The Relationship Between Inhibitory Control and Free Will Beliefs in 4-to 6-Year-Old-Children

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Abstract

This study explores the relationship between beliefs about self-control and the ability to exercise self-control in 4- to 6-year-old children. Sixty-eight children were asked a series of questions to gauge whether they believed that they could freely choose to act against their desires or inhibit themselves from performing desired actions. Children were also asked to provide qualitative explanations for why they could or could not exercise free will, and to complete two inhibitory control tasks: forbidden toy and day/night. Choice responses were negatively correlated with performance on the forbidden toy task, when children performed that task first. There was also a negative correlation between a belief in an internal locus of control, and success on the forbidden toy measure. Refraining from touching a forbidden toy appears to be correlated to less belief in free will. Though this may appear counter-intuitive, it is consistent with cross-cultural research.

Keywords: cognitive development; executive function; social cognition; choice; free will; inhibitory control

Background

Previous research suggests that a belief in one's ability to freely exercise self-control emerges between the ages of 4 and 6. (Kushnir, Gopnik, Chernyak, Seiver, & Wellman, 2015). During this same period, children also become better at practicing self-control (Carlson, 2010). The present study explores the relationship between self-control abilities and corresponding free will beliefs.

A concept of free will may have several different components, which is part of why defining free will can be philosophically problematic. Under one interpretation, free will is viewed as the ability to act free from external physical constraints. Other definitions specify the ability to act against external social or normative constraints, or even internal motivational constraints, such as one's own desires.

In regards to motivational constraints, Kushnir *et al.* (2015) asked 4-to 6-year-old children a series of questions about the freedom to act against or refrain from acting on one's own immediate desires. Children were asked if people can simply 'choose to not' perform a desirable action, such as to not eat a tasty cookie. They were also asked if they could 'choose to' engage in an undesirable action, such as eat a disgusting cracker. Six-year-olds endorsed the freedom to act against desires, including the ability to refrain from desired actions (i.e. to exercise self control). Four-year-olds, on the other hand, tended to believe that people's behavior had to be consistent with their desires, especially in cases that required self-control.

Kushnir *et al.* (2015) argue that this finding reflects a conceptual change in children's folk psychology or theory of mind. Two-year-olds view actions as stemming from desires (Wellman & Woolley, 1990). A belief in free will, or choice, can be viewed as an added component to this causal chain. With this added link, actions need not stem directly from desires, but can be altered through choice.

A theory theory framework suggests that children's beliefs take the form of intuitive theories that undergo continual revision as new evidence is encountered (Gopnik & Wellman 2012). Under this framework a child might initially hold a belief that actions stem from immediate desires, and thus self-control (refraining from desirable actions) is not possible. As they encounter additional evidence they may gradually come to believe that the relationship between desires and actions is mediated by choice.

What types of additional evidence might children receive? One possibility is that children are simply taught a theory of choice and free will by other people, one which includes the message that acting against or refraining from acting on one's own desires is a free choice. Another possibility is that beliefs about choice and related beliefs about self-control stem from first person experiences. Perhaps children witness themselves or other people practicing self-control, and develop a belief in free choice to explain why this is so. Related to this second possibility, young children are continually developing increasing abilities to delay gratification and practice self-control (Carlson, 2010). Endogenous changes in inhibitory control could spur the conceptual change in children's beliefs about free will.

Several lines of research support the possibility of a link between beliefs about free will and inhibitory control. First, researchers have found a positive correlation between the development of inhibitory control and theory of mind (Carlson & Moses, 2001; Oh & Lewis, 2008). As free will beliefs are a subcomponent of theory of mind beliefs, it is possible that this relationship extends to free will beliefs.

Other research suggests that holding a belief in an internal locus of control is positively correlated with self-control (Mischel, Zeiss, & Zeiss, 1974). Children who believe their actions (and thus their choices) are guided by internal processes, like desires, may do better in tasks that require self-control than children who believe their actions are externally guided (by the situation, or by others).

On the other hand, cross-cultural research suggests the opposite relationship. People from interdependent cultures hold a stronger belief in an external locus of causation than do people from independent cultures (Choi, Nisbett & Norenzayan, 1999), and a recent study found that Chinese children hold weaker beliefs about free will than U.S. children (Wente *et al.*, in press). Nevertheless, children from interdependent cultures, like China, tend to outperform U.S. children on inhibitory control tasks (Sabbagh, Xu, Carlson, Moses & Lee, 2006; Oh & Lewis, 2008). This may seem counter-intuitive from a Western perspective. It is possible, however, that children in interdependent cultures think that self–control reflects the direct influence of external social norms, rather than an internal choice to follow those norms.

