever you want to do because nobody gets to boss you around"*
	References to the general ability to choose autonomously	*"she's her own boss"*	*"no one is going to make me"*
		"it's her brain and she can do whatever she wants."	
	I don't know/other/no response		

5.2.3. Explanations

Children's explanations provided additional insight into their reasoning about possibility, choice and constraint. The explanation categories and examples of each are shown in Table 4. As in the previous two experiments, children's explanations were separated based on their answer to the Choice Question – whether they were explaining constraint ("have to") or choice ("choose to") judgments. Explanations for constraint responses fell into two categories – they appealed to either *external* or *internal* reasons for constraint. For example, if the story was about a tasty cookie, a child might say that the character had eat it "because cookies are good" (External Constraint) or "because she wants/likes it" (Internal Constraint).

Explanations for free choice ("choose to" responses) are more focal and fell into three categories. First, children gave two rather surprising types of explanations that invoked possible situations other than those that were described in the story itself. The first type of explanation invoked Alternative External Conditions in addition to, or sometimes even counter to, those expressly described in the story. Most of the alternative external conditions were physical ("sometimes when you open the closet something could fall on your head"), and some were biological (in particular explanations for food choice, e.g. "*some crackers aren't good for you*"). The next category involved invoking internal Alternative Motivations other than the desires expressed in the story ("*she doesn't need whatever's in it*," "*she might be curious next time*").

The final category consisted of explanations that referenced the characters' Autonomy and their ability to make choices more generally, either among desires ("*it's her brain and she can do whatever she wants*") or despite/aside from them ("*she's her own boss*"). More examples from all of these coding categories are found in Table 4. All explanations were coded by the first author and a second coder who was blind to the study's hypotheses and to the condition from which an explanation came. Agreement was 93% (Cohen's $K = .89$). Disputes were resolved through discussion.

Table 5 shows the percentage of explanations falling into each category, separated by response to the Choice Question. Though 4-year-olds were more likely to respond "have to" than "choose to," there were no age differences in patterns of explanations within each type of response ("Have to": Chi Square $(2,43) = .647$, *ns*; "Choose to": Chi Square $(3,93) = 1.84$, *ns*). So, results are shown for both ages combined. Shading is used to highlight the prevalence of each type of explanation, with darker shades indicating more frequent explanations within each type of response and lighter shades indicating less frequent explanations.

When explaining why a character *has to* act on her stated desire, children mentioned the motivations of the character as internal constraints (e.g. "she likes it" or "she is too scared") about half of the time (21/43; 49%, Darker cell). About a third (12/43, 28%, Lighter cell) of the explanations mentioned the external conditions (e.g. "it is yummy" or "it is scary"). This reinforces the idea that children treated desires as constraints on a characters freedom of action.

Most of the explanations for why a character could choose to act against desires invoked alternative possible states of world and mind, rather than appealing to notions

Table 5
Percentages (and proportions) of each type of explanation by response to the Choice Question (Have to/Choose to).

Choice Question Response	Explanation Category	Experiment 4, Percent (proportion)	Experiment 5, Percent (proportion)
"Have to"	External Constraints	28 (12/43)	24 (16/68)
	Internal Constraints	49 (21/43)	57 (39/68)
	I don't know/Other/No response	22 (10/43)	19 (13/68)
"Choose to"	Alternate external conditions	34 (32/93)	50 (30/60)
	Alternate internal motivations	25 (23/93)	18 (11/60)
	Autonomy	17 (16/93)	10 (6/60)
	I don't know/Other/No response	24 (22/93)	22 (13/60)

of autonomy. Most of children's explanations (32/93, 34%; darkest cell) referenced Alternative External Conditions. The next most frequent explanation type made reference to Alternative Internal Conditions (23/93, 25%; lighter cell). Only 17% (16/93; lightest cell) of the explanations referred to Autonomy. The distribution of explanations was marginally unequal (Chi^2 (2, N = 71) = 5.437, p = .066).

