

The Influence of Desires on Young Children's Reasoning

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A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Psychology

in the

Graduate Division

of the

University of California, Berkeley

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Fall 2018

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## Abstract

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Previously developmental psychologists have explored how young children reason about desires, and how desires constrain children's inferences. For example, early research on theory of mind explored when young children come to understand that people have different desires, and how young children reason about conflicting desires across individuals or over the course of time (e.g. Wellman and Liu, 2004). Relatedly, studies have explored how desires influence children's inferences about actions, finding that young children generally believe that people act consistently with their desires (e.g. Kushnir, Gopnik, Chernyak, Seiver, and Wellman, 2015). Studies on wishful thinking and optimism, on the other hand, have found that desires may more broadly constrain inferences across a variety of domains. In particular, studies have shown that desires bias older children's and adults' predictions about stochastic events (e.g. Krizan and Windschitl, 2009). In Chapter 1 I outline previous research exploring how young children reason about desires.

In Chapters 2 through 4 I present a series of cross-cultural developmental studies exploring how desires impact children's inferences. In Chapter 2, I explore the development of beliefs about agency in Chinese and U.S. 4- and 6-year-old children, and if children believe that people can 'choose to' act inconsistently with a desire, or practice self-control. Findings suggest both differences and similarities across groups of children.

In Chapter 3, I present a similar study contrasting Peruvian and U.S. 4- to 7-year-olds. I also explore if developmental changes in beliefs about self-control are related to first person experiences practicing self-control. When contrasting Peruvian and U.S. children, findings suggest differences in beliefs about self-control, however children demonstrated comparable self-control skills. In addition, cultural group mediated the relationship between children's 1<sup>st</sup> person experiences practicing self-control, and their corresponding beliefs about self-control.

In Chapter 4, I present a series of studies exploring the influence of desires on young Peruvian and U.S. children's (3-to 7-year-olds) predictions about stochastic events. Findings suggest that desires strongly constrain young children's inferences across cultures.

Finally, in Chapter 5 I discuss the implications of these findings, as well as present several avenues for future research. These findings more broadly contribute to our scientific understanding of how young children reason about desirable possibilities, and how culture impacts conceptual development.

## Acknowledgments

This work would not have been possible without the intellectual support and guidance from my advisor, Dr. Alison Gopnik. I am also extremely grateful to my collaborators and co-authors, including Sophie Bridgers, Xin (Alice) Zhao, Dr. Liqi Zhu, Dr. Elizabeth Seiver, Denise Segovia, Dr. María Fernández Flecha, Dr. Tamar Kushnir, Mariel Goddu, Teresa Garcia and Elyanah Posner.

I am incredibly grateful to the research assistants who have volunteered their time, and spent numerous hours assisting with the data collection and coding for these studies. Most notably, Yixin Cui, Titus Ting, Emily Anne Schultz, Sophie McMullen, Karen Ramirez Balarezo and Ingrid Del Rosario Abanto Hurtado.

I would also like to thank the past and present members of the Gopnik lab for their support and feedback over the years, including Katherine Kimura, Shaun O’Grady, Emily Liquin, Rosie Aboody, Dr. Zachary Irving, Dr. Caren Walker, Dr. Azzurra Ruggeri, Dr. Nadya Vasilyeva, as well as my dissertation committee, Dr. Mahesh Srinivasan and Dr. Terry Regier, for their thoughtful feedback and guidance.

This research was made possible by financial support from the John Templeton Foundation, the Li Ka Shing Foundation, the McDonnell Foundation, the Bezos Family Foundation, the Chinese Academy of Sciences (KJZD-EW-L04), Carlos Rodríguez-Pastor and Dr. Kaiping Peng.

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# Chapter 1. Introduction

## 1.1 General Introduction

One of the most powerful capacities of humans is the ability to anticipate the future, form predictions, and reason about possibilities. This type of reasoning serves as a basis for intentional behavior and shapes how we interact with other people and the world around us. Preschool age children can explicitly and verbally reason about a variety of possibilities. Take for example the large body of research on theory of mind and counterfactual reasoning (e.g. Harris, German & Mills, 1996; Wellman & Liu, 2004). However, decades of research also suggest that children often make quite different inferences than adults do, and that their reasoning gradually changes over the course of development. In the present dissertation, I present three lines of research that explore how young children reason about desirable possibilities, and the extent that desires constrain young children's reasoning. All three studies explore developmental differences as well as the impact of culture on development.

Traditionally, developmental psychologists have been interested in exploring developmental change, and many have found constructivist frameworks useful. The present dissertation takes a rational constructivist approach and draws upon the theory theory and probabilistic models frameworks. Generally, these frameworks argue that children's beliefs take the form of intuitive theories that undergo continual revision as new evidence is encountered (Carey 1985; Gopnik & Wellman 2012; Wellman and Gelman, 1992).

Children around the world are raised in vastly different environments and encounter different patterns of evidence on a day to day basis. Often developmental psychologists rely on W.E.I.R.D (western, educated, industrialized, rich and democratic) samples and assume that findings will generalize across cultures. However, this assumption can impede scientific progress. Constructivist frameworks, in particular, highlight the need for cross-cultural comparisons and predict that differences in environment will cause corresponding differences in cognitive development. Additionally, conducting cross-cultural comparisons can more broadly contribute to developmental theory by shedding light on environmental and universal factors that drive developmental change.

The present dissertation explores children's conceptual development across cultures. It contains three independent lines of research exploring how young children reason about desirable possibilities. In Chapter 2, I present a study exploring the development of Chinese and U.S. children's beliefs about choice and free will, and how children come to believe that people can 'choose to' act in opposition to their desires. In Chapter 3, I present a similar study, but contrast children from the U.S. and Peru. Additionally, in Chapter 3, I explore the possibility that children's beliefs about self-control and free will stem from their first-person experiences practicing self-control. In Chapter 4, I present a series of experiments exploring the possibility that desires, more generally, constrain young children's inferences. In this chapter, I compare lower-income Peruvian and middle- and lower-income U.S. children. The experiments presented in this dissertation can be broadly classified into two categories: those that explore the impact of



desires on children's beliefs about agency and self-control (Chapters 2 and 3), and those that explore if desires bias children's beliefs about stochastic events (Chapter 4).

While these two lines of work explore development in different domains, they have some important underlying commonalities. The first line of research finds that young children, across cultures, initially believe that desires constrain people's actions, then gradually come to believe that people can 'choose to' act inconsistently with their desires. In this dissertation, I explore why this changes and what evidence, more specifically, might cause children to revise their beliefs about agent causation. Similarly, in Chapter 4 I find that desires initially constrain young children's predictions about stochastic events, however, over the course of time children gradually come to override this initial constraint. In addition, both lines of research find cultural differences in the timeline of developmental change. This is further discussed throughout the dissertation.

Below I outline previous studies exploring how young children reason about desires. In line with the research presented in this dissertation, I have divided the literature review into two categories. The first category introduces research on the development of children's understanding of agent causation, and how children come to understand that people can act in ways that are inconsistent with their desires. After this, I go on to describe previous developmental studies on optimism and wishful thinking.

## **1.2 The Development of Children's Beliefs About Agency**

Decades of research on theory of mind (see Wellman and Liu, 2004, for review) suggest that young children hold very different intuitions about agency than do older children and adults. A subset of research on theory of mind has specifically explored how children reason about desires. Chapters two and three of this dissertation directly extend upon this body of research. Below I have outlined prior studies exploring how young children reason about agent causation and desires.

Some of the first empirical work on theory of mind explored how young children reason about their own desires as well as other people's desires. Repacholi and Gopnik, (1997) explored if 14- and 18- month old children understand that another person can hold a desire that is different than their own. To do so, they designed an experiment where children were asked to predict the experimenter's desires. First, experimenters asked 14-and 18-month olds to choose between two types of food- broccoli and goldfish crackers. After children indicated a preference, the experimenter demonstrated that they preferred the opposite type of food. The experimenter then asked participants to give them some food. To do so, children had to select between the food they themselves preferred, or the food the experimenter preferred. Eighteen-month-olds selected the experimenter's preference, rather than their own. Fourteen-month-olds, on the other hand, offered the type of food that they themselves preferred. Results suggest that 18-month-olds understand that people have desires that may differ from their own desires.

In another study, Gopnik and Slaughter (1991) asked preschool aged children to reason about their own previous desire when it was in conflict with a current desire. For example, in Experiment 1 they asked children to choose between two books. Once the child made a choice, the experimenter read the book to the child, then asked them to choose again. All children chose

the alternative book. After this selection was made, the experimenter asked children to recall their previous desire. They found that 4-year-olds were able to accurately report their past desires, but 3-year-olds were not. In a second experiment, researchers conducted a similar task, but asked children to choose between two boxes of toys, rather than two books. Here they found that both 3- and 4-year-olds had difficulty reporting their past desires.

Moore, Jarrold, Russell, Lumb, Sapp, and MacCallum, (1995) argue that these conflicting results may be the result of variance in the magnitude of children's desires; perhaps participants had a stronger desire for the alternative box of toys than they did for the alternative book. In an experiment, Moore and colleagues asked 3- to 5-year-old children to predict another person's desires, when it was in conflict with their own strong desire or when there was no strong conflict of desire. They found that only 5-year-olds could accurately predict another person's desires when there was a strong conflict of desire; 3- and 4-year-olds could not. However, when there was not a strong conflict of desire, even 3-year-olds could make accurate judgments.

Other research has explored how young children learn and infer another person's preferences. One way that they do so is through observing statistical patterns in behavior. Kushnir, Xu, and Wellman (2010) showed 20-month-old infants and preschoolers buckets that contained two types of items: plastic frogs and plastic duckies. Buckets contained 31 of one type and only 7 of the other. The experimenter then removed 5 items from the bucket. Across conditions, the experimenter either removed a statistically likely sample (e.g. if the majority item was frogs, the experimenter selected 5 frogs), or a statistically unlikely sample (e.g. if the majority item was frogs, the experimenter selected 5 duckies). Children were then asked to hand the experimenter an item. To do so, participants had to choose between a frog and a duck. In this study, participants used the experimenter's previous actions to inform their selection, however they only did this when the experimenter had previously selected an unlikely sample. This suggests that children can infer another person's preferences from viewing their actions over the course of time.

The ability to reason about desires allows children to understand the causes of people's actions and form predictions about how people might act in the future. Wellman and Woolley (1990) argue that 2-year-olds hold a 'simple desire psychology'. Two-year-olds conceive of actions as stemming directly from desires. Adults and older children, on the other hand, hold more complex beliefs about agent causation. For example, they believe that both beliefs and desires inform actions.

In an experiment, Wellman and Woolley (1990) introduced two-year-olds to a character (e.g. Sam) who wanted to bring something (e.g. a rabbit) to school. Sam, however, could not find his rabbit. Two-year-olds were told that the rabbit could be hiding in one of two places. Sam next looked in one of the two locations. Experimenters varied if Sam found or did not find his rabbit. Then children were asked to predict what Sam would do next; would Sam look in the second hiding place for the rabbit, or would Sam go to school? Ninety- seven percent of two-year-olds predicted that Sam would look for his rabbit in the second location when he did not find it in the first location. In contrast with this, when Sam did find the rabbit, 78% of two-year-olds predicted that Sam would go to school. This suggests that 2-year-olds use people's desires to infer their subsequent actions, and, conversely, view actions as the result of desires.

### **1.2.1 The Development of Children's Beliefs About Desire Inconsistent Actions**

While this work suggests that preschool age children understand that people often act in ways consistent with their desires, in actuality people sometimes act in ways that are inconsistent with their desires. This is the focal point of Chapters 2 and 3 of the present dissertation, which explore how children come to believe that people can 'choose to' act inconsistently with their desires. In general, this type of reasoning is more developmentally complex, and it is not until much later that children come to hold adult like intuitions about choice and self-control.

One reason why beliefs about acting inconsistently with desires may be more developmentally complex, is that people, in general, often act consistently with their desires. Furthermore, research on self-control suggests that young children themselves are especially inclined to act congruently with their own desires (e.g. Mischel, 2014). Given this, young children probably receive fewer examples in their day-to-day lives of desire inconsistent actions, while, on the other hand, they receive a lot of evidence that people act consistently with their desires. Thus, initially, it may seem unlikely to children that people can act inconsistently with their desires. Relatedly, other research suggests that children often have a hard time distinguishing between improbable and impossible events more generally, and often treat improbable events similar to impossible ones (Shtulman & Carey, 2007). In the present studies, I share evidence suggesting that young children view desire inconsistent actions (e.g. eating a yucky cracker) similarly to how they view impossible actions (e.g. floating in the air).

Another reason why developing an account of desire inconsistent actions may be so complex, is that there are different underlying reasons for why a person may act inconsistently with their desires. Wellman and Woolley (1990), for example, state that taking a person's beliefs into account can, in part, explain these instances. For example, Sam may want to find his rabbit, and Sam's rabbit may be hiding under the couch. But Sam may not look under the couch for his rabbit. This could be because Sam does not know that his rabbit is under the couch. Generally, it is believed that children do not explicitly factor false beliefs into theories of agent causation until around 4 ½ years of age.

By 5 years of age (or 4 depending on the account) children do reliably understand that desires vary from person to person and over the course of time. They may then start to understand that changes to various factors could lead to changes in a person's desires, and thus cause them to act differently. For example, maybe John generally loves eating ice cream, but right now it is cold outside, so John does not want to eat ice cream. This may cause John to act in a way that seems inconsistent with his more general desires, however it is actually congruent with his current desire. Findings discussed in the present dissertation support the notion that children do appeal to these sorts of hypothetical or alternative possibilities when making post hoc judgments about desire inconsistent actions.

### **1.2.2 The Role of Choice and Free Will in Beliefs About Agency**

Adults often explain desire inconsistent actions by appealing to notions of choice or free will. While young children initially believe that desires are the direct cause of actions, by adulthood people have inserted a notion of choice into this equation. This notion of choice theoretically allows an agent to manipulate their actions independently of desires. For example,

John could really like ice cream, yet not eat it, simply because he can exercise his choice or free will to do otherwise.

Developmental research on children's beliefs about choice, or free will, has explored when children come to believe that people can 'choose to' act inconsistently with their desires. In the first of these studies, 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 'choose 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. Four-year-olds, on the other hand, tended to believe that people's behavior had to be consistent with their own desires.

Kushnir et al. (2015) argue that this finding reflects a conceptual shift 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 model. With this added link, actions need not stem directly from desires, but can be altered through choice. Under the theory theory 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.

### **1.2.3 Introduction to Chapters Two and Three**

Chapters two and three of the present dissertation focus on where this notion of choice or free will stems from, and how children develop a belief that people can 'choose to' act inconsistently with their desires. In particular, chapters two and three investigate what specific type of evidence may lead to the development of a belief in free will. Three hypotheses are explored. The first is that a belief in choice is impacted by cultural notions of agency, and thus variable across cultures. The second is that children's beliefs about choice stem from their own first-person experiences practicing self-control. As children get older, they may come to endorse a belief in choice or free will because they are actually better at practicing self-control. A third possibility is that cultural beliefs about agency impact how children achieve self-control. Some children may view their self-control as externally facilitated, rather than freely chosen, while other children may view their self-control as more freely chosen. Differences in how children experience self-control could in turn impact the development of beliefs about free will.

## **1.3 The Impact of Desires on Young Children's Inferences**

Chapters two and three explore how young children come to hold a belief that people can 'choose to' act inconsistently with their desires. Previous research suggest that desires constrain young children's understanding of agency. One reason for this is that people, in real life, often act consistently with their own desires. Chapter four, in contrast, explores another way that

desires may constrain young children's judgments. In chapter four, I explore if desires themselves directly bias young children's inferences. While Chapters two and three revolve around instances where notions of agency impact beliefs, chapter four explores children's beliefs about chance events that are free of agentive control.

### **1.3.1 Developmental Research on Optimism**

In the present dissertation I explore the development of wishful thinking, or the idea that desires directly bias beliefs, in Peruvian and U.S. children. While previous studies have not explicitly studied wishful thinking in young children, several studies have explored optimism, confidence and positivity more generally. Other studies have explored wishful thinking in older children and adults. Below I outline previous developmental research on optimism, then go on to explain research on wishful thinking.

Several studies have found that young children exhibit a positivity bias when evaluating people's traits and abilities (see Boseovski, 2010 for review). For example, studies have found that young children expect negative traits to improve over the course of time, while they believe that positive traits will continue to persist throughout time (Diesendruck & Lindenbaum, 2009; Heyman & Giles, 2004; Lockhart, Chang, & Story, 2002; Lockhart, Nakashima, Inagaki, & Keil, 2008). Other studies have found that children require less evidence to make a positive judgment about another person than to make a negative judgment (Boseovski & Lee, 2006). Relatedly, Boseovski (2012) found that children were more likely to endorse an informant's testimony about a stranger if they stated that the person was nice than if the person was mean. This suggests that children, in general, hold a very positive outlook in regards to people's traits and abilities.

Other studies have found that young children are quite optimistic about their own abilities, and resilient to negative feedback. In one study, Parsons and Ruble (1977) found that preschool-aged children expected to do well on a puzzle task, even after receiving feedback that they were doing poorly. Six-year-olds were less resilient to this negative feedback. Similarly, Plumert (1995) found that 6-year-olds, but not 8-year-olds, demonstrated over-confidence in their physical abilities. Lockhart, Goddu, and Keil (2017) similarly found that 5-to- 7-year-olds were quite optimistic about their future intellectual abilities, when compared to 8- to 10- year-olds.