To explore the relationship between self-control and free will beliefs, the current study tested 4- to 6-year-olds on the forbidden toy and day/night inhibitory control tasks, and measured their beliefs about free will. Approximately half of the children completed the free will task first, and half completed the inhibitory control tasks first. This allowed us to assess the possibility of carryover effects between tasks. To further explore the relationship between locus of control and self-control, children were asked to explain why they could or could not practice free choice. In Kushnir *et al.* (2015), most explanation types could be classified as internal or external. The present study uses a slightly modified coding scale.

Method

Four- to 6-year-old children were asked a series of questions to gauge whether they believed that people could inhibit themselves from performing desired actions, or act against their desires. To measure inhibitory control, each child also completed the forbidden toy and day/night tasks. Task order was counterbalanced so that some children completed the inhibitory control measures first and others answered the free will questions first.

Participants

Participants were 68 4- 5- and 6-year-olds (*M*=5.37, *Range*= 4.01-6.97 years, 26 males) recruited from a study participant database or local preschool. Additionally, 14 children were excluded from the study. Of these, 8 failed to complete the full study (most because they expressed fear of being alone in the testing room), 5 were excluded due to experimenter error, and 1 due to low English language proficiency. All participants were tested in Berkeley, CA. The sample was predominantly middle and upper middle class and represented the diversity of the local population.

Stimuli

Free Will Task The experimenter used white index cards to draw different activities and foods children suggested.

Day Night Task The day/night images featured in Gerstadt, Hong, & Diamond (1994) were photocopied, and replicas were created. The night card featured a white moon and stars on a black background. The day card featured a white background with a sun outlined in black. Children were tested on 8 of each type of card.

Forbidden Toy Task A marble run and several small marbles were used. The marble run was approximately two feet tall and consisted of a series of tracks the marbles could roll down when placed in the opening at the top.

Procedure

All children were tested in a small testing room located in the Institute of Human Development at the University of California Berkeley, or in an empty room at their preschool.

The order of the free will questions and inhibitory control testing as well as which inhibitory control task was presented first was counterbalanced across participants.

Free Will Task The free will task was modeled after Kushnir *et al.* (2015). All children answered 2 physically impossible control questions, 2 action (desire) questions, and 2 inhibition (desire) questions and 2 possibility control questions taken from Wente *et al.* (in press).

Action (desire) questions gauged whether children believed that they could choose to act against their desires. Children suggested an activity and food that they really

disliked. Then the experimenter drew the activity or food for the child and used the drawings to ask the experimental questions. For example, if the child indicated that they did not like raw onions, the experimenter drew a raw onion and said, "Let's pretend this is a raw onion sitting on the table in front of you. You really do not like raw onions; you really think they taste yucky. Your mom says that it is ok to eat the onion or not eat the onion. Can you choose to eat the onion, or do you have to not eat the onion because you don't like it?"

Inhibition (desire) questions gauged whether children believed that they could choose to inhibit themselves from performing a desired action. Children were asked to name a favorite food and activity. The experimenter drew the food or activity and asked the child if they believed they could choose to inhibit themselves from eating the food or engaging in the activity. For example if the child said they really enjoyed eating ice cream, the experimenter drew a picture of ice cream and said, "Lets pretend that this is ice cream sitting on the table in front of you. You really like ice cream; you really think it tastes yummy. Your mom says it's ok to eat the ice cream or not eat the ice cream. Can you choose to not eat the ice cream, or do you have to eat it because you like it?"

Impossible control questions used similar language, but instead asked children if they believed they could choose to do impossible things. They were, "If you really wanted to could you choose to {float in the air/ walk through a wall} or do you have to {come down/ walk around the wall}?"

Possibility control questions, on the other hand, asked children if they believed they could choose to do possible and desirable things. These questions were, "Can you choose to {walk into the living room/ step down off a step} or do you have to {stay in the kitchen/ stay on the step}?"

Children were also asked to provide a qualitative explanation following their choice response. For example, if the child said they could "choose to not eat the cookie" the experimenter asked, "And why can you choose to not eat the cookie?"

The order that the 'choose to' and 'have to' options were first presented was counterbalanced within and across participants. Question order was counterbalanced across participants. Control and desire questions were alternated.

Day/Night Task The day night task was modeled after Gerstadt, Hong, & Diamond (1994). Children were instructed to say "day" when the experimenter showed them the night card, and "night" when the experimenter showed them the day card. There was a training phase where children had to provide 6 correct answers. The test phase consisted of 8 of each type of card.