The explanations given suggest that children interpreted the choice question with reference to the possibility that other situations or desires might hold, beyond the ones in the story questions themselves. It is striking that the children in Experiments 1 through 3 did not provide similar counterfactual justifications for their judgments of free choice in the case of physical and epistemic possibility, nor did the children in the physical impossibility questions in this experiment. This suggests that the responses in Experiment 4 were not simply a result of the question form. Similarly, it seems unlikely that adults would respond to these questions in this way. Therefore, these responses may be interesting as a developmental way station toward the full adult concept of autonomous free will.

In total, these data point to a key developmental difference in children's understanding of the relation between desires and choices, and thus an important development toward adult-like intuitions about free will. Both 4- and 6-year-olds appropriately distinguished between physical conditions that necessarily render choice impossible, and psychological motivations which do not. However, unlike 6-year-olds, 4-year-olds were much less likely to state that a person can choose to act against her own desires. Four-year-olds may understand that someone cannot overcome knowledge constraints (at least those that stem from external visual obstacles) in making choices, but they do not comparably understand the freedom to choose to overcome constraints imposed by personal desires.

6. Experiment 5: Choosing to act against *one's own* desires

In Experiment 4 we asked children whether another person would have to act in accordance with their desires, or could choose not to. Experiment 5 explored whether children could/would reason about their own desires in the same way. We used a modified version of the procedure in Experiment 4 with the same categories of items (Impossible, Action, Inhibition). However, before asking the Choice Question, we asked each child to express his/her own desires (e.g. "can you think of a food you really [don't] like?"). This initial desired/undesired item was then used as a basis for the Choice Question. For example, if the child responded that she liked ice cream, then the Choice Question was "Could you just *choose* not to eat the ice cream, or do you *have* to eat it because you like it?"

6.1. Method

6.1.1. Participants

Participants were 16 4-year-olds (M = 4.41 years; SD = .18) and sixteen 6-year-olds (M = 6.49 years; SD = .30). The sample was predominantly middle- and upper-middle class and reflected the diversity of the local population.

6.1.2. Materials

Materials consisted of a set of blank index cards and a pencil.

6.1.3. Procedure

Children were interviewed individually at their preschool or at the local science museum. The focal *Choice Question* this time involved the choice to act against children's own desires or inhibit their own desired action. Children were first asked about their own desires, then asked about choice. The Choice questions followed the same form as in Experiment 4, with "choose to" and "have to" or "choose not to" and "have to not" options contrasted and counterbalanced.

The exact sequence of events is shown in Fig. 6. The warm-up phase was identical to Experiment 4, but the questions referenced the child rather than the doll (that is, each question began, "If you really wanted to, could you just choose to…"). As in Experiment 4, children were

	Action Stories (Food Example)	Inhibition Stories (Food Example)	Impossible Stories (Control)
Introduction	Can you think of a food that you really don't like? What is a food you really think tastes yucky?	Can you think of a food that you really like? What is a food you really think tastes good?	Every time you jump up in the air, you always come back down. Now you want it different. You want to just float in the air, not touching anything. You don't ever want to come down.
Choice Question: **(note: order of choose**	Do you *have to not* eat …, or can you *choose to* eat … even though you don't like	Do you *have to* eat …, or can you *choose not to* eat … even though you like	Do you *have to* come back down, or can you just *choose* to float in
to/have to randomized)	it?	it?	the air?
Explanation Prompt:	How could you do that/Why not?		

Fig. 6. Example of sequence of events for Experiment 5. The Action and Inhibition Food stories are shown. The other two stories not shown involved similar questions about a liked/disliked activity.

generally able to distinguish between possible and impossible choices on the warm-up questions. Twenty-five out of 32 children (78%, 12 4-year-olds and 13 six-year-olds) answered all four questions correctly, 4/32 (13%, 2 four-year-olds and 2 six-year-olds) answered three correctly, and only 3/32 (9%, 2 four-year-olds and 1 six-year-old) correctly answered less than three of four (with all those being correct on 2 of 4). Again there were no age differences (4-year-olds: $M = 3.62$, $SD = 0.72$; 6-year-olds: $M = 3.75$, $SD = 0.57$; $t(30) = 0.54$, *ns*) and total number of correct responses was above chance for each item (binomial tests, $p < .001$).