### **1.3.2 The Relationship Between Preferences and Expectations**

While this prior research suggests that young children frequently hold positive beliefs, it is not clear if wishful thinking underpins children's optimism, or if simply preferring one outcome over another biases children's predictions. Alternatively, there are a number of explanations for why young children may have expressed positivity in these previous studies.

One reason why young children may be so confident is they frequently hear positive and encouraging feedback from adults. In support of this argument, Stipek and Daniels (1988) found that kindergarteners generally rated their future academic attainment higher than 4<sup>th</sup> graders, however when kindergarteners were given feedback from adults that was comparable to what 4<sup>th</sup> graders receive, estimates were similar across the age groups. Similarly, Stipek, Roberts and

Sanborn (1984) found that 4-year-olds estimates of success were shaped by adult feedback. This suggests that preschooler's confidence is indeed impacted by social feedback.

With regards to research on traits and abilities, young children may hold different beliefs about the prevalence of positive attributes than do older children and adults. In support of this, Lockhart, Chang, and Story (2002) found that young children, overall, estimate positive traits to be more prevalent than do older children. This difference in prior knowledge may have underpinned children's positivity in the above studies.

A third explanation for the previous findings, is that children likely encounter different patterns of evidence in their day to day lives than do older children and adults. Young children's abilities do rapidly change during development, and often for the better. This may lead young children to believe that traits and abilities will continue to develop in a positive direction over the course of time (Lockhart, Chang, & Story, 2002). In fact, young children may view adults and older children as possessing positive attributes (e.g. running fast) and this may cause them to believe that people can change for the better if they want to.

While several studies have found that young children often hold positive or optimistic beliefs, no studies have explicitly tested if preferences shape young children's expectation, although several studies with older children and adults have. In Chapter 4, I explicitly test the hypothesis that "wishful thinking" or the "desirability bias" causes young children to be optimistic. Previously, research on the desirability bias, or wishful thinking has explored whether desires causally influence beliefs (see Krizan & Windschitl, 2007; 2009 for review). To test this, researchers have attempted to manipulate desirability, while holding all other factors constant, and then measure the effect of desirability on beliefs.

The first 'wishful thinking' study was conducted with 9- to 11-year-old children. In this study, Marks (1951) introduced children to a deck of cards, some of which were marked on one side, and told children the percentage of marked cards in the deck. Across conditions, decks contained different percentages of marked cards (10, 30, 50, 70, and 90%). Across conditions, participants were also told they would win (gain condition) or lose (loss condition) a point if they blindly drew a marked card from the deck. After this, participants were asked to guess which card they thought they would select from the deck. Responses varied according to both the probability and desirability of selecting a marked card. Holding likelihood constant, participants believed they were more likely to select a marked card in the gain conditions than in the loss conditions, suggesting that desirability alters expectations.

Since this time, several variations of this paradigm have been conducted with adults, and results generally suggest that both desirability and probability influence adult's stated expectations as well. Contrasting findings from adults, with those obtained by Marks (1951), suggest that the wishful thinking bias may be stronger for children than it is for adults (see Krizan and Windschitl, 2009 for review).

### **1.3.3 Introduction to Chapter Four**

These findings raise questions about the development of wishful thinking, and how it relates to young children's optimism. Perhaps a wishful thinking bias is acquired during childhood. If this is so, we might predict that the bias would increase with development. Alternatively, maybe desires initially constrain young children's predictions. Children may even

believe that their desires have a causal influence on outcomes. If this is so, we should see a desire bias even in very young children, and it may weaken over the course of development.

In Chapter 4 I contrast lower-and middle-income U.S. children with lower-income Peruvian children. Conducting these cross-cultural comparisons can help disambiguate between the different possible developmental underpinnings of wishful thinking. If wishful thinking is acquired during childhood we might expect that the cultural context could influence if and when children develop a bias. If it is in place early and is modified later, we might expect that, cross-culturally, children would start out being optimistic and that the cultural context would shape the pace in which children learn to override this bias. In fact, some researchers have suggested that such an optimism bias, more generally, could confer an evolutionary advantage in spite of its apparent irrationality (Johnson and Fowler, 2011; McKay and Dennett, 2009; Sharot, 2012; Sharot, Korn, and Dolan, 2011). If so, it might develop very early and independently of evidence. In Chapter 4, we take the first step towards exploring these questions, by testing the developmental trajectory of the wishful thinking bias in lower-income Peruvian and lower-and middle-income U.S. children.

## **Chapter 2. How universal are free will beliefs? Cultural differences in Chinese and U.S. 4-and 6-year-olds**

### **2.1 Introduction**

Free will has long been a topic of debate in western philosophy. On one hand, we think of ourselves as agents with free will, as beings who can intentionally and autonomously choose what to do or not do. On the other hand, this conception seems to conflict with scientific determinism – the belief that events, either mental or physical, are always caused by preceding events. Recently, researchers have found that people tend to endorse a strong conception of free will (Nahmais, Morris, Nadelhoffer, & Turner, 2005; Pronin & Kugler, 2010). For example, adults believe that actions are consciously chosen, and reject claims that free will, or choice, is an illusion (Monroe & Malle, 2010).

Adult concepts of free will may have many different components, which is part of why defining free will is philosophically problematic. However, one central prerequisite for a concept of free will is a belief in the ability of agents to freely choose to do otherwise – I feel that if I simply choose to raise my arm right now I could equally well have chosen to leave it by my side. Recently researchers have started to explore the development of these beliefs in children.

Beliefs about free will are a central component of folk psychology or theory of mind. Infants and toddlers demonstrate an early ability to reason about psychological causation (Kushnir, Xu, & Wellman, 2010; Repacholi & Gopnik, 1997). At two years of age, children explicitly hold a simple desire-perception psychology. They view people's actions as stemming directly from their preferences or desires combined with their perceptions. This simple syllogism undergoes considerable change during early childhood. By age 4 or 5, children explicitly view people much like adults do, as agents whose actions are guided by both desires and beliefs (Wellman & Lui, 2004; Wellman & Woolley, 1990).

A notion of free will, or choice, can be viewed as an added component to this causal chain. It is a causal gateway residing between the beliefs and desires an individual holds and the actions in which they engage (Gopnik & Kushnir, 2014; Holton, 2009). In our everyday adult causal model of the mind, we seem to believe that a person can alter their actions and exercise free will through intervening on this intermediary causal link, regardless of the influence of preceding desires and beliefs.

To act freely implies that alternate choices are possible. To reason about free will, one must reason about what actually happened, or is likely to happen, as well as the other



possibilities that might (have) come about. Thus, the ability to hold a belief about free will is closely tied to the ability to reason conditionally about the hypothetical future, or the counterfactual past. Children also demonstrate an emerging ability to engage in conditional reasoning of this kind during their preschool years (Harris, German, & Mills, 1996).

Researchers have found that children as young as 4 years of age have intuitions about some of the prerequisites for free will. They believe that people have the ability to choose both to act and not act (Gopnik & Kushnir, 2014; Kushnir *et al.*, 2015; Nichols 2004). In one study, researchers (Kushnir *et al.*, 2015) asked children if a story character, Mary, who was standing on a stool could choose to step off of the stool. In another version of the question, Mary had recently stepped off of the stool, and children were asked if she could have chosen to stay on the stool. These questions were contrasted with physically impossible questions. Children were asked if Mary could just choose to step off of the stool and float in the air, or if Mary could have chosen to float in the air rather than step down to the ground. Four-year-olds answered that Mary could choose to step off of the stool or could have chosen to stay on the stool. However, they did not think that Mary could choose to float in the air.

Another set of experiments by Kushnir *et al.* (2015) found that children view epistemic constraints in a similar way. In these studies, children were asked to draw a picture while an experimenter also drew a picture, either within the child's view or not. Then children were asked if they could have chosen to draw the same picture as the experimenter. When they were unaware of what the experimenter was drawing, children believed they could not have chosen to draw the same picture. However, when children could see the experimenter's drawing, they answered that they could have chosen to draw the same picture. In this study, children understood that there could be psychological as well as physical constraints on choice. These results suggest that by age 4, children have a basic understanding of choice and what can constrain it, and that in the absence of obvious physical or epistemic constraints, they believe people can choose to do otherwise.

An additional question, however, is how children understand constraints on free will that might come from our desires. As adults we believe that 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.

This belief 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 do not 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 desires. In fact, as adults we believe that we even have the freedom to act in a perverse way, deliberately choosing to act in a way that goes against our desires. (The character Raskolnikov in Dostoevsky's *Crime and Punishment*, for example, acts perversely just as a way of asserting his free will). Believing in the possibility of performing alternative actions, regardless of desires, constitutes a particularly strong intuitive conception of free choice.

Kushnir *et al.* (2015) also asked children what they thought about choices that were constrained by desires. Four- and 6-year-old children were asked if they believed that they themselves or another person could choose to refrain from a desired action (not eat the cookie) or act against a desire (eat a disgusting cracker). Four-year-olds were less likely to ascribe free choice to other people and to themselves than 6-year-olds. They also were more likely to ascribe free choice to others than to themselves, and they were more likely to ascribe free choice in cases of action than of inhibition – they were more likely to say that someone could choose to eat a disgusting cracker than that they could choose *not* to eat a tasty cookie.

Children were also asked to explain how an alternative action might come about. For example, if a child said that they could choose to not eat a cookie, the experimenter asked, “why can you choose to not eat the cookie?” Most children spontaneously described hypothetical conditions that might change someone’s desires. For example, a child might say they could choose to not eat the cookie even if they wanted to because, “I’m too full” or “it has a lot of sugar.” Although children provided “choose to” answers, their qualitative responses did not express a fully autonomous concept of choice. It is possible, instead, that these answers reflected the idea that alternative conditions, particularly alternative desires, could lead a person to act differently.

However, about 14% of children provided answers that specifically implicated an ability to willfully and autonomously practice self-control. For example, one child said, “you can choose even if you don’t want to.” These explanations suggest that some children, like adults, believe that actions are the result of fully autonomous choices, choices that can override desires.

One way to understand these developments is that between 4 and 6 years of age, children alter their causal model of the mind. They come to insert an autonomous notion of choice between a person’s desires and actions. With this added causal variable, someone can change their course of action even if internal and external conditions remain the same. They can simply exercise their autonomous free will to choose to act otherwise.

What leads to these developmental changes in beliefs about free will? One very plausible answer is that changing free will beliefs stem from changing first-hand experiences of self-control. It is well-known that children develop greater capacities for executive function and self-control during the preschool period. Between 4 and 6 years, children may simply have more experience of acting in spite of their own desires, for example, in circumstances that require self-control or executive monitoring. Children may reflect on their own desires and actions and note that they do not always match, or they may simply experience themselves exercising their own executive capacities and interpret these capacities as free will. Endogenous, internally determined changes of this kind might explain the developmental trajectory in Kushnir *et al.* (2015).

But alternative accounts are also possible. It may also be that children gradually internalize the ideas about free will that prevail in their particular culture, rather than inferring free will from their own experiences. If cultures have different approaches to free will, these different approaches might also be reflected in differences in children’s conceptions. A strong version of this claim might be that children simply take on whatever account of free will prevails in their culture.

A weaker account might be that children integrate many different kinds of information in an attempt to form a single coherent account of the mind that includes conceptions of free will. These sources of information might include their own experiences of choice and self-control,

their observations of choice and control in others, and, particularly significantly, culturally transmitted information about choice and control.

Studying cross-cultural similarities and differences in these developments can speak to these questions. Children from China have been shown to outperform children from the U.S. on executive function tasks (Lan, Legare, Cameron Ponitz, & Morrison, 2011; Sabbagh, Xu, Carlson, Moses, & Lee, 2006). These differences might indicate that the endogenous development of self-control, though similar in kind, is accelerated in these children compared to children in the U.S. In that case we might predict that children from China would ascribe more free will to people and do so at a younger age than children from the U.S.

On the other hand, people from cultures with a stronger independent self-construal have been found to place a greater emphasis on autonomy and agentive causation than people from cultures with a more interdependent self-construal (Markus & Kitayama, 1991; Weisz, Rothbaum, & Blackburn, 1984). If culturally transmitted notions of individuality and autonomy influence beliefs about free will, it follows that children from more independently minded cultures may come to hold a more autonomous view of choice.

Few studies have assessed free will cross-culturally. Sarkissian *et al.* (2010) surveyed adults in India, Hong Kong, Columbia, and the U.S. and found that across all four cultures, most people endorsed an indeterministic view of free will. In particular, participants believed that a person's decisions are not necessarily based upon preceding events. Chernyak, Kushnir, Sullivan, and Wang (2013), on the other hand, found cultural similarities *and* differences in the development of attributions of choice made by Nepalese and U.S. 4- to 11-year-olds. Children from both cultures ascribed choice to people for simple actions, such as drawing a picture, as long as these actions were not subject to physical or epistemic constraints. However, as U.S. children grew older, they were more likely to say that a story character could choose to act against social norms and conventions, whereas the reverse was the case for Nepalese children – as they grew older they were less likely to say that people could act against social constraints.

To further explore the relationship between culture and free will beliefs, the present study replicated Kushnir *et al.* (2015) Experiments 4 and 5. We asked 4- and 6-year-old Chinese children whether they or another person could freely choose to act against their own desires and compared their answers to those provided by the U.S. children in Kushnir *et al.* (2015).

## 2.2 Experiment 1

Chinese 4- and 6-year-olds were asked about the degree of choice they believed other people and they themselves had when they were either performing actions or refraining from actions that were in conflict with their desires. Following this, children were asked to provide a qualitative explanation for their responses. If children's free will beliefs stem from their experience of their own and others' executive functioning capacities, Chinese children might ascribe more choice to other people and themselves since they are more likely to have such experiences. On the other hand, if more general cultural ideas about autonomy influence children's developing intuitions of choice, U.S. children might have a more autonomous view of choice than Chinese children. Alternatively, children in the two cultures might develop in a similar way

## 2.2.1 Method

### 2.2.1.1 Participants

Participants were 67 4- and 6-year-olds ( $M = 62$  months,  $Range = 47 - 82$  months) recruited from a preschool in Beijing, China. An additional 22 participants were excluded from the study due to unknown birthdates ( $n = 8$ ), incorrect age (the child was not 4 or 6) ( $n = 2$ ), experimenter error ( $n = 8$ ), and missing audio files or inaudible responses ( $n = 4$ ).

Chinese participants were predominantly middle class, spoke Mandarin, and were of the Han ethnicity. The U.S. data from Kushnir *et al.* (2015) was collected in Berkeley, CA. The sample was predominantly middle- and upper-middle class and reflected the diversity of the local population.

Participants were randomly assigned to one of two between-subject conditions: the Doll Condition (4-year-olds:  $n = 18$ ,  $M = 52$  months; 6-year-olds:  $n = 16$ ,  $M = 74$  months) and the Self Condition (4-year-olds:  $n = 17$ ,  $M = 52$  months; 6-year-olds:  $n = 16$ ,  $M = 74$  months).

### 2.2.1.2 Stimuli

**2.2.1.2.1 Doll Condition.** A small, female doll named Nini and small replicas of a wooden bed, a box, soup, and cake were used to act out the different stories.

**2.2.1.2.2 Self Condition.** White index cards were used by the experimenter for drawing images representing the different food items and activities the children described.

### 2.2.1.3 Procedure

Children were tested individually by the experimenter in an empty classroom at their preschool. The procedure was modeled after Experiments 4 and 5 in Kushnir *et al.* (2015). The procedure was translated and back-translated by fluent Mandarin speakers to insure accuracy and cultural competence. Particular items were modified to be more culturally appropriate (*e.g.*, instead of asking children about cereal they were asked about soup, a common breakfast food in China). The word “choose” was translated throughout using the Mandarin word “xuanze.” Xuanze reflects the mental process of deciding between two or more possibilities and is very similar to the English “choose.” “Have to” was translated throughout by the word “yiding.” Yiding is used to express necessity or certainty and is quite similar to the English “have to.”

Both conditions consisted of a warm-up phase, involving two question types: physically possible and impossible questions, and a test phase, involving three question types: physically impossible control questions, action (desire) questions, and inhibition (desire) questions. In the warm-up phase, children were asked whether Nini or they themselves could choose to perform physically possible or impossible actions if they really wanted to. In the test-phase, the

physically impossible questions also asked children if Nini (the Doll Condition) or if they themselves (the Self Condition) could choose to perform physically impossible actions. The action questions asked children if Nini or they themselves could choose to perform an undesirable action. The inhibition questions asked children if Nini or they themselves could choose to refrain from performing a desirable action. More specifically, these experimental questions asked children about desires and contrasted “choose to” with “have to not” or “choose not to” with “have to” depending on the type of question, action or inhibition respectively.

The order of the questions in the test phase was randomized across participants. The physically impossible control questions were always the third and fifth questions asked. The order of the ‘choose’ option or the ‘have’ option was counterbalanced within participants.

**2.2.1.3.1 Doll Condition.** Children were told that they were going to play a game about things people can and cannot do. The experimenter then introduced children to a doll named Nini and instructed them to pretend she was “a real person just like you and me.” The experimenter proceeded to ask children four warm-up questions that prompted them to think about possible and impossible physical choices. Each question began, “If Nini really wanted to, could she just choose to... 1) ...turn invisible; 2) ...smile; 3) ...jump up and down; and 4) ...run faster than a train.” If children answered incorrectly, they were prompted until they responded correctly.

After the warm-up phase, the test-phase began. The experimenter acted out six different stories. For the two physically impossible control questions, the experimenter asked if Nini could *choose to* {float in the air / walk through a wall} or if she *had to* {come down / walk around the wall}. For the action questions, the experimenter asked children if Nini could *choose to* {eat soup she thought was yucky / look under a bed of which she was afraid} or if she *had to not* {eat the soup / look under the bed}. For the inhibition questions, the experimenter asked children if Nini could *choose not to* {eat cake she thought was yummy / look in a box about which she was curious} or if she *had to* {eat the cake / look in the box}.