Forbidden Toy Task This task was modeled after the forbidden toy procedure in Carlson (2005). The experimenter introduced children to an enticing toy, a marble run, and demonstrated how it worked. The experimenter then said that s/he had forgotten something and had to leave the room to go and get it. The child was told not to touch the toy while the experimenter was gone. Children waited 5 minutes for the experimenter to return.

Results

Free Will Task

Children answered 4 question types: possible control, impossible control, inhibition desire and action desire. For each of these question types, children answered 2 questions. Response patterns did not differ across the 2 questions, and thus the data were combined for further analysis. For each question type, children received a 'choose to' score that ranged from 0-2. A 0 indicates that the child provided no 'choose to' responses, whereas a 2 indicates that they provided 2.

An initial set of independent samples t-tests were used to examine whether children's answers differed as a result of task order (free will first vs. inhibitory control first). Children were more likely to provide inaccurate 'choose to' answers to the impossible control questions when the free will task was conducted first, $t(66)= 2.54$, $p=.013$. However children's answers were well below chance for both orders of presentation: free will first, $t(32)= 3.72$, $p=.001$; inhibitory control first, $t(34)= 16.23$, $p<.001$. There was no effect of task order for the other 3 question types. There was also no effect of task order when examining just the children who passed the forbidden toy task.

Overall, children provided 'choose to' responses significantly less than chance for the impossible control questions, $t(67)=-15.93$, $p<.001$, and significantly more than chance for the possible control questions, $t(67)= 33.04$, $p<.001$. This indicates that children believed they could not choose to perform impossible actions, yet did believe that they could choose to perform unconstrained actions. It also suggests that children understood the language and structure of the questions.

A 4(Question type: Action vs. Inhibition vs. Impossible Control vs. Possible Control) x 3(Age: 4 vs. 5 vs. 6) Repeated Measures ANOVA on mean 'choose to' responses indicated a main effect of question type, $F(3, 195)= 99.49$, $p<.001$, a main effect of age, $F(2, 65)= 10.84$, $p<.001$, and a interaction between age and question type, $F(6, 195)= 5.54$, $p<.001$.

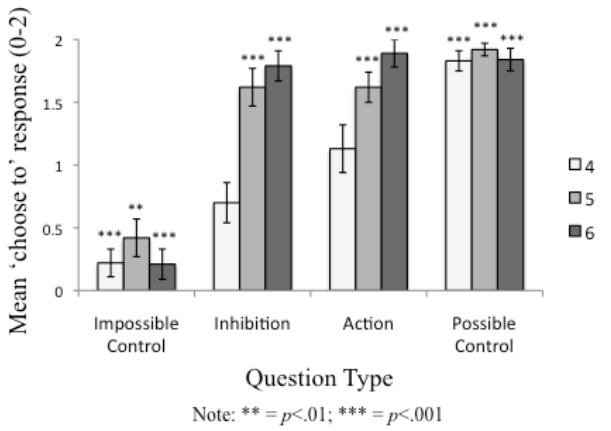
Paired sample t-tests were used to explore the main effect of question type. Children provided more 'choose to' responses for both the inhibition desire questions, $t(67)= 9.09$, $p<.001$ and the action desire questions, $t(67)= 10.09$, $p<.001$ than the impossible control questions. They also provided fewer 'choose to' responses for both the inhibition desire questions $t(67)=4.96$, $p<.001$ and action desire questions $t(67)= 3.4$, $p=.001$ than the possible control questions. There was a trending difference in responses between the action and inhibition questions, $t(67)=1.99$, $p=.051$, suggesting that children might have provided more choose to responses for the action questions.

Independent samples t-tests also revealed that 4-year-olds provided significantly fewer 'choose to' responses than 5-year-olds, $t(47)$= 3.76, p<.001. There was no difference between 5- and 6-year-olds.

To explore the age by question type interaction, four Univariate ANOVAs looked at the effect of age on 'choose to' responses for each of the 4 question types. There were no developmental differences for the impossible control and possible control questions, but there was a difference for the action questions, $F(2, 65)$= 6.38, p=.003. Independent samples t-tests indicated that 5-year-olds provided more 'choose to' responses than 4-year olds, $t(47)$= 2.17, p=.035, but that there was no difference between 5- and 6-year-olds. There was a similar finding for the inhibition questions, $F(2, 65)$= 15.5, p<.001, the difference between 4- and 5-year-olds was significant $t(47)$= 4.23, p<.001, but the difference between 5- and 6-year-olds was not.