The test phase contained two Action stories, two Inhibition stories, and the same two Physically Impossible Stories as in Experiment 4. The Action and Inhibition stories each involved a desirable/undesirable food and activity, as before. However, this time the experimenter asked children about their own desired and undesired foods and activities to depict on the cards. For example, she would ask, "Now can you think of a food that you really like? What's a food that really tastes good?" The child would answer something like "ice cream!" Then the experimenter would draw an ice cream cone on cardstock and place the card in front of the child. If the child would not answer, the experimenter suggested some commonly liked and disliked foods and activities.

In pilot studies children sometimes interpreted the "have to" question as a reference to mother's injunctions, consistent with other studies showing that 4-year-olds often conflate compulsion with obligations. For example, they might say that they had to not eat the ice-cream, even though they liked it, because their mother said that they could not. Therefore we modified the procedure to include the phrase "your mom says it's OK to eat the ice cream or to not eat the ice cream" (see Schult & Wellman, 1997, for a similar required modification). With this addendum, no child said "have to do" for an undesirable or "have to not do" for a desirable activity, indicating they did not confuse choice and obligation. Following the choice question, children were asked to explain their answer.

6.2. Results and discussion

Once again results did not differ between the two Action and Inhibition story types (food and activity, McNemar's tests, *ns*) and so they were combined for further analysis for a score of 0–2. A 2 (Age: 4 vs 6, between subjects) x 3 (Story Type: Action vs. Inhibition vs. Physically Impossible, within subjects) MANOVA on the average number of "choose to" responses showed a main effect of Age ($F(1,30) = 8.99$, $p < .01$) a main effect of Story Type ($F(2,60) = 13.53$, $p < .001$) and an Age X Story Type interaction ($F(2,60) = 5.29$, $p < .01$).[4] The means and standard errors for each Story Type by Age are shown in Table 6, as well as comparisons to chance performance and comparisons between ages. We conducted follow up analyses as in Experiment 4.

6.2.1. Differences between Impossibility and Desire

To begin again with just the Physically Impossible Stories, children in both age groups appropriately responded

[4] When considering the subset of 29 children who answered at least 3 of the 4 warm up questions correctly, both main effects and the interaction remain significant. When considering only the subset of 25 children who answered all four warm-up questions correctly, there is a marginal main effect of Age ($F(1,23) = 2.96$, $p = .064$), a significant a main effect of Story Type ($F(2,46) = 12.90$, $p < .001$) and no Age X Story Type interaction ($F(2,46) = 1.87$, *ns*).

Table 6
Average number of "choose to" responses (max 2) in Experiment 5.

	4-year-olds (N = 16)		6-year-olds (N = 16)		Age difference
	M (SE)	Difference from chance	M (SE)	Diff from chance	
Physically impossible stories	.25 (.14)	$t(15) = -5.20$, $p < .001$	.19 (.14)	$t(15) = -5.98$, $p < .001$	Ns
Action stories	.44 (.18)	$t(15) = -3.58$, $p < .001$	1.38 (.18)	$t(15) = 1.86$, $p = .08$	$t(30) = 3.67$, $p = .001$
Inhibition stories	.63 (.21)	ns	1.31 (.21)	Ns	$t(30) = 2.31$, $p = .028$

that they themselves could not "choose to" perform the impossible action (4-year-olds: M = .25 out of 2, SE = .14, $t(15) = 5.20$, $p < .001$; 6-year-olds: M = .19 out of 2, SE = .14, $t(15) = 5.98$, $p < .001$). Thus, as in Experiment 4, children responded accurately to a "choose to" question, and in comparison to Experiment 2, children reasoned about the physical constraints on own choices in much the same way that they reason about constraints on the choices of others.

Next, we again compared children's judgments when the story character's choice was impossible (Physically Impossible Stories) to each story type in which choices were possible but against the characters stated desires (Action and Inhibition Stories, respectively). This time, there was no difference for 4-year-olds between Physical Impossibility stories and either type of desire story (4-year-olds: Physical Impossibility vs. Action, $t(15) = .899$, *ns*, Physical Impossibility vs. Inhibition, $t(15) = 1.70$, *ns*). Thus, 4-year-olds judged themselves as having to follow their own stated desires. In contrast, 6-year-olds judged themselves relatively free to thwart their own desires; they showed differences between desires and physical impossibility (6-year-olds: Physical Impossibility vs. Action, $t(15) = 4.28$, $p = .001$, Physical Impossibility vs. Inhibition, $t(15) = 4.7$, $p < .001$).