**2.2.1.3.2 Self Condition.** The procedure for the Self Condition was identical in structure to the Doll Condition. However, instead of asking children about a doll, children were asked questions about themselves. Children were also told that their mom (or dad) said that it was ok to do the action or not do the action. (In pilot testing with the U.S. children Kushnir *et al.* (2015) found that children often interpreted the “have to” question as a question about constraints imposed by adults unless this phrase was added).

For the four desire test questions, children were asked to select a food and activity they really liked as well as a food and activity they really disliked. The experimenter then drew the children’s selections on a card and used the card to discuss the scenario. For example, if a child said that ice cream was her favorite food, the experimenter then drew a picture of ice cream and said, “Let’s pretend that this is ice cream right here on the table in front of you. And you really like ice cream. You really think ice cream is yummy. Your mom says that you can eat the ice cream or not eat it. So do you *have to* eat the ice cream because you like it or could you *choose not to* eat the ice cream?” In contrast, if the child said that they did not like broccoli, the experimenter would draw a picture of broccoli and say, “Let’s pretend that this is broccoli right here on the table in front of you. You really do not like broccoli. Your mom says that you can eat the broccoli, or not eat the broccoli. So do you *have to* not eat the broccoli because you don’t like

it, or can you *choose to* eat the broccoli?” Children’s yes/no answers to the questions in the warm-up phase and choose/have answers to the questions in the test phase were recorded.

**2.2.1.3.3 Qualitative Responses.** In both conditions, after each question, children were prompted to explain their response. For example, the experimenter would say, “and why can you choose to not eat the ice cream?” Qualitative responses were coded according to the coding scheme developed by Kushnir *et al.* (2015).

<b>Have to</b>		
	<b>Explanation</b>	<b>Example</b>
<b>Internal</b>	Mental factors that constrain choice, such as beliefs, desires or other psychological factors.	<i>“I like it”</i> <i>“I don’t like running”</i> <i>“Because I’m afraid of spicy foods”</i>
<b>External</b>	Constraints on choice that are external to the agent’s mind. These include physical, biological, or social factors.	<i>“Cake is good”</i> <i>“Nini is hungry”</i> <i>“It’s good for you”</i>
Other/ I don’t know/ No response		
<b>Choose to</b>		
<b>Alternate Internal</b>	Hypothetical internal conditions that allow for choice, such as a person’s beliefs, desires or other psychological characteristics.	<i>“Maybe she’s curious”</i> <i>“She doesn’t know what the soup tastes like”</i> <i>“She is afraid that it is poisonous”</i>
<b>Alternate External</b>	Hypothetical external conditions that allow for choice, generally reference physical, social, or biological factors.	<i>“I can play outside if my good friends are there”</i> <i>“What if it’s yummy”</i> <i>“There might be a gift from mom there”</i>
<b>Autonomy</b>	A person holds the ability to practice choice independent of internal or external factors.	<i>“You can choose not to play with blocks or play”</i> <i>“You can choose even if you don’t want to”</i>
Other/ I don’t know/ No response		

Table 2.1. Qualitative response explanations and examples.

Different codes were assigned depending on whether the child initially gave a “choose to” or “have to” answer. If children initially provided a “have to” answer, their answers to the open-ended questions were coded as *internal*, *external*, or *other*. Internal answers referred to mental factors internal to the agent that constrain choice. External answers referred to factors

outside the agent that constrain choice. For example, if the child answered that Nini “had to” eat the cake, the child might say that this was so because, “She likes it” (internal) or because, “Cake is good” (external). Answers that were neither internal nor external, or both internal and external were coded as other.

If the children initially provided a “choose to” answer, their open-ended responses were coded as *alternate internal*, *alternate external*, *autonomous*, or *other*. Alternate internal answers referred to hypothetical internal mental conditions, not specified in the story, in which a person would make the alternative choice, whereas alternate external answers referred to hypothetical external conditions in which a person would make the alternative choice. For example, if the child answered that the character could “choose to” eat the yucky soup, they might further explain that she could choose to do so “because she’s curious” (alternate internal), or “because it’s healthy” (alternate external).

Autonomous answers, in contrast, referred to a person’s general ability to make a choice. For example, in response to the question “why can you choose to eat the yucky food?” the child might say, “you can choose even if you don’t want to” or “she’s herself and she can just choose what she wants to do.” All answers that did not fit into this coding scheme were coded as other.

Two coders fluent in Mandarin and English were trained on this coding scheme. First, fidelity to the coding presented in Kushnir *et al.* (2015) was assessed using a subset of the U.S. data. Both research assistants scored above 90% agreement. Following this, they coded all Chinese data directly from audio recordings of the experiment. Reliability between coders for qualitative explanations was 88.43%. Coder agreement for the “choose to” or “have to” response was 97.9%. The two coders met to resolve discrepancies.

## 2.2.2 Results

U.S. children’s responses from Kushnir *et al.* (2015) were directly compared to Chinese children’s responses. For each of the two agent conditions (self and other), children were asked to answer three question types (action, inhibition, and physically impossible control). For each of these three question types, children were asked to answer two questions. Responses across these two questions did not differ and were combined for further analysis.

Children received a 1 for each “choose to” response and a 0 for each “have to” response. For each question type, children were assigned a score ranging from 0-2. A score of 0 meant that the child provided two “have to” responses, whereas a score of 2 meant that the child provided two “choose to” responses. Figure 2.1 provides means, standard errors, and comparisons to chance. Inspection of Figure 2.1 shows that response patterns differed across the 3 question types. Accordingly, data was analyzed using a 3-way analysis of Culture X Agent X Age for each question type.

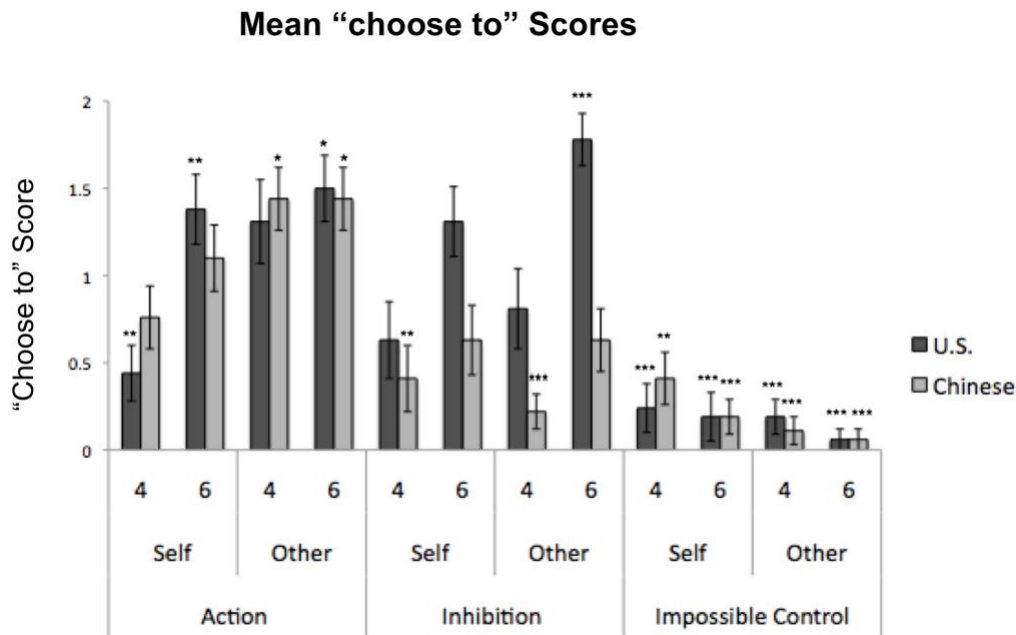


Figure 2.1. Mean “choose to” scores (0-2) from Chinese Children in Experiment 1 and U.S. children from Kushnir et al. (2015). Asterisks indicate a significant difference from chance: (\*)  $p < .05$ , (\*\*)  $p < .01$ , (\*\*\*)  $p < .001$ , using two-tailed t-tests.

**2.2.2.1 Impossible Control Questions.** A 2(Culture: Chinese vs. U.S., between subjects) x 2(Agent: Self vs. Other, between subjects) x 2(Age: 4 vs. 6, between subjects) ANOVA on mean “choose to” responses yielded a main effect of condition,  $F(1, 124), p = .047, \eta_p^2 = .1$ . Children believed themselves ( $M = .26; SD = .31$ ) more able to do physically impossible actions than other people ( $M = .1; SD = .54$ ). There were no other significant differences between groups: age ( $p = .133$ ); culture ( $p = .77$ ). Importantly, however, one sample t-tests revealed that response patterns were far below chance for both agent conditions, self:  $t(64) = -11.01, p < .001$ ; other:  $t(66) = -23.79, p < .001$ , and 111 of the 132 children answered both control questions correctly. This indicates that children do not believe that people can simply choose to do impossible things, and they understood the structure of the questions. However, the few children who got this wrong were more likely to do so when asked about themselves than about others.

**2.2.2.2 Action Questions.** A 2(Culture: Chinese vs. U.S., between subjects) x 2(Agent: Self vs. Other, between subjects) x 2(Age: 4 vs. 6, between subjects) ANOVA on mean “choose to” responses yielded a main effect of agent condition,  $F(1, 125) = 14.39, p < .001, \eta_p^2 = .1$ , and a main effect of age,  $F(1, 125) = 6.83, p = .01, \eta_p^2 = .05$ . There was no cultural difference, ( $p = .88$ ). Children were more likely to say that other people ( $M = 1.43, SD = .8$ ) could act against their desires than that they themselves could ( $M = .91, SD = .84$ ). Older children ( $M = 1.35, SD = .77$ ) provided more “choose to” responses than younger children ( $M = 1, SD = .87$ ). Additionally, there



was a trending age by condition interaction,  $F(1,125)=3.79, p=.054, \eta_p^2=.03$ , suggesting that 4-year-olds might have a greater “other person bias” than 6-year-olds.

Comparisons to chance using one sample t-tests revealed that U.S 4-year-olds in the self-condition provided “choose to” answers significantly below chance,  $t(15)=-3.58, p=.003$ , and Chinese 4-year-olds answered significantly above chance in the other person condition,  $t(17)=2.41, p=.028$ . U.S. 6-year-olds provided “choose to” answers significantly more often than chance in the other person condition,  $t(17)=2.27, p=.015$ , as did Chinese 6-year-olds,  $t(16)=2.41, p=.029$ .

**2.2.2.3 Inhibition Questions.** A 2(Culture: Chinese vs. U.S., between subjects) x 2(Agent: Self vs. Other, between subjects) x 2(Age: 4 vs. 6, between subjects) ANOVA on mean “choose to” responses yielded a main effect of culture,  $F(1, 125)=25.34, p<.001, \eta_p^2=.17$ , and age,  $F(1, 125)=18.66, p<.001, \eta_p^2=.13$ . U.S. children ( $M=1.15, SD=.92$ ) provided more “choose to” answers than Chinese children ( $M=.46, SD=.7$ ), and 6-year-olds ( $M=1.11, SD=.88$ ) provided more “choose to” answers than 4-year-olds ( $M=.5, SD=.79$ ). There was no difference between conditions ( $p=.38$ ). A trending age by culture interaction,  $F(1, 125)=3.897, p=.051, \eta_p^2=.03$ , suggests that cultural differences increased with age.

One sample t-tests revealed that Chinese 4-year-olds provided fewer “choose to” answers than chance in both conditions: self  $t(16)=-3.05, p=.01$  and other  $t(17)=-7.71, p<.001$ , whereas U.S. 6-year-olds provided “choose to” responses at above chance levels in the other person condition,  $t(17)=5.1, p<.001$ .

**2.2.2.4 Qualitative Responses.** The overall number and percentage of each type of response given is presented in Table 2.2. A series of Fisher’s exact tests were used to test for cultural differences between the U.S. and Chinese children’s responses. Chinese data was compared to the coding presented in Kushnir *et al.* (2015).

Action Questions							
	Have to			Choose to			
	Internal	External	Other	Alternate Internal	Alternate External	Autonomy	Other
Chinese	24 (43.64%)	27 (49.09%)	4 (7.27%)	32 (40.51%)	41 (51.9%)	0 (0%)	6 (7.59%)
U.S.	33 (60.00%)	14 (25.45%)	8 (14.55%)	15 (19.48%)	34 (44.16%)	8 (10.39%)	20 (25.97%)
Inhibition Questions							
Chinese	65 (63.73%)	34 (33.33%)	3 (2.94%)	6 (18.75%)	20 (62.5%)	4 (12.5%)	2 (6.25%)
U.S.	27 (48.21%)	14 (25.00%)	15 (26.79%)	19 (25.00%)	28 (36.64%)	14 (18.42%)	15 (19.74%)

Table 2.2. Qualitative responses provided by children in Chapter 2, Experiment 1.

Qualitative responses for the “have to” answers are analyzed first. For action questions, there was a significant difference across cultures in the proportion of internal and external explanations (Fisher’s exact test,  $p=.03$ ). U.S. children were more likely to give internal reasons to explain why a person could not act against a desire, and Chinese children gave more external reasons. There was no cultural difference when inhibition and action question types were analyzed together ( $p=.21$ ), or when inhibition questions were analyzed alone ( $p=1.00$ ).

Children’s qualitative explanations for the “choose to” questions were analyzed next. There was no cultural difference in the proportion of alternate internal vs. alternate external explanations overall ( $p=.25$ ) or for action ( $p=.18$ ) and inhibition ( $p=.20$ ) questions individually. U.S. children provided a total of 96 alternate internal and alternate external explanations, and 22 autonomous explanations. Chinese children provided a total of 99 alternate internal and alternate external explanations, and 4 autonomous explanations. This difference was significant; U.S. children provided more autonomous explanations than Chinese children (Fisher’s exact test,  $p<.001$ ). Overall, 14.38% of U.S. children’s “choose to” responses were accompanied by an autonomous explanation, whereas only 3.6% of Chinese children’s were.

Ten out of 66 U.S. children (15.15%), six 6-year-olds and four 4-year-olds, and 3 of 67 Chinese children (4%), two 6-year-olds and one 4-year-old, provided at least one autonomous explanation. More U.S. children provided at least one autonomous explanation than Chinese children, (Fisher’s exact test,  $p=.04$ .)

To check that this difference was not a product of coding discrepancies across cultures, the two coders who coded the Chinese data recoded the U.S. data. Fisher’s exact tests again confirmed that this difference held across cultures. Using exactly the same coders, U.S. children provided more autonomous explanations than Chinese children overall ( $p<.001$ ). In addition, more U.S. children provided at least one autonomous explanation than Chinese children ( $p=.008$ ).

## **2.3 Experiment 2**

Chinese children provided fewer “choose to” responses than U.S. children for inhibition questions, but an equivalent number of “choose to” responses for action questions. One possibility is that the language used in the translations made Chinese children less likely to provide “choose to” answers overall. An additional set of control questions was designed to test this. Chinese children were asked if people could choose to perform physically possible actions if they wanted to. The question language mirrored that of Experiment 1.

### **2.3.1 Method**

Participants were 14 4-year-olds ( $M= 52$  months,  $Range= 47 - 58$  months) and 15 6-year olds ( $M= 74$  months,  $Range= 70 - 82$  months). An additional 9 participants were excluded due to

unknown birthdates ( $n=5$ ), incorrect age (experimenter tested 5-year-olds) ( $n=3$ ), experimenter error ( $n=1$ ), and incomplete audio file ( $n=1$ ).

All children participated in a warm-up phase that was identical to Experiment 1. Following this, children were asked 4 physically possible control questions: 2 questions about themselves and 2 about Nini. The order of the 4 questions, as well as whether the particular question was about Nini or the child, was randomized across participants. Questions asked if Nini or the child could *choose to* {sit in a chair/ step down a stair to get toys/ stand on tiptoes to reach a jacket/ walk from the kitchen to the living room} or if they *have to* {stand/ stay on the step/ leave the jacket there/ stay in the kitchen}.

### 2.3.2 Results

Children received a 1 for each “choose to” response and a 0 for each “have to” response. Children were assigned a score ranging from 0-4. A one-sample t-test revealed that children’s answers ( $M=3.83$ ,  $SD=.38$ ) were significantly above chance,  $t(28)=25.6$ ,  $p<.001$ . This held for each age individually: 4-year-olds,  $t(13)=19.14$ ,  $p<.001$ , and 6-year-olds,  $t(14)=16.84$ ,  $p<.001$ . Twenty-four of the 29 children answered all 4 questions correctly. These findings suggest that the cultural difference for the inhibition questions in Experiment 2 was not simply due to the phrasing of the questions. Chinese children were happy to say that an agent could choose to act when those choices did not conflict with the agent’s desires.

## 2.4 General Discussion

There were many similarities across cultures. Children from the U.S. and China ascribed similar amounts of choice to people for the action and physically impossible control questions. Both cultural groups at both ages consistently said that people could not choose to do things that are physically impossible, such as float in the air. In both cultures, children also believed that other people were more able to freely choose to act against their desires, than they were able to inhibit their desires. For example, both U.S. and Chinese children were more likely to say that people could choose to eat something they did not like than that they could choose to refrain from eating something they did like. Note that this was true even though the “have to not” question in the action case included a double negative and might have been more confusing than the simpler “have to” in the inhibition case. Across cultures, children also ascribed more choice to other people than to themselves for action questions.