Overall, children provided more 'choose to' responses for desire questions than for impossible control questions, and fewer 'choose to' responses for the desire questions than for possible control questions. Children's 'choose to' responses for the desire questions increased between ages 4 and 5. Means and comparisons to chance (1) are presented in Figure 1.

Figure 1: Mean 'choose to' response



Note: ** = p<.01; *** = p<.001

Qualitative Explanations

To explore children's beliefs about locus of control, children were also asked explain their answers to the choice questions. For example, if a child answered that they had to eat a cookie, the experimenter asked, "Why do you have to eat the cookie?" All answers were coded as internal, external, or other. See Table 1 for further information about explanation coding.

Each child was assigned an internal and external score. These were asymmetrical because some answers were coded as 'other.' Scores indicated the proportion of internal or external explanations given. For example, if the child provided 3 internal explanations and 1 external explanation they received an internal score of .75 and external score of .25. Overall, the mean internal score was .411, SD= .358, and mean external score was .564, SD= .364. A one-way ANOVA revealed that there were no significant developmental differences. Independent samples t-tests did reveal that children who completed the free will task first trended towards providing more internal explanations than children who completed the inhibitory control portion first $t(66)$=.1.92, p=.059. The ratio of internal to external explanations was similar when the free will questions were asked first. However, children who completed the inhibitory control tasks first provided significantly more external than internal explanations, $t(34)$= -2.77, p=.009.

Table 1: Explanation Coding

Explanation Type	Definition	Example Explanations
Internal	References to mental states or processes, or choice itself	*"I don't want to."* *"Your brain says what you want to do."* *"I can choose to go anywhere or not go anywhere."*
External	References to factors external to the child's mind	*"Because it's not fair."* *"My mommy is ok with it."* *"It's so good."* *"What if you have a tummy ache."*
Other	*"I don't know"*/ no answer/ irrelevant answer/ combination of internal and external	

Day/Night Task

All children received a day/night score ranging from 0-16. A score of 0 meant that the child provided no correct answers whereas a score of 16 meant that the child provided all correct answers. Means and standard errors are presented in Table 2.

Table 2: Day/Night Scores

	N	Mean	SE
4-year-olds	23	9.17	.87
5-year-olds	25	10.4	1.01
6-year-olds	19	13.11	1.03

An independent samples t-test indicated that children's answers did not differ based on task order. A 3(Age: 4 vs. 5 vs. 6) Univariate ANOVA on day/night score revealed that children's performance improved with age, $F(2, 64)$= 3.88, p=.026. Independent samples t-tests indicated that the difference between 4- and 6-year-olds was significant, $t(40)$= 2.93, p=.006. No other age differences reached significance.

Forbidden Toy Task

Children waited 5 minutes for the experimenter to return to the room, and received a score ranging from 0-300 based on the number of seconds they waited without touching the toy. For example, if the child touched the toy 18 seconds into the delay period, they received a score of 18. An independent samples t-test indicated that children's wait time did not differ as a result of task order. A 3(Age: 4 vs. 5 vs. 6) Univariate ANOVA did not reveal age differences. Children also received a pass/fail score. Exactly half the children, 34, passed, and half the children failed. Fisher's exact tests confirmed that age differences in the pass/fail variable were not significant.

Relationship Between Measures

Next we explored the relationship between measures. Children's answers to the inhibition and action desire questions were combined and all children received a free will score that ranged from 0-4. A higher score indicates that the child provided more choose to responses.

Table 3: Correlations between measures

	Internal	D/N	External	Forbidden
(a) Partial correlations all data combined (n=68)				
Free Will	.06	.01	-.08	-.11
Internal Score		-.07	-.89*	-.31*
Day/ Night			.12	.01
External				.25*
(b)Partial correlations for free will first (n=33)				
Free Will	.03	-.17	-.03	.21
Internal Score		-.3	-1*	-.35
Day/ Night			.3	.00
External				.35
(c) Partial correlations for inhibitory control first (n=35)				
Free Will	.14	.14	-.19	-.43*
Internal		.27	-.73*	-.15
Day/ Night			-.14	-.02
External				.06

Partial correlations controlling for age were calculated using the following variables: free will score, internal score, external score, day/night score and forbidden toy wait time. Results indicate that internal score was negatively correlated with forbidden toy wait time, $r(64)=-.31$, $p=.012$, whereas external score was positively correlated, $r(64)= .25$, $p=.042$. Running a similar analysis using the pass/not pass variable confirmed this finding. A One-Way ANOVA on mean external score revealed that children who passed the forbidden toy task provided more external explanations than children who failed, $F(1, 67)= 5.37$, $p=.024$.