6.2.2. Differences between Action and Inhibition stories, by age

For the Action and Inhibition Stories, we again conducted a 2 Age (4 vs 6, between subjects) × 2 Story Type (Action vs. Inhibition, within subjects) MANOVA on the total number of "choose to" responses. There was a main effect of Age ($F(1,30) = 11.66$, $p < .01$) and no other significant effects. Table 6 shows comparisons of the mean number of "choose to" responses between age groups, and also the mean number of "choose to" responses to chance for each age group. Six-year-olds responded "choose to" significantly more often than 4-year-olds when asked about their own ability to act against or inhibit stated desires. At the same time, 6-year-olds' did not endorse free choice at above chance levels for inhibition stories and did so only marginally for Action stories.

In sum, 4-year-olds, but not 6-year-olds, mostly said that they were *not* free to act against their own stated desires. Together with the results of the previous analysis, this suggests that 4-year-olds feel constrained by their own stated motivations, and even that they may treat them as similar to physical impossibility.

6.2.3. Combined analysis – Experiments 4 and 5

The results of Experiment 5 suggest that there are differences between children's endorsement of free choice for themselves or for another person at both ages. Four-year-olds are actually *more* likely to say that their desires determine their own actions, making their own actions less free. Although 6-year-olds endorse their own freedom to choose more often than four-year-olds, they too do so less clearly for their own desires than when they are asked about the desires of another person.

In order to confirm these suggested differences, we compared the results of Experiments 4 and 5 directly. Fig. 7 shows those results. First, we note that the differences are specific to questions about acting against desires, and are not due to first versus third-person perspective more generally. All children responded to questions about

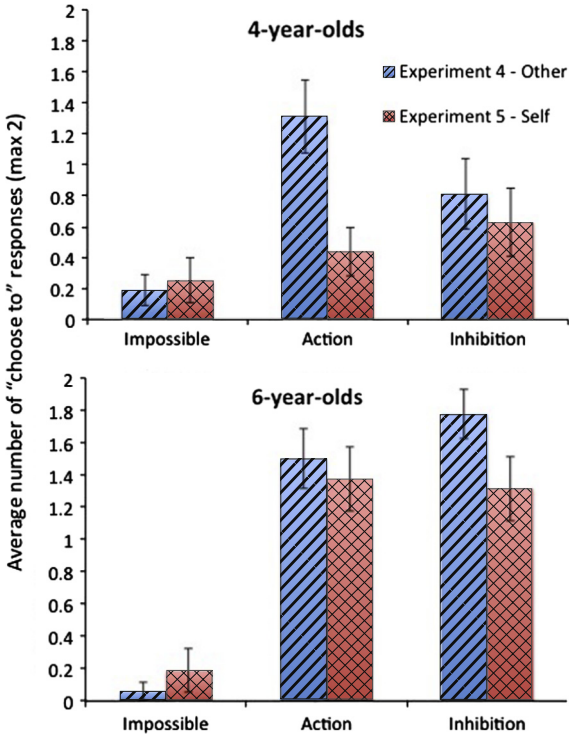


Fig. 7. Average number of free choice responses (max 2) across the three Story Types – Impossible Action control stories, Action stories, and Inhibition stories – in Experiments 4 and 5. Bars represent standard errors of the mean.