There were similar developmental trends across cultures. Four-year-olds provided fewer “choose to” responses than 6-year-olds. Importantly, Chinese and U.S. 4-year-olds did attribute some choice to other people in the action cases and attributed more choice in the action cases than in the physically impossible cases. These findings show that the 4-year-olds’ responses were not due to a global tendency to select “have to” answers.

Children’s answers for the inhibition questions were different across cultures. Chinese children were less likely than U.S. children to say that people could choose to inhibit their desires. Chinese and U.S. children provided comparable answers for the action questions, and

Chinese children endorsed choice when asked the physically impossible control questions in Experiment 2. This suggests that the cultural difference was not due to an overall tendency for Chinese children to provide fewer “choose to” responses, or to the translation of the script.

Most of the children who provided “choose to” responses also provided alternate internal or alternate external explanations. Generally, children answered that people could choose to do otherwise in the sense that if their desires or circumstances were different, they might act differently. Children tended to postulate desires or circumstances that were different from those in the original vignettes. There was only one example, in either cultural group, where children justified a “choose to” answer by contrasting the specified desire with a second order desire or norm. One Chinese child said, “she likes it but there will be none left if she eats it.”

These responses do not indicate a fully autonomous understanding of free will. However, they might reflect an intermediate developmental stage in the progress towards an autonomous conception of free will. Indeed, in some philosophical accounts, the notion of free will reduces to this sense of “evitability” – i.e., the sense that choices could have been different (Dennett, 1984).

Some children provided explanations indicating that they view choice in a more philosophically controversial way, as causally autonomous. This notion of free will was significantly more prevalent in U.S. children’s responses (14% vs. 4% of “choose to” answers).

Two aspects of these results weigh against the idea that developments in the understanding of free will are simply the result of increased first-person experiences of self-control. First, children tended to attribute more choice to others than to themselves for the action questions. Second, Chinese children ascribed less choice for inhibition questions, yet test better than U.S. children on inhibitory control tasks (Lan *et al.* 2011; Sabbagh *et al.*, 2006).

While these results do not lend direct support for the simple first-person hypothesis, there may also be other explanations for this apparent incongruity between free will beliefs and self-control. First, neither Lan *et al.* (2011) nor Sabbagh *et al.* (2006) administered a measure of “hot” inhibitory control, such as a delay of gratification task. Second, we do not know how the actual children in this study would perform on executive functioning tasks. A good next step would be to ask children about their free will beliefs and measure their self-control abilities.

Alternatively, it is possible that broader cultural differences actually influence children’s understanding of self-control, which in turn influences their beliefs about free will. Rather than simply having a first-person experience of autonomous will, children’s understanding of their own and others’ abilities to control their actions might be influenced by cultural conceptions.

The canonical Western account of self-control envisions conflicts between desires and norms that are resolved by an autonomous agent – consider the classic picture of the agent with a devil on one shoulder and an angel on the other whispering opposing instructions. However, people could also view social and normative concerns as direct constraints on actions. Norms may simply override desires without the involvement of agency. Results from Chernyak *et al.* (2014) suggest that both younger children in the US and older children in Nepal may conceive of normative constraints in this way. In this study children said that an agent is not free to simply act against a norm. For example, children said that it would not be possible to choose to hurt another child’s feelings, or to choose to wear pajamas to school. If children in China understand self-control in this way, that is, as a direct application of social or normative constraints, rather than as the influence of norms on an autonomous agent, this might explain the apparent contradiction between their executive control abilities and their free will intuitions.

Inhibition questions were generally more difficult than action questions. This difficulty actually goes against at least Western adult intuitions – it would seem on the face of it easier to resist a tasty cookie than to actively eat an unpleasant one. This somewhat puzzling data pattern suggests that there might be some difference between inhibition and action that makes it more difficult for young children to imagine choice in situations of inhibition. There are several reasons why this could be the case. For example, the executive control literature suggests that inhibition may be particularly difficult for young children, which might suggest that there is indeed some contribution of first person experience to these responses. Cases of inhibition might also be more salient and unambiguous. There is also an asymmetry in whether the situation involves a desirable object, in the inhibition case, or an undesirable one, in the action case. This remains a question for further study.

It appears that children do not simply reflect on their own experience of self-control to create a concept of free will. On the other hand, it also appears that they do not simply internalize the conceptions of the culture around them. The developmental pattern where physical and epistemic constraints precede desire constraints, understanding others precedes understanding the self, and understanding action precedes understanding inhibition is common across cultures and does not seem to simply reflect the beliefs of either U.S. or Chinese adults.

However, it is not clear how adults in China and the U.S. would answer these questions. It is possible that adults within both cultures hold similar beliefs. It is also possible that cultural differences continue on into adulthood. Several studies have found cultural differences in adults' beliefs about social causation and choice (Markus & Kitayama, 1991; Miller, Das & Chakravarthy, 2011; Morris & Peng, 1994; Savani, Markus, Naidu, Kumar & Berlia, 2010).

These results underscore the complexity of everyday free will beliefs. Previously, philosophers and psychologists have debated whether the strongest intuitions of free will are really widespread among ordinary people, and if they are ultimately accurate. Studying the development of free will intuitions across cultures suggests that ideas about free will can vary in important and illuminating ways. Children develop an understanding of physical, epistemic, social and motivational constraints on free will at different times, and this developmental progression varies in different cultures. Similarly, we saw differences in the ways that children treat cases of inhibition versus cases of action, and cases that involve the self-versus cases that involve others. All this suggests that coming to an understanding of free will is a complicated and protracted process, which involves combining the experience of the self and others, as well as incorporating cultural conceptions. Our adult understanding of free will is not simply the result of either first-person experience or cultural internalization.

## **Chapter 3. The relationship between beliefs about free will and the development of self-control: A cross-cultural comparison of U.S. and Peruvian Children**

### **3.1 Introduction**

The paradox of free will has long interested philosophers and more recently has gained traction with psychologists. On the one hand, we conceive of ourselves as agents with free will, and individuals who can intentionally decide to control their actions. On the other hand, we believe that actions are caused by preceding factors, such as our desires. Self-control is one example of this paradox. Adults often believe that people possess self-control and can freely choose to override their desires (Wente, Zhao, Gopnik, Kang, & Kushnir, forthcoming). However, in reality, self-control is quite difficult- if self-control was simply a matter of exercising free choice, then substance abuse, gambling, weight loss, or budgeting would not present such difficulties.

While the paradox of free will may feel intractable, it actually raises a number of practical empirical questions for developmental psychologists, primarily why do we believe that we have free will and what are the developmental origins of these beliefs? Thinking more specifically about cases of self-control, it seems feasible that free will beliefs about self-control could stem from our actual experience with exercising self-control. Alternatively, these beliefs may stem from exogenous sources. If so, they should be acquired during childhood and may covary with cultural philosophies of agent causation. A third possibility, which we argue for in the present paper, is that cultural notions of agency shape the experience of self-control, which in turn shapes the relationship between first person experiences with self-control and beliefs about free will. In the present study, we explore the development of free will beliefs in Peruvian and U.S. children. In particular, we measure the impact of first person experiences with self-control on corresponding beliefs about free will and explore if the relationship between beliefs and abilities is similar across cultures.

Central to most philosophical definitions of free will is the ability to choose to do otherwise, such as choosing to act against your own desires. For example, if wanted a cookie, and ate one, could you have also chosen to not eat that cookie? This conception of free will is relevant to self-control, which by definition involves overriding alternative desires. The studies in the present paper center around this definition of free will. We explore when and how children come to believe that they can act in ways that override their own desires.

From an early age, children view desires as constraining or causing actions. Infants and toddlers believe that people act congruently with their desires. They also understand that desires

vary from person to person and they can accurately infer another person's desires after witnessing their actions (Kushnir, Xu, & Wellman, 2010; Repacholi & Gopnik, 1997; Wellman, & Woolley, 1990). With age, children develop more complex beliefs about agent causation. By the preschool years, children understand that beliefs, in addition to desires, guide actions, and that people can hold false beliefs, or beliefs that differ from one's own (see Wellman & Liu, 2004 for review). These developing intuitions about agency are commonly referred to as a 'theory of mind.'

Beliefs about choice and free will are an additional, and lesser studied, component of theory of mind. Adults believe that actions are guided by desires, however many adults also believe that people can use free will to override their desires, and act in opposition to them (Wente, et al., forthcoming). In this sense, free will or choice, can be viewed as an added component to the causal chain that extends between desires and actions, a component that can be independently manipulated to cause a change in outcome.

Young children have basic intuitions about choice and free will. Four-year-olds, from different cultural backgrounds, believe that people cannot 'choose to do otherwise' when actions are physically constrained and thus impossible; for example, they believe that people cannot simply 'choose to' walk through a brick wall or float in the air. However, they do believe that people could have chosen to do otherwise when actions are simple and unconstrained, such as choosing to step down from a stool, rather than stepping up onto a stool (Kushnir, Gopnik, Chernyak, Seiver, and Wellman 2015). A growing body of evidence suggest that young children's intuitions about these more straightforward choices are similar across cultures (Chernyak, Kang, & Kushnir, under revision; Wente, Bridgers, Zhao, Seiver, Zhu & Gopnik, 2016; Zhao, Kang, Wente, Gopnik, Zhu & Kushnir, 2017).

Beliefs about self-control, however, are more developmentally and culturally complex. It is not until 6 years of age that U.S. children reliably state that people can 'choose to' act in opposition to their desires (e.g. choose to not eat a tasty cookie or choose to eat a disgusting cracker). Earlier than this, children tend to believe that people have no choice but to act consistently with their desires (e.g. people have to eat a cookie if they want to). Furthermore, there is cultural variation in when these beliefs develop, with studies finding that children tested in China and Singapore endorse less free will to practice self-control than U.S. children (Chernyak, Kang, & Kushnir, in press; Kushnir et al., 2015; Wente et al., 2016; Zhao, et al. 2017). These cross-cultural findings are particularly interesting, given that both Chinese and Singaporean children have been shown to score higher on measures of executive functioning, which generally encompasses self-control, than U.S. children (Lan, Legare, Cameron Ponitz and Morrison, 2011; Sabbagh, Xu, Carlson, Moses and Lee, 2006).

Recently, one cross-cultural study directly compared U.S., Chinese, and Singaporean children on a set of self-control tasks and inhibitory control tasks, as well as measured their beliefs about free will. In this study, researchers found no differences in self-control performance across the three cultures (Zhao et al., 2017). Even so, Singaporean children reported weaker beliefs about the free will to practice self-control than Chinese and U.S. children. These findings could indicate that beliefs and experience do not necessarily align.

How can we account for the conceptual change in free will beliefs as well the cultural differences in the developmental timeline? Intuitively, it seems that free will beliefs about self-control could stem from actual changes in children's capacity to practice self-control. A large body of literature has documented developmental improvements in self-control during early

childhood (e.g. Carlson, 2010; Carlson & Moses, 2001; Mischel, 2014; Oh & Lewis, 2008). Children may be more likely to endorse the ability to freely practice self-control as they get older simply because they are actually better at practicing self-control.

However, as explained above, cross-cultural comparisons suggest a lack of correspondence between beliefs about free will and children's self-control capacity- if free will beliefs solely stemmed from first person experiences with self-control, we would expect Singaporean, Chinese, and U.S. children to hold equally strong beliefs about free will, indeed, the development of these beliefs might even be accelerated in Chinese and Singaporean children, who often show better inhibitory control. However, experimental evidence suggests the opposite of this pattern. One explanation for these findings is that beliefs about self-control and free will stem from exogenous sources, rather than from developing self-control capacities. Free will beliefs could be influenced by, or even originate from, more tacit cultural notions around agency. The self-construal framework (Markus & Kitayama, 1991) holds that people from more individualistic cultures more frequently view their actions as stemming from internal causes (such as free will), while people from more interdependent cultures more frequently view their actions as stemming from external causes, such as social or normative considerations. In line with this perspective, several studies have found that adults' beliefs about choice and agent causation vary accordingly across cultures (Kitayama, Snibbe, Markus, & Suzuki, 2004; Kokkoris, Kuhnen & Yan, 2013; Miller, Das & Chakravarthy, 2011; Morris & Peng, 1994; Savani, Markus, Naidu, Kumar & Berlia, 2010). As a result, culturally defined notions of agency could directly shape the development of children's beliefs, and cause divergence across cultures, regardless of children's actual first-person experiences with self-control.

However, an explanation for the cross-cultural disconnect between beliefs and abilities may not be so straight forward. Cultural beliefs about agency could themselves influence children's experience of self-control which in turn could influence their concept of free will, as argued by Wenthe et al. 2016. If Western children experience their self-control as internally caused and autonomously guided, then they may perceive their first-person experiences with self-control as evidence that is relevant for conceptions of free will. As Western children get older, they may more readily endorse the free will to practice self-control because they are actually getting better at practicing self-control, and, also relative to children with a more interdependent mindset, they more readily incorporate their first-person experiences with self-control into their overarching beliefs about free will. On the other hand, children from more interdependently minded cultures, such as Singapore and China, may frequently view and experience their self-control as externally caused. Children, in particular, may often believe that adults (or other societal norms or general routines) shape their actions. If this is so, children may frequently achieve self-control without the perceived exercise of free will. As a result, children from more interdependently minded cultures, such as China and Singapore, may be less likely to use their first-person experiences with self-control to shape their overarching beliefs about free will. This could cause cultural differences in the timing in which children develop beliefs about free will, regardless of their capacities for self-control; children from more interdependently minded cultures may require more evidence or different evidence than Western children to form a fully-fledged belief in free will. In the present paper we explore this possibility. We measure how much beliefs about free will and self-control are shaped by first person experiences, and if the relationship between the two is consistent across U.S. and Peruvian children.



Some experimental evidence supports the notion that self-control is perceived and experienced differently across cultures. Previous studies on free will (Kushnir et al., 2015; Wentz et al., 2016; Zhao et al., 2017) have asked participants to explain why they could or could not choose to practice self-control. For example, if a participant said that they could ‘choose to not’ eat a cookie, the experimenter asked them, “Why can you choose to not eat a cookie?” Results indicated that some participants, most commonly U.S. 6-year-olds and adults, do endorse a stronger, and more philosophically controversial notion of complete autonomy. These participants indicated that choice can be used to override or shape desires. For example, one child said, “You can choose to not eat a cookie even if you want to.” Other participants provided responses more congruent with notions of scientific determinism. These participants stated hypothetical adjustments or addendums to the experimenter’s story, which would then logically change an individual’s desires, and ultimately cause them to act differently. For example, when asked why someone could eat something that they did not like, children responded, “Maybe she’s curious” and “What if it’s yummy?” In previous studies, adults and children from the U.S. provided the purely autonomous category of responses more frequently than adults and children from China (Kushnir et al. 2015; Wentz et al., 2016; Wentz, et al., forthcoming). These results indicate that there are differences across cultures in beliefs about choice and agency and support the notion that culture impacts people’s causal representations of self-control.

Additional evidence comes from a recent study by Zhao and colleagues (2017). Zhao, et al. (2017) directly measured Chinese, Singaporean and U.S. children’s beliefs about free will and self-control, and how it relates to children’s developing inhibitory control abilities. Inhibitory control tasks included two measures of self-control: a toy sort task and a gift wrap task. In this study, U.S. children’s beliefs about self-control did correlate with their inhibitory control scores. U.S. children who scored higher on inhibitory control also held stronger beliefs about free will and self-control. No correlations were observed for Singaporean and Chinese children. One interpretation of these findings is that U.S. children’s first-person experiences with self-control shapes their beliefs about free will, and as a result there is a correspondence between their beliefs and abilities. However, in this study, children were asked about another individual’s ability to practice free will, rather than their own ability to do so. It would seem more likely that first-person experiences with self-control would shape first person free will beliefs and this link remains unexplored. Furthermore, the results were correlational, and thus provide only weak evidence for a causal relationship in either direction.

Other experimental work has documented cultural differences in children’s behavior while exercising self-control. Lamm, Keller, Teiser, Gudi, Yovsi, Freitag, et al. (2017) conducted the classic marshmallow experiment comparing German and Nso children from Cameroon. They found that children from the two backgrounds exhibited very different patterns of behavior during the delay. German children tended to display more self-distraction and motor activity, such as turning away from the treat or walking away. Cameroonian children, on the other hand, tended to down regulate their behavior, and displayed less motor activity. Some even fell asleep during the delay. This finding is broadly in line with the hypothesis presented above- the idea that culture impacts how self-control is experienced and achieved. As a result, culture could mediate the influence of self-control experience on beliefs about free will.

In the present study, we explore the relationship between first-person experience with self-control and beliefs about free will across cultures. Peruvian and U.S. children were asked to

complete two types of measures. They were asked to complete two self-control tasks (toy sort and gift wrap tasks) and were asked questions to gauge their beliefs about free will.

While previous studies on free will have sampled children from China, Singapore, Nepal, and the U.S., and found variation across cultural groups (Chernyak, Kushnir, Sullivan, and Wang, 2013; Chernyak, Kang, & Kushnir, in press; Kushnir, et al., 2015; Wente et al., 2016; Zhao, et al., 2017), no studies have sampled children from Peru. Peruvian children were tested as part of a broader effort to extend developmental research to an underrepresented population of children. Recently much attention has been drawn to the lack of sampling diversity within the social sciences. A recent review of literature found that less than 1% of studies sampled children from South or Central America. Comparatively 90.53% sampled children from W.E.I.R.D. cultures (western, educated, industrialized, rich and democratic) (Nielsen, Haun, Kärtner, Legare 2017). Furthermore, Central and South America are quite culturally diverse, with Peru containing a host of more remote indigenous Andean, and Amazonian subcultures, as well as a variety of European-Amerindian and Amerindian subcultures within the urban areas. In fact, the authors are unaware of any published developmental psychology research published prior to 2017 sampling children from the specific population tested in the present study- lower class urban Andean-Amerindian children. Given this lack of previous research, the Peruvian comparison was exploratory.