Splitting data by task order again revealed that children who provided external explanations were more successful at the forbidden toy task, but only when they answered the free will questions first. There was a trending negative correlation between internal score and forbidden toy wait time, $r(29)=-.35$, $p=.051$, and a trending positive correlation between external score and forbidden toy wait time, $r(29)=.35$, $p=.051$. Again, a One-Way-ANOVA confirmed that children who passed provided significantly more external explanations if they completed the free will task first, $F(1, 32)= 5.195$, $p=.03$.

For children who completed the inhibition tasks first, there was a negative correlation between children's free will score and wait time during the forbidden toy task, $r(32)=-.433$, $p=.01$. A Univariate ANOVA on free will score, controlling for age, and using the pass/not pass variable confirmed this finding. When the inhibitory control tasks were completed first, children who passed the forbidden toy task provided significantly fewer 'choose to' responses than children who failed, $F(1, 32)= 7.133$, $p=.012$.

Discussion

Children's answers to the free will questions were consistent with results of previous studies (Kushnir *et al.*, 2015). Older children ascribed more choice than younger children for the desire questions, and they trended towards ascribing more choice in cases of action than inhibition. There were no developmental differences for the control questions. There were developmental differences on the day/night task. Older children scored higher than younger children. Age did not predict performance on the forbidden toy task. Half the children passed this task, and half touched the toy.

Neither the forbidden toy task nor the day/ night task was positively correlated with free will beliefs. Previous research found a positive relationship between the development of theory of mind and executive functioning. In particular, studies have found a correlation between cool executive functioning tasks, such as the day night task, and theory of mind (Carlson & Moses, 2001, Sabbagh *et al* 2006). The present results do not suggest that free will beliefs are related to executive functioning in the same way that theory of mind beliefs are, although they do not necessarily rule out this possibility.

Both qualitative explanations and choose to responses were related to the forbidden toy task. Children who answered the free will questions first, and provided external responses, were more likely to later pass the forbidden toy task. Also, children provided more external explanations if they answered the free will questions after completing the inhibitory control measures.

At first, these results seem at odds with previous research showing that holding a belief in an internal locus of control enhances self-control (Mischel, Zeiss & Zeiss, 1974). However, this prior work assumes a strong internal motive; the child decides if they want persist and work towards a reward. The forbidden toy task, on the other hand, has a strong external motive – to obey the experimenter's rule not

to touch the toy. No reward is given for those who pass, other than the reward of following the rule.

Analysis also revealed a negative relationship between self-control abilities and beliefs about free will. Of those who completed the inhibition tasks first, children who preformed better on the forbidden toy measure provided fewer 'choose to' responses to the free will questions than those who failed.

Ego depletion (Baumeister, Bratslavsky, Muraven, & Tice, 1998) could explain the negative correlation found in this study. Children may have depleted their willpower practicing self-control, and then subsequently answered that they could not further practice self-control. However, there were no order effects for the desire free will questions. The experience of control itself did not make children less likely to endorse free will, suggesting that ego depletion cannot explain these results. Instead, children who passed the task were less likely to endorse free will than those who did not.

These results are consistent with cross-cultural results where inhibitory control is correlated with an external locus of control and lesser belief in free will. One explanation is that people perceive acts of self-control differently. There is evidence that some actions, particularly actions based on external moral norms, may not be viewed as freely chosen. Furthermore, the extent that they are tends to differ across cultures (Chernyak & Kushnir, 2014; Chernyak et al, 2013). Some children may have not touched the toy because they did not believe that they had the choice to touch the toy. In order to fail, on the other hand, children must first conceive of the choice to touch the toy. Their subjective experience during the forbidden toy task may have subsequently influenced answers during the free will task. In this sense, the subjective first person experience of practicing self-control could, over time, shape beliefs about free will.

These findings suggest a number of ways that the practice of self-control may relate to beliefs about self-control. First, we found that children who provided external explanations performed better on a forbidden toy self-control task. However, this relationship is in the opposite direction than previous findings. Second we found that children provided more external explanations after completing the inhibitory control tasks. Finally, we found a relationship between the experience of self-control and free will beliefs, but this relation was that children who exercised self-control were less likely to endorse free will. Future research should consider how beliefs about free will relate to both internally and externally motivated acts of self-control, and how culturally variable experiences influence children's abilities and beliefs.

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