physical possibility in the same way regardless of whether they were asked in third or first person; a 2 (Agent: Other vs Self) × 2 (Age: 4 vs 6) ANOVA revealed no significant main effects or interactions (all *Fs*(1,61), *ns*). Next, we compare the remaining two sets of questions about the freedom to act against desires. A 2 (Agent: Other vs Self, between subjects) × 2 (Age: 4 vs 6, between subjects) × 2 (Story Type: Action vs Inhibition, within subjects) MANOVA revealed a main effect of Agent ($F(1,62) = 6.47$, $p < .05$) and a main effect of Age ($F(1,62) = 18.27$, $p < .001$) and a 3-way interaction between Experiment, Age, and Story Type ($F(1,62) = 5.09$, $p < .05$). The main effect of Agent is consistent with the interpretation above – that children were more likely to endorse choice for another than for themselves. The main effect of Age further confirms the developmental differences in children's reasoning about choice between ages four and six; 6-year-olds are more likely to endorse free choice than 4-year-olds. The three-way interaction is interpretable by looking at the data for each experiment separately (see Tables 3 and 6): it is driven by the fact that four-year-olds did endorse another person's ability to act against, but not to inhibit, her desires (a significant interaction between age and story type in Experiment 4), but the same was not true for their own desires (only main effects in Experiment 5). We speculate on these third- versus first-person differences more in the general discussion.

6.2.4. Explanations

Table 5 shows the explanations alongside those from Experiment 4, once again shaded to represent frequency of explanation type within each type of response to the choice question. All coding was done by the first author plus a hypothesis- and condition-blind coder. Agreement was 94.5% (Cohen's $K = .83$). Disputes were resolved through discussion. The pattern over all explanations for both "have to" and "choose to" responses are similar to the patterns in the previous experiment. As shown in the dark gray cells, children who said that they *had to* act on their expressed desires were more likely to give internal rather than external explanations for their lack of choice. This time, the difference was significant (*Chi square* (1, $N = 547$) = 9.618, $p < .01$).

Children who said that they could *choose to* act against their desires were significantly more likely to describe alternative external conditions that would enable them to make a choice, rather than appealing to alternative desires (30/60, 50%, dark gray cells). Children were less likely to mention alternate internal motivations (11/60, 18%, lighter cells) and autonomy (6/60, 10%, lightest cells) than in the previous experiment (*Chi square* (2, $N = 47$) = 20.468, $p < .001$). Thus, children here offered various counterfactual possibilities to justify their own freedom of choice. In much the same way that they explained another person's ability to choose to act against his/her desires in Experiment 4, however, they were slightly more likely to invoke external, rather than internal, changes to explain the conditions under which they could choose to act against their own desires.

As a final analysis of the explanations of both Experiments 4 and 5, we looked for the number of times the words "choose" or "choice" occurred as part of children's explanations (for both "have to" and "choose to" responses). We found that 6/43 (14%) explanations in Experiment 4 did so, and 10/68 (15%) in Experiment 5. Moreover, though the use of these words was not frequent, they were used most often when children were appealing to general notions of autonomy (5/6 in Experiment 4 and 5/10 in Experiment 5 were part of an explanation which appealed to the character's/the child's autonomy). For example, statements such as "she can choose what she wants to do b/c she's herself" or "Because you can choose and umm you get to do whatever you want to do because nobody gets to boss you around." This anecdotal evidence suggests that adult-like notions of choice and free will might align with corresponding semantic developments, which we discuss below as an area for further study.

7. General discussion

In this series of experiments, we asked children about their own and other's "ability to do otherwise" contrasted with both external (i.e. physical) and internal (i.e. mental) circumstances that place limitations on that ability. Our results reveal some early adult-like intuitions, as well as important developmental changes. By age four, children show complementary understandings that sometimes alternative actions are possible and that sometimes circumstances place constraints on those possibilities. In Experiment 1, 4-year-olds reasoned that a story character could have done otherwise only when the alternative action was physically possible, but could *not* have done otherwise when the alternative was physically impossible. In Experiment 4, we replicated and extended this basic understanding of physically impossible alternative actions with a differently-worded question about "choosing" to perform hypothetical future actions.

Young children can also reason about possibility and constraint in the case of their own actions. In Experiment 2, preschoolers experienced a contrast between a free shape-drawing activity and a physically constrained one (one in which their hand was prevented from moving). Paralleling the results of Experiment 1, children reasoned that they could have drawn an alternative shape in the free drawing case but not in the physically constrained case. Going beyond physical constraints, in Experiment 3, children experienced the freedom to choose their own preferred drawing across two conditions, and were later asked about both a possible alternative and an alternative that was limited by lack of knowledge (drawing the same thing as the experimenter when they couldn't see what the experimenter had drawn). Preschoolers appropriately distinguished between alternatives, correctly stating they could do otherwise as long as they were not epistemically constrained. In Experiment 5 with differently worded questions, we confirmed that children believe their own future choices are similarly constrained by physical impossibility.