In the present study, we measured children's beliefs about their own ability to freely practice self-control, using a measure developed by Kushnir et al (2015). These same children completed two self-control tasks, a gift wrap task and a toy sort task. Children were divided into two conditions: they either answered the free will (self-control) questions first or completed the self-control tasks first. This allowed us to explore possible carry over effects between the two types of tasks, and to help distinguish causality from correlation. Additionally, children completed the classic Piagetian conservation of number task. This, in addition to age, was used to partial out any covariance between tasks that could be attributed to general developmental change.

There are several possible outcomes for the present study. One possibility is that experience will shape subsequent beliefs about self-control, however it is also possible that asking children to think about free will or self-control could shape their subsequent performance on the self-control tasks. In line with this second possibility, research with adults and children suggests that mindset impacts self-control (Haimovitz, Dweck, & Walton, 2015; Job, Dweck, Walton, 2010; Savani & Job, 2017). If self-control experience shapes subsequent beliefs, there should be a relationship between measures for children who completed the self-control tasks first, but not those who answered the free will questions first. If beliefs about free will influence self-control ability, we should see the opposite pattern. Alternatively, both tasks could have a causal influence on each other, or a third variable could account for both beliefs and abilities. If so, a relationship between the measures should be observed for children in both conditions. Finally, there may be no relationship between the two types of measures.

Cross-cultural comparisons of Peruvian children can answer two types of developmental questions about free will. The first question is if and when the Peruvian children come to endorse a belief in the free will to practice self-control. As noted above, previous cross-cultural studies have found that these beliefs do frequently differ across cultures, however previous studies have not explored the development of free will beliefs in Peruvian children. Another question is if the relationship between beliefs and abilities is consistent across the two cultures. On one hand, the

relationship between measures could be similar in Peru and the U.S. If so, this will support the cross-cultural robustness and replicability of study findings. On the other hand, we may observe very different trends across cultures; it is possible that we will observe a relationship between measures for the U.S. children, but not the Peruvian children. This would corroborate findings from Zhao et al. (2017).

## 3.2 Experiment 1

### 3.2.1 Methods

**3.2.1.1 Participants.** Experiment 1 included 149 4- and 5-year-olds ( $M$  age = 5.01,  $range$  = 3.92- 6.02) from the U.S. Seventy-six children completed the self-control tasks first ( $M$  age = 4.99,  $range$  = 3.92- 6.02) while 73 answered the free will and conservation questions first ( $M$  age = 5.03, and  $range$  = 4.08- 5.97). Additionally, 4 U.S. children were tested and not included in this final sample. Two were dropped due to experimenter error, and 2 due to a lack of English language fluency.

Children were tested at university affiliated preschools, or other private preschools in the San Francisco Bay Area. Most children were from a middle- or upper middle-class background and represented the diversity of the local area.

**3.2.1.2 Stimuli.** For the toy sort task, the experimenter used 3 clear bins, labeled with a green, red, or blue sticker. They also used 18 toys, each labeled with a green, red or blue sticker (6 of each color). During the gift wrap task, the experimenter wrapped a clear plastic rattle in green tissue paper. During the free will task, the experimenter used small white pieces of paper to draw food and activities that children liked and disliked. For conservation of number, the experimenter used 10 U.S. pennies.

**3.2.1.3 Procedure.** Children were tested in private office spaces at their school. Children were placed into one of two conditions based on the order in which they completed the tasks (self-control tasks first, or free will questions and conservation of number first). Within each of these two conditions, the order of the two self-control (gift wrap and toy sort) tasks was also counterbalanced, as was the order of the free will and conservation of number tasks. The order in which the individual free will test items were asked was also counterbalanced.

**3.2.1.3.1 Free Will Task.** This task was modeled after Kushnir et al. (2015). Children first completed a warm up phase, where they answered some basic questions about choice (“Can you just choose to turn invisible?”, “Can you just choose to run faster than a train?”, “Can you just choose to smile?”, “Can you just choose to turn your skin the color green?”). If children incorrectly answered any of these questions they were prompted by the experimenter until they gave a correct response. This was to ensure that children understood that questions should be answered according to real life possibilities rather than pretense.

Following this initial warm up phase, children were presented with 8 test vignettes. These included 4 experimental and 4 control questions. Two *impossible control* questions asked

children if they could do impossible actions (“Can you just choose to float in the air, or do you have to come down?” and, “Can you just choose to walk through the brick wall, or do you have to walk around it?”), whereas 2 *possible control* questions asked children if they could do simple and unconstrained actions (“Can you just choose to walk from the kitchen to the living room, or do you have to stay in the kitchen?” and “Can you just choose to walk down the stairs, or do you have to stay standing at the top of the stairs?”). These questions ensured that children, in general, understood the language and structure of the experimental questions, and were willing to provide both response types when questions were clear and straight forward. Control questions also provide a baseline measurement of expected noise and can also be used to validate the translation of the measure to Spanish, as the language and structure was consistent across control and experimental questions.

Experimental questions asked children if they could act in opposition to their desires, e.g. practice self-control. The experimenter first prompted children to name a food and activity that they liked and disliked. Then the experimenter drew the items, and asked children if they could choose to act in opposition to their desires. For example, if a child said they really liked cookies, the experimenter drew a cookie on a piece of paper, then asked the child, “Can you just choose to not eat the cookie, or do you have to eat the cookie?” The experimenter alternated between stating the ‘choose to’ or ‘have to’ option first. For example, alternatively they might say, “Do you have to eat the cookie, or can just choose not to?” There were 4 questions total, two of which asked children if they could refrain from doing something or eating something that they liked. These are termed *inhibition* questions. The other 2 asked children if they could do or eat something that they do not like. These are termed *action* questions. Examples of the control and experimental vignettes are listed in Table 3.1. All control and experimental questions included a phrase stating that the participant’s parents said either option was ok. This was to remove any external constraints caused by their parents’ general preferences, and prompt children to answer in accordance with their perceived internally driven self-control abilities.

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### Definitions and Examples of Test Questions

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Question Type	Definition	Example Questions
Possible Control	Asks children if they can ‘choose to’ engage in simple actions	“So, let’s say that you are standing in the kitchen and there’s a doorway into the living room. You don’t want to be in the kitchen, you want to be in the living room. And your parents say it’s okay for you to go into the living room or not. Can you choose to go into the living room or do you have to stay in the kitchen?”
Impossible Control	Asks children if they can ‘choose to’ do physically impossible actions	“You know how every time you jump up in the air, you always come back down. Let’s say that today you want it different. You want to just float in the air, not touching anything. You don’t ever want to come back down. And your parents say it’s okay for you to float in the air or not. Can you just choose to float in the air, or do you have to come back down?”

Inhibition	Asks children if they can ‘choose to’ refrain from eating/ doing something that they want to do.	“Can you think about something fun that you really like to do? What’s something that you really want to do?” (e.g. child says “playing with blocks”). “OK, so let’s pretend this is you and these are your blocks. You really like playing with blocks, you think playing with blocks is a lot of fun. And your parents say it’s okay for you to play with your blocks or not. Can you just choose not to do play with your blocks, or do you have to play with them?”
Action	Asks children if they can ‘choose to’ eat something/ do something they do not like	“Can you think of a food that you really don’t like? What is a food you really think tastes yucky?” (e.g. child says “peppers”). “OK, let’s pretend that peppers are right here on the table. You really don’t like eating peppers; you think peppers taste really yucky. And your parents say it’s okay for you to eat the peppers or not. Can you just choose to eat the peppers, or do you have to not eat them?”

Table 3.1. Definitions and examples of the free will experimental and control questions.

**3.2.1.3.1.1 Qualitative Responses.** As in previous studies, children were prompted to provide qualitative responses after providing a ‘choose to’ or ‘have to’ response. For example, if a child responded that they could choose to not eat a cookie, the experimenter asked them, “Why can you choose to not eat a cookie?” If children provided a ‘have to’ response, responses were coded as internal, external, or other. If children provided a ‘choose to’ response, responses were coded as alternate internal, alternate external, autonomous, or other. Definitions and examples are given in table 3.2.

**3.2.1.3.2 Toy Sort.** Developed by Denham, Warren-Khot, Bassett, Wyatt, and Perna (2012), children were presented with 3 clear bins, each labeled with 1 of 3 sticker colors (red, green, or blue). Then the experimenter poured 18 toys on the table, while exclaiming, “Oh no! My toys are all a mess! We can’t play with them right now, but I need you to help me pick them up and put them where they belong.” Then the experimenter explained that the toys, which also contained blue, red or green stickers, needed to be placed in the bin with the matching sticker color. The experimenter told children when to begin picking up the toys. The primary measurement was if children played with any of the toys while they were picking them up.

**3.2.1.3.3 Gift Wrap.** Developed by Kochanska, Murray, Jacques, Koenig, and Vandegest (1996), children were told that the experimenter had a surprise for them but needed to wrap it before they gave it to them. Then children were instructed to turn 90 degrees, and not look while the experimenter wrapped the surprise. The experimenter spent 1 minute wrapping the surprise. The surprise was a noisy rattle wrapped in neon green tissue paper. The experimenter measured if the children peeked while the toy was being wrapped. Note that this task was very difficult for children; the stimuli was quite noisy, and the 90-degree angle made it easy for children to peek at the flashy surprise by simply moving their eyes.

**“Have to”**

	<b>Explanation of Code</b>	<b>Example Responses</b>
<b>Internal</b>	Mental factors that constrain choice, such as beliefs, desires or other psychological factors.	<i>“I don’t like it.”</i> <i>“Cause you don’t want to.”</i> <i>“Because I want to play with my friend.”</i> <i>“Because I love it.”</i>
<b>External</b>	Constraints on choice that are external to the mind. These include physical, biological, or social factors.	<i>“Because it’s so fun.”</i> <i>“It’s dirty.”</i> <i>“Because it’s yucky.”</i> <i>“Or else you waste them.”</i>
<b>Other/ I don’t know/ No response</b>		

**“Choose to”**

<b>Alternate Internal</b>	Hypothetical internal conditions that facilitate the alternative (undesirable) response, such as a person’s beliefs, desires or other psychological characteristics.	<i>“If you wanted to.”</i> <i>“... when I’m excited I don’t want to eat them.”</i> <i>“Because you might not want to.”</i> <i>“Cause Care Bear movies I thought were fun before I watched it.”</i>
<b>Alternate External</b>	Hypothetical external conditions that facilitate the alternative (undesirable) response, generally reference physical, social, or biological factors.	<i>“Cause it’s good for you.”</i> <i>“Cause they don’t taste yummy anymore.”</i> <i>“Because what if I’m not hungry.”</i> <i>“If they are sitting out on the table all night they would be bad for you to eat.”</i>
<b>Autonomy</b>	A person holds the ability to ‘choose to’ act in opposition to their desires independent of internal or external factors.	<i>“Because it’s your own mind.”</i> <i>“Because it’s yourself and you can just choose what you want to do.”</i> <i>“Because I can control my body.”</i> <i>“I can choose whatever I want to do with my body.”</i>
<b>Other/ I don’t know/ No response</b>		

Table 3.2. Definitions and examples of qualitative response categorization.

**3.2.1.3.4 Conservation of Number.** Originally developed by Piaget (1968), children were shown two rows containing 5 pennies a piece. The procedure began with pennies equally spaced across the two rows. The experimenter asked, “Does this row have more pennies? Does this row have more pennies? Or do they both have the same number of pennies?” while pointing to the appropriate row(s). Then the rows were expanded and contracted so that one row was longer than the other, however the two still contained an equal number of pennies. The experimenter gave the same prompt. This was done one more time, resulting in a total of 3 prompts. Children were scored on if they stated that the rows contained an equal number of pennies, or if they believed that one row had more pennies than the other.

**3.2.1.4 Coding.** All data was coded by the experimenter and a second coder, when possible, from video. Discrepancies were resolved by a third coder. Agreement for all dependent measures was above 80%. Qualitative responses were transcribed from video. Qualitative responses were classified by a primary bilingual coder. A subset of data (57 children, or 228 responses) was coded by a second coder. The two coders agreed on 91.67% of classifications. Discrepancies were resolved through a meeting between the two coders and the first author. The primary coder then went on to complete coding for experiments 1, 2 and 3.

## 3.2.2 Results

**3.2.2.1 Free Will Scores: Control Questions.** Children were assigned a 1 for each 'choose to' response given and a 0 for each 'have to' response. First, we explored children's responses to the control questions. For the two *possible control* questions, 134 of 148 children, or 93.7%, (1 child was not asked this question) responded that they could choose to walk from the kitchen to the living room, and 128 of 149, or 85.9%, responded that they could choose to step down the stairs. The mean 'choose to' score was 1.77 ( $SD = .5$ , scale= 0-2). A one-sample t-test confirms that this is significantly above chance,  $t(147) = 18.89, p < .0001$ . For the *impossible control* questions, 32 of 149 children, or 21.48%, responded that they could choose to float in the air, and 46 of 149 children, or 30.9% responded that they could choose to walk through a brick wall. The mean impossible control score was .52 ( $SD = .65$ , scale= 0-2). A one-samples t-test confirms that this is significantly below chance,  $t(148) = -8.9, p < .0001$ . A paired- samples t-test confirms that children answered the impossible and possible control questions differently,  $t(147) = 18.6, p < .0001$ . This suggests that, in general, children understood the language and phrasing of the control questions, which mirrors that of the experimental questions.

**3.2.2.2 Free Will Scores: Experimental Questions.** Next, we analyzed children's responses to the experimental questions. For the inhibition questions, 81 of 149, or 54.4% of children stated that they could choose to refrain from eating a desirable food, and 83 of 149, or 55.7% said they could choose to refrain from engaging in a desired activity. The mean inhibition score was 1.1 ( $SD = .86$ , scale- 0-2). For the action questions, 73 of 149 (or 49%) children stated that they could choose to eat an undesirable food, while 75 of 149 (or 50.3%) stated that they could choose to engage in an undesirable activity. The mean action score was .99 ( $SD = .88$ , scale= 0-2). The mean 'choose to' score for all 4 experimental questions was 2.09 ( $SD = 1.52$ , scale= 0-4). A paired samples t-test confirmed that there was no significant difference between children's responses to the action and inhibition questions,  $t(148) = 1.53, p = .128$ .

Next, data was split by order: free will questions first or self-control tasks first. For the free will first group, the mean 'choose to' score was 2.23 ( $SD = 1.56$ , scale= 0-4). The mean inhibition score was 1.19 ( $SD = .88$ , scale= 0-2) and the mean action score was 1.04 ( $SD = .89$ , scale=0-2). For children who completed the self-control tasks first, the mean 'choose to' score was 1.96 ( $SD = 1.47$ , scale=0-2). The mean inhibition score was 1.01 ( $SD = .84$ , scale=02) and the mean action score was .95 ( $SD = .88$ , scale= 0-2). Independent- samples t-tests compared children's overall scores across these two orders. Results suggest no overall differences in children mean 'choose to' responses for the experimental questions based on task order ( $t(147) =$

1.1,  $p = .275$  for total choose to score;  $t(147) = .65$ ,  $p = .518$  for action questions;  $t(147) = 1.27$ ,  $p = .206$  for inhibition questions).

**3.2.2.3 Qualitative Responses.** Each of the 149 children were prompted to provide four qualitative responses, one for each of the experimental questions. This resulted in a total of 596 qualitative responses. Of these, 284 followed a ‘have to’ response and 312 followed a ‘choose to’ response. Looking only at the explanations that followed a ‘have to’ responses, 124 (or 43.7%) provided responses categorized as external, 118 (or 41.5%) provided responses categorized as internal, and 42 (or 14.8%) provided responses categorized as other. Looking only at the explanations that followed the ‘choose to’ responses, 117 (37.5%) were categorized as alternate external, 78 (25%) were categorized as alternate internal, 12 (3.8%) were categorized as autonomous choice, and 105 (33.7%) were categorized as other. Additional analyses are located after Experiment 3.

**3.2.2.4 Self-Control Scores.** Sixty-one, or 40.9% (of 149) children played with at least 1 toy during the toy sort task, and 102, or 68.5%, (of 149) children peeked during the gift wrap task. 27 of 149 children (or 18.1%) passed both self-control tasks, 81 (or 54.4%) passed 1 task, and 41 (or 27.5%) failed both tasks. Splitting the data by condition (free will questions first vs. self-control tasks first), reveals that for children who answered the free will questions first, 16 of 73 children (or 21.9%) passed both tasks, 37 (or 50.07%) passed 1 task, and 20 (or 27.4%) failed both tasks. For children who completed the self-control tasks first, 11 of 76 (or 14.5%) passed both tasks, 44 (or 57.9%) passed 1 task, and 21 (or 27.6%) failed both tasks. Across both tasks, children failed an average of 1.09 self-control tasks ( $SD = .67$ , scale = 0-2). An independent samples t-test indicates no effect of task order on overall self-control performance,  $t(147) = .697$ ,  $p = .487$  (mean self-control score for children who answered the free will questions first = 1.05,  $SD = .7$ ; mean self-control score for children who completed the self-control tasks first = 1.13;  $SD = .64$ ).

**3.2.2.5 Conservation of Number.** Children answered 3 conservation of number questions. Children received a 1 for each correct answer, and a 0 for each incorrect answer. The mean score was 1.64 ( $SD = .94$ , scale = 0-3).