Together, these results show that preschool children already have the requisite understanding that not all human intentional actions are the reflect choices; their

judgments about the ability to do otherwise rest on an early understanding that human actions can be psychologically motivated but also physically limited (Schult & Wellman, 1997). Moreover, despite prior findings that preschoolers' overinflate their own agency and intentionality (Foley & Ratner, 1998; Kushnir et al., 2008; Montgomery & Lightner, 2004), this did not undermine children's judgments. That is, we did not find that preschoolers were generally biased to believe that their own intentional actions were always free. Instead, they understood that their physical and mental capacities could be limited, and that such circumstances limit the possibility of engaging in alternative actions.

Beyond this basic understanding, our results also show important developmental changes between younger and older children when it comes to their beliefs about the ability of agents to freely act against their own desires. In Experiment 4, we asked 4- and 6-year-olds about whether a story character had the ability to choose to act against their own desires. At both ages, children endorsed the story character's choice to act against desires more often than against physical possibility. However, only 6-year-olds did so at levels above chance for all types of actions. Children were particularly likely to deny that a character could choose to inhibit a desirable action.

We found similar, and indeed stronger developmental differences in Experiment 5 when children were asked about their own choices. Six-year-olds again endorsed their own ability to act against desires, in both action and inhibition cases, but 4-year-olds were likely to say they could *not* act in the alternative way and were more likely to do so than when reasoning about others' choices in Experiment 4. Here they often referred to their desires as the reasons why they were not free to choose otherwise.

Children's explanations further suggest that their ability to reason about the relation between choice and desire is interestingly related to their ability to imagine alternative possibilities that would actually lead to different desires. Thus, many children at times changed their interpretation of the story–making up alternate external conditions or internal motivations for the story character (or for themselves), which might exist and therefore cause alternate actions. Some of these alternatives were very straightforward ("nothing that's gonna jump out and scare her") others creative and even funny ("sometimes when you open the closet, something could fall on your head"). Most such explanations were appropriately constrained by physical, biological, and psychological theories about the causes of human action – that is, children offered real alternatives, not fantastical ones. Even the youngest children, though they endorsed choice less often than older children, offered the same sorts of alternate explanations for free choice as older children. This kind of counter-factual reasoning might constitute an interesting intermediate developmental stage in children's understanding of free will. That is, children might understand the idea that desires and actions can play out in alternative ways, in Dennett's (2003) terms that outcomes are "evitable" as opposed to inevitable, before they develop an adult-like belief in absolute autonomy.

In contrast, only a minority of children, and mostly older ones, gave justifications for their "choose to" responses that fit the full adult conception of free will. Interestingly, none of the justifications appealed to second-order or conflicting desires. Instead, these children asserted a more absolute autonomy ("she's her own boss"). If and how young children express an understanding of conflicting desires is an interesting open question.

These results build on children's early emerging understanding of psychological agents; that they are distinct from physical objects, and that actions of agents (but *not* actions of objects) can be intentional and have a variety of psychological causes. We add to these prior results that, at least by age four, children appreciate that alternative possibilities for intentional actions are present to the extent that actions are not limited by physical and mental circumstances.

Moreover, we argue that when they reason about agents, children have a psychologically appropriate understanding of choice. Importantly, children do more than understand that events have possible alternative outcomes (it might rain tomorrow or it might not), they further understand that psychological agents (self and others) can select among alternative actions—they can choose to do otherwise.

The evidence that children go beyond merely thinking about the presence of alternatives and instead think about choices between alternatives is indirect but twofold. First, in Experiment 3, and again in Experiments 4 and 5, children reason appropriately about the psychological possibilities for the actions they or another person chose, not merely about physical possibilities. For example in Experiment 3, in the mental constraint condition, children could have physically drawn the line; if they were merely talking and thinking about physical alternatives that was an obviously possible alternative (as is clear from their actions in the free drawing condition). Yet children reasoned their actions were constrained anyway in spite of these multiple physically possible alternatives. Children similarly directed themselves to psychological constraints in the face of multiple physical options in Experiments 4 and 5.