**3.2.2.6 Relationship Between Measures.** Next, we explored the relationship between measures. First, we conducted a partial correlation between the self-control scores (scale = 0-2; 2 = failed both tasks, 1 = passed 1 task, and 0 = passed both tasks) and the free will ‘choose to’ scores (scale = 0-4, with higher scores indicating a stronger belief in free will) while controlling for children’s age and conservation score. Results revealed a significant correlation between beliefs and self-control abilities,  $r(144) = -1.73$ ,  $p = .036$ .

Next, we split the data by task order (free will questions first vs self-control tasks first). This analysis was used to explore if one task had a causal influence on the other task. For example, answering the free will questions first could shape children’s self-control performance. If so there should be a correlation for those children who answered the free will questions first. Alternatively, the immediate and salient experience of success or failure at self-control could shape children’s beliefs about their own abilities. If so, there should be a correlation for those children who completed the self-control tasks first.



Splitting the data by task order, and controlling for age and conservation scores, revealed a significant correlation for the children who completed the self-control tasks first,  $r(72) = -.333$ ,  $p = .004$ . However, there was no significant correlation for children who answered the free will questions first,  $r(69) = -.05$ ,  $p = .677$ . (An identical analysis was conducted excluding children who provided incorrect responses to 3 or 4 of the control questions, and results were similar). Thus, it appears that immediate first-person experience with self-control shaped children's beliefs about their free will to practice self-control.

To further explore this, we conducted a Univariate ANOVA with free will score as the dependent variable, self-control score (passed 2 tasks vs. passed 1 task vs. failed both tasks), and task order (free will questions first vs. self-control tasks first) as predictor variables, and age and conservation scores as covariates. Age significantly predicted children's beliefs about self-control,  $F(1, 141) = 6.19$ ,  $p = .014$ . Conservation score also significantly predicted children's beliefs about free will,  $F(1, 41) = 8.28$ ,  $p = .005$ . Self-control score was not a significant predictor,  $F(2, 141) = 2.19$ ,  $p = .115$ . Task order was also not a significant predictor,  $F(1, 141) = 1.79$ ,  $p = .183$ , however the interaction between task order and self-control score was significant,  $F(2, 141) = 3.21$ ,  $p = .043$ .

To explore this interaction, the data was split by task order, and 2 Univariate ANOVAs were conducted using free will score as a dependent variable, self-control score as a predictor variable, and age and conservation score as covariates. For children who answered the free will questions first, conservation of number significantly predicted their beliefs about self-control,  $F(1, 68) = 9.22$ ,  $p = .003$ . No other predictors were significant (age  $F(1, 86) = .83$ ,  $p = .366$ ; self-control score,  $F(1, 68) = .505$ ,  $p = .606$ ). For children who completed the self-control portion first, age predicted free will beliefs,  $F(1, 71) = 5.78$ ,  $p = .019$ , as did self-control score  $F(2, 71) = 9.43$ ,  $p = .008$ . Again, this suggests that completing the self-control tasks directly before answering the free will questions altered children's free will beliefs, however answering the free will first questions did not affect performance on the self-control tasks.

Finally, we were curious if the experience of success or failure differentially altered children's responses. To explore this, data was split by self-control score. Independent-samples *t*-tests were used to explore the responses children gave to the free will questions and compared children who answered the free will questions first to those who completed the self-control tasks first. This allowed us to use the free will first group as a baseline to measure the effects of self-control on beliefs. For children who passed both self-control tasks, the mean free will score for the children who answered the free will questions first was 2.25 ( $SD = 1.84$ ) whereas the mean score for children who completed the self-control tasks first was 2.45 ( $SD = 1.51$ ). This difference was not significant,  $t(25) = -.304$ ,  $p = .764$ . For children who failed both tasks, the mean free will beliefs score for the children who answered the free will questions first was 2.35 ( $SD = 1.63$ ) whereas the mean score for children who completed the self-control tasks first was 1.14 ( $SD = 1.35$ ). This difference was significant,  $t(39) = 2.59$ ,  $p = .014$ . Thus, it appears that passing both tasks did not significantly increase children's tendency to endorse free will, however failing both tasks reduced children's belief in free will- see Figure 3.1.

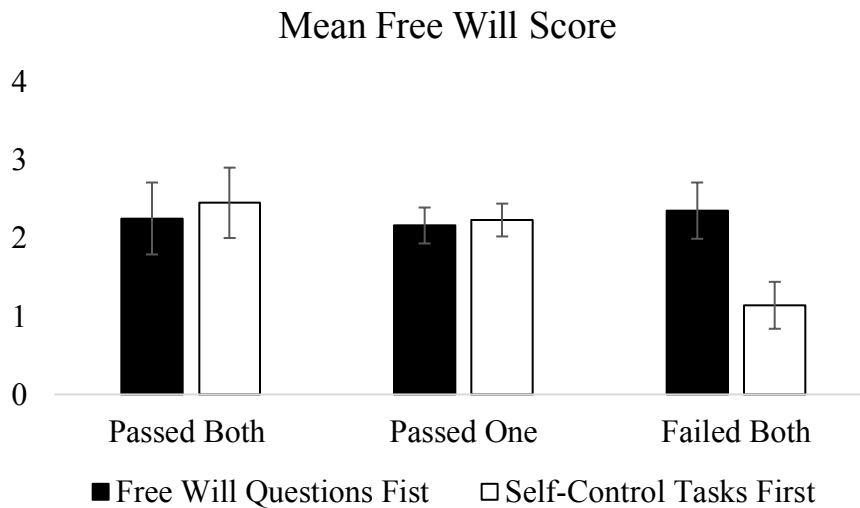


Figure 3.1. Children’s mean free will score by condition (free will questions first vs. self-control tasks first) and self-control score (passed both tasks vs. passed one task vs. failed both tasks). Results indicate that failing both tasks reduced children’s subsequent beliefs about their own free will,  $t(39)= 2.59, p=.014$ .

### 3.2.3 Experiment 1 Discussion

Experiment 1 indicates that experience shaped children’s subsequent beliefs about free will and self-control. This lends support to the idea that beliefs about free will are shaped by first person experiences with self-control, at least for children in the U.S.

In Experiment 1, we saw that recent failure at self-control reduced children’s subsequent beliefs about free will, however there is no indication that success increased children’s belief in free will or caused them to endorse free will. Given this, it seems possible that a belief in free will stems solely from external sources- such as culturally transmitted notions of agency. However, this conclusion is premature given that there are several alternative explanations for this asymmetry between success and failure.

One possibility is that failure is a more salient experience than success. If this is so, follow-up studies could attempt to make successful experiences more salient for children, then measure if that enhances children’s beliefs about free will. In this scenario, failure could be more salient for a number of reasons. One possibility is that this asymmetry between success and failure is underpinned by an error in children’s expectations- perhaps children went into the self-control tasks expecting success and were surprised when they failed. This unexpected failure could have had a strong impact on subsequent beliefs because it was surprising for children. Another possibility is that the tasks were really difficult for the children; less than 20% of children actually passed both tasks. Perhaps, after children failed the tasks they realized how difficult self-control actually is, and this led children to report that they could not practice self-control in a future hypothetical situation. A third possibility is that children viewed their self-control on these tasks as being externally caused; the experimenter did instruct children to practice self-control. If

so, it may follow that children believed they were successful because they had no choice but to follow the experimenter's instructions, rather than because they practiced free will. However, if children failed, they may have viewed this failure as an internal breakdown of their self-control. In fact, in previous studies, children have been more likely to attribute failure at self-control to internal factors, such as preferences or desires, and success at self-control to external sources (Kushnir et al. 2015; Wentz et al. 2016).

Regardless, it is clear that there is some impact of experience on free will beliefs for U.S. children, and in particular failure seemed to reduce children's subsequent belief in free will. This corroborates findings from Zhao et al. (2017), where correlations between inhibitory control and free will beliefs were observed for U.S. children but not for Chinese or Singaporean children. In Experiment 2, we extend our research to a novel population of children from Peru. Given the exploratory nature of this research, Experiment 2 serves as an initial pilot study to gather baseline data on Peruvian children's beliefs about free will and their self-control abilities.

## 3.3 Experiment 2

### 3.3.1 Methods

**3.3.1.1 Participants.** Experiment 2 included 16 Peruvian 4- and 5-year-olds ( $M$  age = 5.04,  $Range$  = 4.32 to 5.89). Peruvian children were recruited and tested at Innova schools in Lima, Peru. Innova schools is a chain of private schools that serves families from emerging middle-class backgrounds (families transitioning from lower SES to middle SES). Schools were located in lower income neighborhoods in central Lima, or in the outskirts of the city. Most children were second or third generation internal immigrants from the Andean highlands and are from indigenous familial backgrounds.

**3.3.1.2 Translation.** Materials were translated from English to Spanish then back translated by bilingual members of the research team, including an experienced Peruvian linguist who specializes in language acquisition. For the free will questions, "have to" was translated to "tienes que" were as "just choose to" was translated to "puedes simplemente escoger".

**3.3.1.3 Procedure.** Children were tested in a private office in their school. Study procedures were identical to those in Experiment 1, however the experiment was conducted in Spanish.

### 3.3.2 Results

**3.3.2.1 Free Will Results.** Children answered 4 control questions and 4 experimental questions. Children were given a 1 for each 'choose to' response and a 0 for each 'have to' response.

Control questions were again divided into *impossible* and *possible* control questions. Thirteen (of 16) children stated they could 'choose to' walk from the kitchen into the living

room, and 11 (of 16) children said they could ‘choose to’ walk down the stairs. For the possible control questions, the mean ‘choose to’ score was 1.5 (or 75%,  $SD = .51$ ). A one-sample t-test confirms that this is significantly above chance,  $t(15) = 3.16, p = .006$ . For impossible control questions, 2 (of 16) children stated they could choose to float in the air, and 7 (of 16) said they could choose to walk through a brick wall. The average ‘choose to’ score for the impossible control questions was 0.56 (or 28%,  $SD = .63$ ). A one-sample t-test confirms that this is significantly below chance,  $t(15) = -3.42, p = .004$ . A paired samples t-test confirms that the difference between the two question types was also significant,  $t(15) = 4.04, p = .001$ , indicating that children differentiated between possible and impossible questions.

Similar to previous studies, conducted in various countries, Peruvian children reliably responded that people could choose to do simple unconstrained actions, but could not choose to do impossible ones. This suggests that Peruvian children sufficiently understood the structure and phrasing of the control questions, which was identical to that of experimental questions.

Children were asked 4 experimental questions. Very few ‘choose to’ responses were given, a total of 6 across all 4 of the questions (64 questions total; 9% of total responses). No child provided more than 1 choose to response. Three children responded that they could choose to eat a food that they did not like. Otherwise, 1 ‘choose to’ response was given for each of the other 3 question types. Children’s choose to responses ( $M = .38, SD = .62, \text{scale} = 0-4$ ) were significantly below chance (2),  $t(15) = -10.4, p < .0001$ .

While shockingly few Peruvian children endorsed free will, relative to the above age matched U.S. sample, similar cultural differences have been documented in previous studies comparing U.S. children to Chinese, Nepalese, and Singaporean children.

**3.3.2.2 Self-Control Tasks.** Children were scored on if they peeked during the gift wrap task, as well as if they played with any of the toys during the toy sort task. Seven of 16 (43.8%) children played with at least 1 toy during the toy sort task, and 12 of 16 children (75%) peeked during the gift wrap task. Six children failed both tasks (37.5%), 7 children failed one task (50%), and 3 children passed both tasks (12.5%).

**3.3.2.3 Conservation of Number.** Children answered 3 conservation of number questions, and were assigned a score of ‘1’ for each correct response given (that the rows had an equal number of pennies), and a ‘0’ for each incorrect response given. The mean score was 1.56 (scale = 0-3;  $SD = .81$ ).

### 3.3.3 Experiment 2 Discussion

Experiment 2 provides a baseline for Peruvian 4- and 5-year-olds self-control beliefs, as well as data on their self-control and conservation of number abilities. These results suggest that self-control beliefs are extremely weak in Peruvian 4- and 5-year-olds, and that Peruvian 4- and 5-year-olds tend to believe that they have to act consistently with their desires. Notably, however, they did provide accurate responses to the control questions, which contained identical language and structure. Furthermore, Peruvian children were willing to provide ‘choose to’ responses when asked if they could perform simple and unconstrained actions, like walking into the living room. This suggests that they did understand the questions asked, and the structure and

translating did not bias them into providing ‘have to’ responses. Moreover, children’s performance on the self-control tasks and conservation tasks was comparable to that of the U.S. children. Given this, it appears that Peruvian 4- and 5-year-old children view desires as strong constraints on their actions.

Because of the lack of variation in responses from Peruvian children, we decided to test a slightly older sample of Peruvian children in Experiment 3. Previous research with Chinese and U.S. children suggests that, with age, children begin to endorse beliefs about self-control (Kushnir et al. 2015; Wentz et al., 2016). Six- and 7-year-old Peruvian children were sampled in Experiment 3. This age range was chosen because we believed there would be a reasonable amount of variance in children’s responses to both the free will questions and self-control tasks.

## 3.4 Experiment 3

### 3.4.1 Methods

**3.4.1.1 Subjects.** Participants included 100 Peruvian 6- and 7-year-olds ( $M$  age= 7.07,  $range$ = 6.03- 7.99). Fifty of these children completed the self-control tasks first ( $M$  age= 7.11,  $range$ = 6.03- 7.99), and 50 completed the free will tasks first ( $M$  age= 7.02,  $range$ = 6.03- 7.99). Two additional Peruvian children were excluded from analysis due to experimenter error. Children were recruited and tested at the same locations as in Experiment 2.

**3.4.1.2 Procedure.** The study procedures were identical to Experiment 2.

### 3.4.2 Results

**3.4.2.1 Control Questions.** Again, children were assigned a score of 0 for each ‘have to’ response and a 1 for each ‘choose to’ response. Eighty-seven (87%) children stated that they could not choose to float in the air, and 83 (83.8%, one child was not asked this question) stated that they could not choose to walk through a brick wall. The mean impossible control score was .29 ( $SD$ = .54,  $scale$ = 0-2). A one-samples t-test confirms that this is significantly different from chance,  $t(98)$ = -13.05,  $p$ <.0001.

For the possible control questions, 92 (92%) children stated that they could choose to walk from the kitchen to the living room, and 81 (81%) stated that they could choose to walk down the stairs. The mean score for the possible control questions was 1.73 ( $SD$ = .45,  $scale$ = 0-2). A one-samples t-test confirms that this is significantly above chance,  $t(99)$ = 16.36,  $p$ <.0001.

A paired samples t-test confirms that children answered the impossible and possible control questions differently,  $t(98)$ = 19.17,  $p$ <.0001. Taken together these results suggest that children believed that they cannot choose to do impossible actions, however can choose to do possible actions. Again, it also suggests that children understood the language and phrasing of the test questions, and that items were translated appropriately.

**3.4.2.2 Experimental Questions.** For the inhibition questions, 28 (28%) children responded that they could choose to inhibit themselves from performing a desirable activity, and 24 (24%) stated that they could choose to inhibit themselves from eating a desirable food. The mean ‘choose to’ score for inhibition questions was .52 ( $SD = .76$ , scale= 0-2). A one-samples t-test confirms that this is significantly below chance,  $t(99) = -6.33$ ,  $p < .0001$ . For the action questions, 36 (36%) children stated they could choose to perform an undesirable action, and 50 (50%) stated they could choose to eat a food they did not like. The mean action score was .86 ( $SD = .78$ , scale= 0-2). This did not significantly differ from chance,  $t(99) = -1.8$ ,  $p = .075$ . A paired-samples t-test confirms that children did provide ‘choose to’ responses significantly more often for the action questions than for the inhibition questions,  $t(99) = 3.73$ ,  $p < .001$ . The mean ‘choose to’ score across the 4 self-control questions was 1.38 ( $SD = 1.24$ , scale= 0-4). An independent samples t-test indicated that children who completed the self-control tasks prior to answering the free will questions provided significantly more ‘choose to’ responses ( $M = 1.64$ ,  $SD = 1.24$ ) than those who did the reverse ( $M = 1.12$ ,  $SD = 1.19$ ),  $t(98) = 2.14$ ,  $p = .035$ . This trend was also significant when looking at only the inhibition questions (free will first group:  $M = .36$ ,  $SD = .66$ ; self-control first group:  $M = .68$ ,  $SD = .82$ ),  $t(98) = 2.15$ ,  $p = .034$ , but not when looking at the action questions (free will first group:  $M = .76$ ,  $SD = .8$ ; self-control first group:  $M = .96$ ,  $SD = .75$ ),  $t(98) = 1.29$ ;  $p = .2$ .

**3.4.2.3 Qualitative Responses.** Each of the 100 children were prompted to provide four qualitative responses, one for each of the experimental questions. This resulted in a total of 400 qualitative responses. Two hundred and two of the qualitative responses were preceded with a ‘have to’ response where as 138 were preceded with a ‘choose to’ response. For the ‘have to’ responses, 132 (50.4%) of children’s qualitative responses were categorized as external, 105 (40.1%) were categorized as internal, and 25 (9.5%) were categorized as other. For the ‘choose to’ responses, 88 (63.8%) were categorized as alternative external, 16 (11.6%) were categorized as alternative internal responses, 2 (1.4%) were categorized as autonomous choice responses, and 32 (23.2%) fell into the other category. Analyses of qualitative responses are presented after Experiment 3.

**3.4.2.4 Self-Control Scores.** Twenty-five (25%) children played with at least one toy during the toy sort task, and 34 (34%) peeked during the gift wrap task. Fifty-eight children (58%) passed both tasks, 25 (25%) failed 1 task, and 17 (17%) failed both tasks. The mean self-control score across both tasks was .59 ( $SD = .77$ , scale= 0-2, with higher scores indicating weaker self-control). An independent samples t-test indicated that there was no effect of task order on self-control performance,  $t(98) = 1.44$ ,  $p = .152$ .

**3.4.2.5 Conservation of Number.** The mean conservation score was 1.95 ( $SD = .98$ , scale= 0-3). One child did not complete the conservation task.

**3.4.2.6 Relationship Between Measures.** First, we conducted a partial correlation between the self-control scores (scale= 0-2; 0= passed both, 1= passed 1 task, and 2= failed 2 tasks) and the free will ‘choose to’ scores (scale= 0-4, higher scores indicate greater endorsement of choice) while controlling for children’s exact age and conservation score. There was not a significant correlation between self-control abilities and free will beliefs,  $r(95) = -.128$ ,  $p = .21$ .

Next, we split the data by task order (free will questions first vs. self-control tasks first) to explore possible carry over effects from one task to another, also controlling for children's age and conservation scores. The correlations again did not approach significance for either order (free will questions first,  $r(45) = -.166$ ,  $p = .265$ , self-control tasks first,  $r(46) = -.093$ ,  $p = .529$ ).

Next, we conducted a Univariate ANOVA with free will score as the dependent variable, self-control score (passed 2 tasks vs. passed 1 task vs. failed both tasks), and task order (free will questions first vs. self-control tasks first) as predictor variables, and age and conservation scores as covariates. Task order was significant,  $F(1, 91) = 4.97$ ,  $p = .028$ . As discussed above, the free will score was higher for children who completed the self-control tasks prior to answering the free will questions (mean free will score = 1.64,  $SD = 1.24$ ) than for children who did the reverse (mean free will score = 1.12,  $SD = 1.19$ ). No other variables approached significance (self-control score,  $F(2, 91) = .77$ ,  $p = .465$ ; conservation of number,  $F(1, 91) = 1.33$ ,  $p = .251$ ; age,  $F(1, 91) = .56$ ,  $p = .456$  and interaction between self-control score and task order,  $F(2, 91) = 1.77$ ,  $p = .302$ ).

### 3.4.3 Experiment 3 Discussion

Peruvian children displayed strong self-control abilities yet displayed weak beliefs about their own free will. The majority of children passed both self-control tasks (58%), however children provided 'choose to' responses for only 34.5% of the experimental self-control questions. Importantly, however, children stated that people could not choose to do impossible actions but could choose to do simple unconstrained actions. Given that the question structure and language was identical across control and experimental questions, it seems that children understood the phrasing and intent of the experimental questions, and actually believed that they cannot 'choose to' act inconsistently with their desires. Unlike Experiment 1, there was no evidence for a relationship between beliefs about free will and self-control experience.

Experiment 3 also yielded some additional trends worthy of discussion. First, Peruvian children provided 'choose to' responses more frequently for action questions than for inhibition questions. This trend was observed by Wente et al. (2016), when asking Chinese and U.S. children these same questions. This suggests that, cross-culturally, children may come to endorse stronger beliefs about self-control for cases of action (eating or doing something undesirable) than for cases of inhibition (refraining from eating or doing something desirable). Another finding from Experiment 3 was that children held stronger beliefs about self-control after completing the self-control tasks. One interpretation of this finding is that completing the self-control tasks actually caused children to endorse free will. However, this seems unlikely given that correlations were not observed at the individual level. Given the lack of corroboration across analyses, and the relatively weak  $p$  value ( $p = .035$ ), it is highly possible that this was a spurious result.

Looking across the three experiments presented in this paper, there appears to be several noteworthy trends, both developmental and cross cultural. Next, we conduct a series of cross-experiment analyses to explore trends across groups of children.

## 3.5 Cross-Experiment Data Analyses and Discussion

### 3.5.1 Cross-cultural comparisons of Peruvian and U.S. 4- and 5-year-olds.

Data sets from 4- and 5-year-olds from the U.S. and Peru were combined to explore cross-cultural trends. First, we look at children's responses to the experimental free will questions. The mean 'choose to' score for U.S. children was again 2.09 ( $SD= 1.53$ , scale= 0-4) and the mean score for the Peruvian children was .38 ( $SD= .62$ , scale= 0-4). An independent samples t-test confirms that the Peruvian children provided significantly fewer 'choose to' responses than the U.S. children  $t(38.94)= 8.66$ ,  $p<.0001$ . Note that Levene's test for equality of variance indicated unequal variance,  $F= 21.59$ ,  $p<.0001$ , so the degrees of freedom were adjusted from 163 to 38.94. There was not a significant difference across cultures for the control questions (possible control,  $t(17.06)= 1.66$ ,  $p=.116$ , again Levene's test indicated unequal variance,  $F= 5.15$ ,  $p=.025$ , so degrees of freedom were adjusted from 162 to 17.06; impossible control,  $t(163)= .231$ ,  $p=.818$ ).

Next, we looked at children's performance on the self-control measures. In the U.S., the mean self-control score was 1.09 ( $SD= .67$ , scale= 0-2 with higher scores indicating worse self-control). In Peru, the mean self-control score was 1.19 ( $SD= .75$ ). This difference was not significant,  $t(163)= .524$ ,  $p=.601$ . There was also no difference across cultures on the conservation of numbers task, with U.S. children scoring 1.64 ( $SD= .94$ , scale= 0-3) and Peruvian children scoring 1.56 ( $SD= .81$ ),  $t(163)= .335$ ,  $p= .738$ .

Results indicate that U.S. and Peruvian children scored comparably on the self-control tasks, the conservation of number task, and the control questions of the free will task. Peruvian children, however, provided significantly fewer 'choose to' responses to the experimental questions, suggesting that they are less likely than U.S. children to believe that they can 'choose to' act inconsistently with their own desires, even though children were *actually* equally good at practicing self-control across cultures.

### 3.5.2 Developmental Trends in Peruvian Children.

Data sets from Experiments 2 and 3 were contrasted to explore developmental trends in Peruvian children. First, we explored children's beliefs about free will using their total 'choose to' responses from the four experimental questions. An independent samples t-test compared the younger group (4s-5s) with the older group (6s-7s). Again, the mean 'choose to' score for the younger group was .38 ( $SD=.63$ , scale= 0-4). For the older group, the mean 'choose to' score was 1.38 ( $SD=1.24$ , scale= 0-4). This difference was significant,  $t(37.95)= 5.07$ ,  $p<.0001$ , indicating that Peruvian children are more likely to endorse the free will to practice self-control with age. Note that Levene's test for equality of variance indicated unequal variance,  $F= 9.93$ ,  $p=.002$ , so degrees of freedom were adjusted from 114 to 37.95.

Next, we looked at children's scores on the self-control tasks. Again, the mean self-control 'fail' score for the younger group was 1.19 ( $SD= .75$ , scale= 0-2 with higher scores indicating worse self-control) and the mean score for the older group was .59 ( $SD= .77$ ). An independent samples t-test reveals that the older children displayed better self-control on the toy



sort and gift wrap tasks than the younger children,  $t(114) = 2.9, p = .004$ , suggesting that as Peruvian children get older, they become better at practicing self-control.

One final independent samples t-test contrasted children on the conservation of numbers task. The average score for the younger Peruvian children was 1.56 ( $SD = .81$ , scale = 0-3) and the average score for the older Peruvian children was 1.95 ( $SD = .98$ ). This difference did not reach significance,  $t(22.72) = -1.71, p = .101$ . Levene's test for equality indicated unequal variance, so degrees of freedom were adjusted from 113 to 22.72.

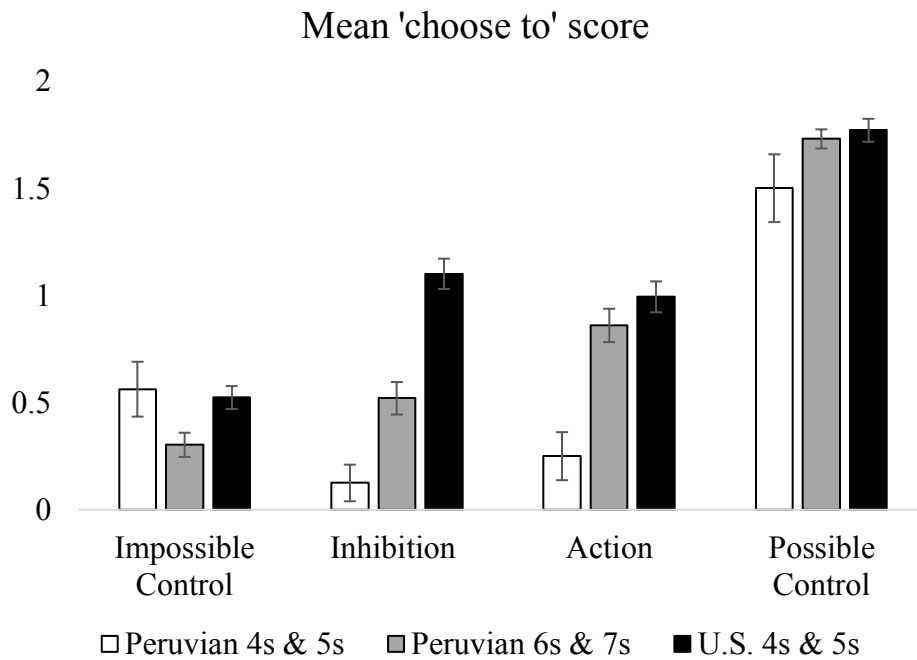


Figure 3.2. Average 'choose to' scores given by children from Experiments 1, 2 and 3. Error bars represent one standard error of the mean.

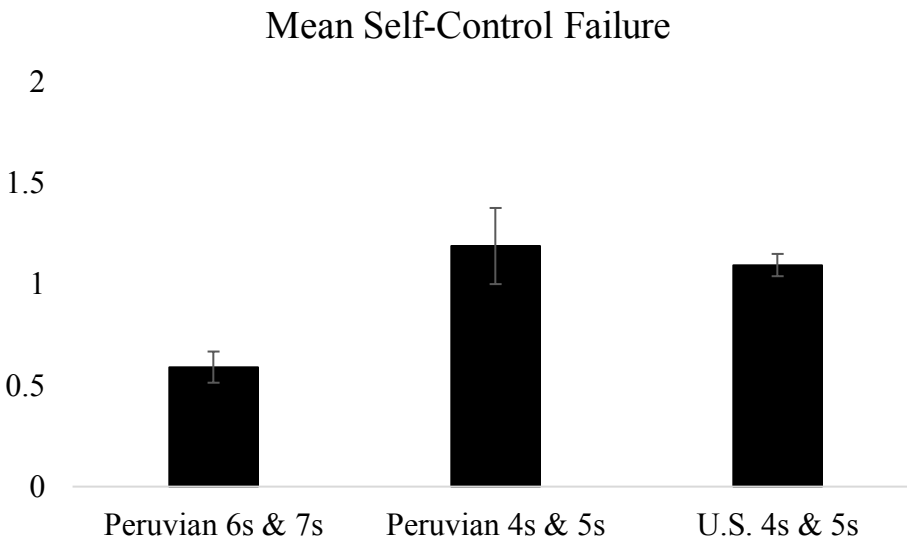


Figure 3.3. Mean number of children who failed the two self-control tasks. Higher scores indicate more self-control failure. Error bars indicate one standard error of the mean.

### 3.5.3 Comparison of U.S. 4-and 5-year-olds and Peruvian 6-and 7-year-olds.

Finally, we contrasted children from Experiments 1 and 3, to explore trends in self-control beliefs and abilities across cultures. In addition, given the small sample in our pilot study of 4-and 5-year-olds in Peru, we wanted to confirm the result with the much larger sample of 6-7-year-olds. If the older children in Peru still provided fewer choose to responses than the younger US children, that would confirm the findings we observed with the younger children.

On average, U.S. 4-and 5-year-olds provided 2.09 ( $SD= 1.52$ , scale= 0-4) ‘choose to’ responses, and Peruvian 6-and 7-year-olds provided an average of 1.38 ( $SD= 1.24$ ) ‘choose to’ responses when asked the experimental questions. An independent samples t-test confirmed that younger U.S. children provided significantly more ‘choose to’ responses than older Peruvian children  $t(237.7)= 4.07$ ,  $p<.0001$  (Levene’s test for equality of variance indicated unequal variance,  $F= 11.31$ ,  $p=.001$ , so degrees of freedom were adjusted from 247 to 237.7). This trend held for the inhibition questions (mean U.S. score= 1.1,  $SD= .53$ ; mean Peruvian score= .52,  $SD= .76$ , scale= 0-2),  $t(247)= 5.47$ ,  $p<.0001$ , however it did not hold when looking at action questions (mean U.S. score= .99,  $SD= .88$ ; mean Peruvian score= .86,  $SD= .78$ ),  $t(229.13)= 1.26$ ,  $p=.211$ . Again, the Levene’s test for equality of variance indicated unequal variance,  $F= 4.9$ ,  $p=.028$ , so degrees of freedom were adjusted from 247 to 229.13).

In contrast, the older Peruvian children, however, responded more accurately to the impossible control questions (mean= .3,  $SD= .56$ , scale= 0-2) than the younger U.S. children (mean= .52,  $SD= .65$ ),  $t(230.22)= 2.83$ ,  $p=.005$  (Levene’s test for equality of variance indicated unequal variance,  $F= 12.61$ ,  $p<.001$  so degrees of freedom were adjusted from 246 to 230.22). Children answered the possible control questions comparably across groups (mean U.S. score=

1.77,  $SD = .5$ ; mean Peruvian score = 1.73,  $SD = .45$ , scale = 0-2),  $t(246) = .65$ ,  $p = .515$ . These results indicate that children were equally likely to provide ‘choose to’ responses when asked if they can choose to engage in simple unconstrained actions such as walking from their kitchen to their living room, however the older Peruvian children were more likely than the younger U.S. children to respond that people cannot choose to do impossible actions if they want to, such as float in the air or walk through a solid brick wall.

Moreover, while the older Peruvian children were less likely to state that they can ‘choose to’ practice self-control, particularly inhibition-oriented self-control, they did display more advanced performance on the conservation of numbers and self-control tasks than the younger U.S. children. In the U.S., children, on average, failed 1.09 ( $SD = .67$ , scale = 0-2) of the self-control tasks, whereas the Peruvian children failed an average of .59 ( $SD = .77$ , scale = 0-2) of the self-control tasks,  $t(192.91) = 5.34$ ,  $p < .0001$  (Levene’s test for equality indicated unequal variance,  $F = 12.45$ ,  $p < .001$ , so degrees of freedom were adjusted from 247 to 192.91). The older Peruvian children also performed significantly better than the younger U.S. children on the conservation of number task (mean Peruvian score = 1.95,  $SD = .98$ ; mean U.S. score = 1.64,  $SD = .94$ ),  $t(203.12) = 2.44$ ,  $p = .016$ . Levene’s test for equality indicated unequal variance,  $F = 4.08$ ,  $p = .045$ , so degrees of freedom were adjusted from 246 to 203.12.

Finally, we compared the qualitative responses children provided across cultures. To do so, we first split responses by culture (Peru and the U.S.) as well as by preceding response (‘choose to’ and ‘have to’). Within each of these groups, we then created a ratio composed of the total number of target responses given by the total number of remaining responses given. For example, 284 explanations given by U.S. children were preceded with a ‘have to’ response. Of the 284, 118 explanations were coded as internal. Therefore, the ratio for U.S. children who provided internal responses after a ‘have to’ response was calculated as 118:166. Ratios were conducted for each of the 7 answer types and 2 cultures- resulting in a total of 14 ratios. These ratios were then used to conduct a series of Fisher’s exact tests to compare children across cultures. This resulted in a total of 7 cross-cultural comparisons. To account for the multiple comparisons, Bonferroni’s correction was applied, and the significance threshold was adjusted from .05 to .007. A summary of findings is presented in Table 3.3.

	Have to			Choose to			
	Internal	External	Other	Alternate Internal	Alternate External	Autonomy	Other
<b>U.S. 4s and 5s</b>	118 (41.5%)	124 (43.7%)	42 (14.8%)	78 (25%)	117 (37.5%)	12 (3.8%)	105 (33.7%)
<b>Peruvian 6s and 7s</b>	105 (40.1%)	132 (50.4%)	25 (9.5%)	16 (11.6%)	88 (63.8%)	2 (1.4%)	32 (23.2%)
<b>Fisher’s Exact</b>	$p = .728$	$p = .123$	$p = .068$	$p = .001$	$p < .0001$	$p = .244$	$p = .027$

Table 3.3. Summary of qualitative explanations given by U.S. 4- and 5-year-olds and Peruvian 6- and 7-year-olds.

Using this adjusted significance threshold, we found two significant differences across the two cultures. Both of these differences were found when children provided ‘choose to’

responses prior to providing qualitative explanations. We found that Peruvian children were significantly more likely than U.S. children to provide external qualitative explanations,  $p=.001$ , when explanations were preceded with a ‘choose to’ response. Conversely, Peruvian children were also less likely than U.S. children to provide qualitative explanations categorized as internal  $p<.0001$  when children’s explanations were preceded by a ‘choose to’ response. No other responses were significant. In sum, this suggests that when Peruvian children stated ‘choose to’ they were less likely to attribute choice and self-control to internal factors than were U.S. children, and instead attributed choice to external factors, relative to U.S. children.

### **3.6 General Discussion**

In this paper, we present a series of studies exploring children’s beliefs about free will—particularly the free will to practice self-control, and how this relates to children’s first-person experiences practicing self-control. Cross-cultural investigations were conducted to explore the relationship between self-control beliefs and self-control abilities. Several previous cross-cultural studies have found that free will beliefs differ across cultures, with U.S. children expressing stronger intuitions about free will than Chinese, Singaporean, and Nepalese children (Chernyak, et al., 2013; Chernyak, Kang, & Kushnir, in press; Kushnir, et al., 2015; Wentz et al., 2016; Zhao, et al., 2017). In this paper, we found that U.S. children also express stronger intuitions about the free will to practice self-control than Peruvian children.