To be clear, our target question by itself does not ensure that children are talking about agentive choices rather than physical alternatives. To take an example, imagine an alternative version of Nichols' (2004) original experiment in which the ball was dropped, not into a box, but rather into a tube in the shape of an inverted "Y" with two possible landing locations. If after seeing the ball land in one location and not the other, children were asked, "Did the ball have to do that, or could it have done otherwise?" they could easily respond that the ball could have gone down to the other side.[5] This example illustrates why answers to the "can do otherwise" question may not distinguish between human choices and actions of inanimate objects. But, by targeting psychological constraints in situations where agents could do otherwise on the basis of physically possible alternatives alone (e.g. draw a line, draw a dot,

[5] This example was suggested by reviewer comments on a previous version of the manuscript.

draw a circle, draw a scribble) we can disentangle choice from mere alternatives.

The second clear, source of evidence that children are thinking about choices and not merely physical alternatives in our tasks come from their explanations. In their explanations in Experiments 3, 4 and 5, children do not merely talk about physical alternatives (which they sometimes appropriately mention) but also about alternative psychological motivations and autonomy.

However, it is worth asking whether other questions could possibly tap children's understanding of choices versus alternatives more directly. For adults, questions directly asking about choices and choosing could do so. As discussed in our introduction preschool and early elementary-age children use "choose' very rarely, and much less often than they use such terms as "have to" or "can". Moreover we don't know if these children understand "choose" in the same way that adults do. To our knowledge, children's developing understanding of these "choice" words has received essentially no research attention. Directly addressing this question is an important avenue for future research.

Our results reveal that 4-year-old children have intuitions about their own and others ability to do otherwise which in some ways resemble our adult intuitions, and in some ways are remarkably different. First, 4-year-old children distinguish between agents' free actions and actions that are physically and mentally constrained. We also find, however, that is not until age 6 that children consistently reason that psychological motivations do not necessarily constrain our actions, and that we have the ability to choose alternative actions that go against our desires. Why might we see this developmental change? Four-year-olds were very accurate in answering very similar questions about physically and epistemically possible and impossible actions. Moreover, their responses to the action questions in Experiment 4 suggest that they do sometimes endorse the ability to choose to act against desires (at least, the ability to do things that one does not want to do) and also that they generally differentiate psychological motivations from physical constraints. This suggests that their failure to answer the questions about desire as consistently as 6-year-olds, is not due to difficulties in understanding modality or possibility questions, nor to a confusion between physical and psychological causes for action. Rather, it points to a more broad-ranging conceptual change.

In particular, we propose there might be an earlier intuitive causal theory in place by four, or even in late infancy, in which desires are the immediate and *necessary* cause of choices and actions and so are tightly linked to choice itself. Between four and six that intuitive theory may be replaced by a theory in which a more powerful sense of choice is a further causal factor, choice as a separate mental activity that can itself influence and modify not only actions but desires. This conceptual change might be the result of increased first-person experiences of inhibition and control (Carlson, 2010). Alternatively, it might reflect an attempt to find a causal explanation for the broad pattern of actions found in the behavior of others as well as oneself.

In fact, philosophers, psychologists, and neuroscientists have suggested something like this as a model for adult intuitions of free will. (Baumeister et al., 2010; Holton, 2009; Wegner, 2002). "Free will" is a belief that a separate mental entity – namely choice – is able to intervene on the connection between our desires and our actions, in order to explain the cases where desires and actions are not simply congruent.

What other changes might be responsible for or linked to this development? During the period from 4 to 6 children become increasingly able to actually control or inhibit their own desires. We know that capacities for executive control and deferred gratification steadily increase in this age range (Mischel, Shoda, & Rodriguez, 1989). Speculatively, the development of an understanding of free will might be linked to these changes in several ways.

First, children's experience of their own increasing efficacy in controlling or changing their desires might lead them to develop a notion of choice as separate from desire. Alternatively, the development of a conception of choice as a causal force separate from desires might actually lead children to be more effective at regulating their own actions. Thus, this key component of our adult concept of free will—that we can want something but not choose it, or choose something but not want it—might have benefits for children's ability to regulate and control their own behavior.

Beyond mere speculation, there are two findings that suggest that the causality might go in the second direction – that is, that separating will (or choice) from desire increases self-control. First, in deferred gratification tasks, children who succeed do so by strategically intervening to influence their own mental states, for example, they envision the marshmallow as a puffy cloud, or close their eyes. It appears that changes in deferred gratification are not primarily due to the fact that children's "will" simply increases endogenously. Instead it seems that children come to realize that they can causally influence their own mental states. Second, in the current studies children were actually significantly more likely to endorse freedom of choice for other hypothetical children than for themselves. Further research exploring the empirical link between executive control, deferred gratification and beliefs about choice and free will would be of great interest.

These findings can also help shed light on the philosophical and psychological arguments about whether "free will" is illusory. Several philosophers and psychologists have pointed out that there is a more straightforward "might do otherwise" sense of free will—the sense that free will involves choosing among alternatives unconstrained by external factors—that is unproblematic. Our findings suggest that children also find this sense of free will straightforward. This sense of free will is in place from very early in development—manifest in children's understanding that choice involves the availability of alternative possible actions. This sense of free will is also aligned with children's early understanding of causal actions. In reasoning about physical causes, children know that stating "X causes Y" is synonymous with stating that intentionally acting to cause X ("intervening" on X) will bring about its effect Y (Bonawitz et al., 2010; Gopnik et al., 2004; Kushnir et al., 2005, Waismeyer et al., 2012). Children can likely

incorporate free, unconstrained choice into this notion of intervention without difficulty. In fact, even young infants may have this conception of action and intervention.

With a slightly more sophisticated theory of mind, children could expand their causal theory to include more psychological variables – i.e. desires and beliefs – along with the physical ones. Once again, children can incorporate their notion of choice to think about the appropriate interventions on such variables. For example, if one wanted to change the actions of another person, one could act to change his or her desires or beliefs. Put another way, with increasing theory of mind abilities, children may be more likely to "intervene" to causally influence the other person's mind rather than their physical actions. "Free will" would simply be the unconstrained operation of all these causal processes.

The difficulty in thinking about free will (for philosophers and even lay adults) comes when the exercise of free will is somehow seen as exogenous and capable of interfering with the causal process by which mental and biological states lead to actions. One interesting possibility is that this problematic notion builds on the developments we see between ages 4 and 6, expanding further on a divide between choice and desire.

However, while our results show that six-year-olds can think of choices separately from desires, this in itself is not a problematic belief in a metaphysically exogenous and causally anomalous "free will." Six-year-olds can just think that choice has separate influences from desire, and still believe that choice has causes (just separate causes). With this view they can also, like younger children, easily think about intervening on mental states without yet believing in a fully exogenous problematic kind of free will.

At the same time, the intuitions about absolute autonomy that were articulated in some small number of our children's explanations, particularly among the 6-year-olds might reflect the early beginning of the more problematic causal and metaphysical intuitions some of us have about free will.

Regardless of developments beyond 6 years, the combined results of our studies offer a first systematic look at children's developing intuitions about intentionally enacted alternative actions and thereby the intuitions that underpin free will. Our approach, of asking direct questions about "the ability to do otherwise," follows prior empirical and philosophical work which suggests that notions of free choice and constraints on choice are central to our adult free will beliefs. We think there is much to be gained from applying this method to a wider range of situations in which children must reason about choice and constraint (see Chernyak & Kushnir, 2014; Chernyak et al., 2013 for recent applications to children's understanding of moral and social constraints). Thus we offer not only evidence that children share some of our most fundamental adult intuitions, but also a framework to guide further inquiry– that our earliest ideas about free will are based in our developing conceptual knowledge about the internal and external forces which influence, cause, and limit human actions. In this framework, as children's knowledge of physical, psychological, and biological influences on actions grows and changes, their ideas about freedom and choice change as well.

In sum, our research demonstrations several crucial intuitions related to our adult belief in free will that are in place in the preschool period, as well as still other intuitions that scaffold an extended process of development, inference and conceptual change. Understanding the complex developmental origins of this central yet elusive concept may also help us to understand how to think about free will as adults.

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