In the present studies, cross-cultural comparisons of Peruvian and U.S. children provide strong evidence that self-control beliefs and actual abilities may not always align. We found that U.S. children endorsed stronger intuitions about their own abilities to practice self-control, compared to Peruvian children, however, when ages were matched, children scored comparably on self-control tasks across cultures. Furthermore, contrasting the older 6- and 7-year-old Peruvian children with the younger 5- and 6-year-old U.S. children, indicates that U.S. children hold stronger intuitions about their own abilities to freely practice self-control than Peruvian children, even though they are actually worse at practicing self-control, when self-control is measured by the toy sort task and gift wrap task. This finding is in line with results from Zhao et al (2017). In this study, researchers found that U.S., Singaporean, and Chinese children scored similarly on measures of inhibitory control, however Singaporean children had weaker intuitions about the ability to freely practice self-control.

In the introduction of this chapter we stated 2 possible explanations for an incongruence between beliefs and abilities. One possibility is that beliefs about free will are not grounded in first person experiences with self-control but are culturally transmitted. The second possibility is that culture impacts the way that self-control is experienced, and this in turn shapes the development of free will beliefs differentially across cultures. Results from the present study provide some support for this second hypothesis. In the present study, there was a correlation between free will beliefs and abilities in the U.S., and the results also indicated that experience with self-control altered U.S. children’s subsequent beliefs about free will. In contrast there was no relationship between the two measures for the Peruvian children. Additionally, qualitative responses indicate that Peruvian children were more likely to attribute their self-control to external factors, whereas U.S. children were more likely to attribute self-control to internal factors.

Taken together, this suggests that there is some degree of cultural variance in how self-control is experienced, and this in turn could gradually cause divergence in free will beliefs over the course of time. Specifically, U.S. children may more frequently view their self-control as internally caused, by other preferences or desires for example, and more frequently update their free will beliefs after they exercise self-control. Peruvian children may more frequently believe their self-control is due to external factors, like parental rules or social norms, and, as a result, are less likely to incorporate their experiences into their free will beliefs. Differences in the degree that children attribute acts of self-control to internal explanations could explain why the development of free will beliefs is accelerated in U.S. children relative to Peruvian children, as well as why children from both cultures do increasingly endorse free will with age. However, the current investigation only partially supports this hypothesis; a relationship between measures was only observed for children who failed at self-control. Children did not adjust their beliefs after success. This leaves open the question of where these beliefs originate from, and if free will beliefs do actually stem from first person experiences.

It is possible that beliefs about free will originate from culturally transmitted notions of agent causation. Indeed, the lack of evidence for the first-person hypothesis renders this a strong possibility. Perhaps support for a belief in free will initially stems from exogenous source and is later fine-tuned as first-person experience accumulates.

Another possibility is that free will beliefs are premised on first person experiences with self-control, and this could be the case for children across cultures, but the present paper may lack support for this due to methodological limitations. One limitation of the present study is that the self-control tasks had a strong external component. The experimenter asked children to practice self-control, and children may have not perceived much choice when doing so. This could theoretically impact children differently across cultures. Children holding a more interdependent self-construal may have been more strongly impacted by external constraints on their actions than children holding a more independent self-construal. As a result, children with more interdependent mindsets may have less readily incorporated this experience into their beliefs about free will. Currently, it is unknown how the Peruvian children tested in the present studies would score on measures of self-construal, however, given the present results it seems possible that these children hold a more interdependent mindset than the U.S. sample.

This interpretation could also explain the asymmetry between success and failure observed in the U.S. sample. Perhaps many children viewed success as externally prompted by the experimenter, and thus failed to alter their beliefs about free will in accordance with their success. Failure, on the other hand, may have been viewed as an internal breakdown of their own free will to act in opposition with their desires, and thus shaped subsequent responses to the free will questions. One good next step would be to conduct a similar study but replace the self-control tasks with a self-control task that is more internally driven, such as the classic marshmallow experiment.

Another limitation of the present paper is that few Peruvian children failed both self-control tasks; this smaller number of children, in addition to a weaker baseline for free will beliefs, could explain why there was no relationship between measures in Peru. Given this, one important next step would be to test a similar sample of Peruvian children but select self-control tasks that are more challenging.

### 3.7 Conclusion

The present chapter provides several important contributions to the study of free will and self-control. First, in the present investigations we found that Peruvian children were much less likely than U.S. children to state that people can simply ‘choose to’ act inconstantly with their desires. However, beliefs in free will increase with age. These findings are consistent with several other cross-cultural studies on free will beliefs. Given the large cultural differences observed between Peruvian and U.S. children, one good next step would be to explore free will beliefs in Peruvian and U.S. adults. It is possible that this difference persists into adulthood, or, alternatively, adults across cultures may come to hold comparable beliefs about free will.

Second, we found that Peruvian children were more likely than U.S. children to attribute acts of self-control to external factors. U.S. children more frequently believed that their self-control was internally caused. Previous studies have found that individuals from independent cultures more readily attribute social causation to internal factors, whereas individuals from interdependent cultures more frequently attribute the causes of actions to external or contextual factors. This may suggest that the Peruvian children we tested hold a more interdependent self-construal, however further investigation of this would be useful.

Third, we found that U.S. children’s beliefs about free will are shaped by their first-person experiences with self-control. Children who failed both self-control tasks were less likely to endorse free will if they failed the tasks prior to answering the free will questions. This indicates that beliefs about free will are, to some extent, impacted by the experience of self-control. Interestingly, however, there was little evidence that first person experience with successful self-control causes children to hold a belief in free will or accelerates the development of free will beliefs.

Finally, the present study indicates that the relationship between experience and beliefs could be different across cultures. Results indicate a correlation between U.S. children’s beliefs and abilities, however we did not find this correlation in the Peruvian sample. This finding is similar to that of Zhao et al. (2017) where a relationship between beliefs and abilities was observed for U.S. children, but not for Chinese and Singaporean children. Future research can more specifically explore why this might be the case, and if similar results would be obtained using different self-control tasks.

## **Chapter 4. Young children are wishful thinkers: Cross-cultural and cross-SES evidence for an early optimism bias**

### **4.1 Introduction**

A large body of research suggests that people often hold unrealistically positive expectations about their future (e.g., Armor & Taylor, 1998; Sharot, 2012; Sharot, Korn, & Dolan, 2011; Sheppard, Klein, Waters, & Weinstein, 2013; Weinstein, 1980), a phenomenon described as an ‘optimism bias’ or ‘unrealistic optimism’. Within this broad body of research, some research specifically suggests that desires influence adults’ and older children’s predictions – termed “the desirability bias”, or “wishful thinking” (see Krizan & Windschitl, 2007; 2009 for review). In the present paper, we explore wishful thinking in young children, ages 3 to 7, from Peru and the U.S.

For decades researchers have documented a link between preferences and expectations (Granberg & Brent, 1983; Hayes, 1936; Ogburn, 1934; Wann & Dolan, 1994). For example, Granberg and Brent (1983) tallied survey data across 8 presidential elections and found that 4 out of 5 U.S. adults believed their preferred presidential candidate would win. In another study, Weinstein (1980) measured college students’ beliefs across a variety of situations, finding that students often overestimated their own likelihood of positive future events, while underestimating the likelihood of negative ones (relative to estimates made about another person). Example items included liking their future job, owning their own home, traveling to Europe, becoming an alcoholic, committing suicide, and having a heart attack. Since this time, the optimism bias has become a popular area of research within the social sciences, with a 2011 review paper reporting over 900 published papers on the topic (Shepperd, Klein, Waters, & Weinstein, 2011).

People may hold optimistic expectations for a number of different reasons. For example, in the case of the presidential elections, people may choose a presidential candidate because they believe that candidate will win. Another possibility is that peoples’ presidential preferences, as well as their election expectations, could be driven by a third variable, such as their knowledge of the candidates. Because of this, some studies have attempted to measure if desires are themselves a direct cause of optimism. Research on “the desirability bias”, or “wishful thinking” explores whether desires specifically causally influence beliefs (see Krizan & Windschitl, 2007; 2009 for review). To test this, researchers have attempted to manipulate participant’s desires, while holding all other factors constant, and then measure the effect of desirability on beliefs.

In previous studies on wishful thinking, games of chance have been used to vary desires, while holding probability constant. The first of these studies was conducted with 9-to 12-year-old children in the United States. In this study, Marks (1951) familiarized these children with a deck of cards, some of which were marked on one side, and told children the percentage of marked cards in the deck. Across conditions, decks contained different percentages of marked cards (10, 30, 50, 70, and 90%). Participants were told they would either win (gain condition) or lose (loss condition) a point if they blindly drew a marked card from the deck. Then, participants were asked to guess which card they thought they would randomly select from the deck. Marks found that participants believed they were more likely to select a marked card in the *gain* conditions than in the *loss* conditions, even though the probability was matched across conditions. Children's estimates of drawing their preferred card was heavily skewed across the different ratios. When the probability of drawing a desirable marked card was 5 to 5, 90% of children believed they would draw the desirable card. When the probability of the desirable outcome was a slim 1 to 9, 47% of children still stated they would draw the desirable card.

Since this time, several variations of this paradigm have been conducted with adults, however none have been conducted with younger children. In one of these studies, Irwin (1953) used a nearly identical paradigm to Marks (1951). Irwin found that when the marked card was desirable, 61% of participants (across the various probabilities) stated they would draw a marked card, however when the marked card was undesirable, only 48% did so, suggesting an effect of desirability on adults' stated expectations as well. Meta-analyses drawing upon several similar studies yielded comparable findings (Krizan & Windschitl, 2007; 2009), suggesting that the bias may be weaker for adults than for school aged children.

These results raise questions about the development of the wishful thinking bias. Do young children develop a wishful thinking bias with age? Or do they begin with a bias and gradually learn to rationally overcome it, as the above research may suggest? In the present study, we explore wishful thinking in a sample of younger children, ages 3 to 7. We also explore the robustness of this bias across cultures and socioeconomic status (SES) by testing lower- and middle-class U.S. children as well as Peruvian children.

#### **4.1.1 Developmental Research on Optimism and Positivity**

Several previous developmental studies have found that young children often have a positivity bias, particularly when evaluating traits and abilities (see Boseovski, 2010 for review). For example, several studies have found that younger children expect negative traits to change across development but believe that positive traits are more stable (Diesendruck & Lindenbaum, 2009; Heyman & Giles, 2004; Lockhart, Chang, & Story, 2002; Lockhart, Nakashima, Inagaki, & Keil, 2008). Other research has looked at children's attributions about personality traits, finding that young children will extend a positive attribute after viewing only one instance of a positive behavior, but require more evidence to make a negative inference (Boseovski & Lee, 2006). Relatedly, Boseovski (2012) explored children's endorsement of an informant's testimony, finding that children were more likely to endorse an informant who stated a person was nice, rather than one who stated they were mean.

Other studies have found that young children exhibit over-confidence across a variety of situations. Parsons and Ruble (1977) found that preschool-aged children expected to do well on a



puzzle task, even after being told that they were doing poorly; however, 6-year-olds were less resilient to this negative feedback. Similarly, Plumert (1995) found that 6-year-olds, but not 8-year-olds, demonstrated over-confidence in their physical abilities, such as running fast. In another study, Lockhart, Goddu, and Keil (2017) found similarly that 5- to 7-year-olds were more likely to think that they would eventually acquire complete knowledge than were 8- to 10-year-olds.

Although these studies do suggest that young children hold optimistic beliefs about traits and abilities, these results are not strong evidence for wishful thinking. It is possible that children more readily endorsed positive traits because they aligned with their own desires- e.g. wishful thinking. However, it is also possible that they answered positively for several other reasons. First, experimental evidence suggests developmental differences in children's prior knowledge about personality traits; younger children believe that positive traits are more prevalent than older children (Lockhart, Chang, & Story 2002). A strong prior belief in favor of positive attributes may cause inferential biases, even after viewing evidence to the contrary (Gopnik, Griffiths, & Lucas, 2015; Seiver, Gopnik, & Goodman 2013). Second, research suggests that younger children also believe people have more control over the development of traits, than do adults (Lockhart, Chang, & Story, 2002; Stipek & Mac Iver, 1989). This may cause younger children to believe that people can improve over time if they want to.

Relatedly, as Lockhart, Chang, and Story, (2002) note, young children receive different patterns of evidence in their day to day lives than do older children and adults. For example, young children's traits and abilities do rapidly change during development, which may lead children to believe that traits and abilities are quite malleable. Young children may also believe that adults express more positive traits than children; for example, adults do run much faster, and have acquired a much larger body of knowledge. As a result, children may come to believe that with age everyone's relative standing will improve.

Adults may also selectively provide younger children with positive and encouraging feedback, and this may lead children to develop optimistic beliefs about their own abilities. While kindergarteners generally rate their future academic attainment higher than 4<sup>th</sup> graders do, Stipek and Daniels (1988) found that kindergarteners who were given salient positive and negative feedback, similar to what 4<sup>th</sup> graders generally receive, rated themselves comparably to 4<sup>th</sup> graders. In another study, Stipek, Roberts and Sanborn (1984) found that 4-year-old children adjusted their estimates of success in response to adult feedback. Both of these studies suggest that social feedback does shape children's beliefs about their own abilities.

A few developmental studies have systematically varied desirability. In one study, Stipek, Roberts and Sanborn (1984) explored whether 4-year-olds' overconfidence was impacted by incentivizing success. Children were introduced to a challenging task. In an incentivized condition, children were told they would receive a reward for success; children in a control condition were not rewarded for success. After struggling with the task, children's estimates of eventual success remained higher when success was incentivized than when it was not, suggesting that manipulating desirability altered children's expectancies about outcome. However, again, it is not clear that wishful thinking actually underpinned these results. It is possible that through offering an incentive, experimenters altered children's motivation, which in turn could rationally impact their actual likelihood of success.

In another study, researchers measured children's ability to infer another person's desires, however they systematically varied whether or not the correct inference conflicted with

children's own desires. They found that 3- and 5- year-olds could make accurate inferences when there was no conflict of desire, however, when desires did conflict with the correct response, 3-year-olds were not able to override their own conflicting desires. Five-year-olds could. Authors suggest that these developmental differences may be related to changes in inhibitory control or executive functioning (Moore, Jarrold, Russell, Lumb, Sapp, & MacCallum, 1995).

Taken together, research supports the notion that young children frequently hold optimistic beliefs, particularly about traits and abilities, however it is not clear that this is due to a wishful thinking bias. In fact, research suggests that a number of factors may influence children's beliefs about traits and abilities- including developmental changes in prior knowledge about the baseline rates of positive attributes, beliefs about the general controllability of traits and abilities, and feedback from adults.

Previous studies have, however, explored wishful thinking in school aged children and adults, generally finding a bias when asking participants to make binary predictions about stochastic events. Contrasting across studies reveals that the bias may attenuate with age. However, no previous studies have directly tested wishful thinking in young children, and in particular measured if desires influence young children's predictions about stochastic events. In the present paper, experimenters directly manipulated participants' own desires, and measured if doing so influenced their subsequent probability judgments during games of chance.

#### **4.1.2 Probability Judgments in Early Childhood**

One reason that a Marks (1951) wishful thinking style of paradigm has not been extended to young children sooner is because of the earlier consensus that young children have difficulty understanding probability. In the first of these studies, Piaget and Inhelder (1975) introduced 5- to 12-year-old children to a container holding two colors of chips. The proportion of each color varied. Children were asked to point to the color of chip they believed would be randomly selected. Children under the age of seven did not appear to factor probability into their predictions.

Other studies have challenged this position, showing that under certain conditions young children do demonstrate a basic understanding of probability (Denison & Xu, 2014; Yost, Siegel, & Andrews, 1962). For example, Yost, Siegel, and Andrews (1962) informed five-year-old children that they would receive a prize if they randomly selected a specific color of chip from a container. Then children were shown two containers, one with a higher proportion of desirable chips than the other. Children were asked to point to the container they wanted to take a chip from. Children tended to point to the container with the higher proportion of desirable chips. In this study, Yost, Siegel, and Andrews also administered a variation of Piaget and Inhelder's task and found again that children did not make accurate probability judgments. However, they also found that if children completed the above described task prior to the Piagetian task, they reliably made accurate predictions on the Piagetian task.

Given the mixed results in these previous studies, the present studies include baseline control conditions that explore three-to seven-year-olds' ability to make accurate and explicit verbal probability judgments after viewing a distribution. These control conditions are similar to the classic Piagetian task but were designed to be simpler and more straightforward for children.

### 4.1.3 The Influence of Culture and Socioeconomic Background on Wishful Thinking

Another question is whether sociocultural context influences the development of wishful thinking. Cross-cultural and cross-socioeconomic research can help disambiguate between the different possible developmental underpinnings of wishful thinking. If wishful thinking is acquired during childhood we might expect that the environment might influence when and how children develop a wishful thinking bias, and children may acquire this bias differentially across cultures. If it is in place early and is modified later we might expect that children in different cultures would start out with a wishful thinking bias, and that cultural differences would emerge later in development. This latter pattern has been observed in other types of cross-cultural developmental studies (Astuti, Solomon, & Carey, 2004; Miller, 1984). In the present study, we compare children from our field site in Lima, Peru to a middle-class sample of children from the U.S.A. We also tested a sample of lower-income preschool children from the U.S.A.

A recent survey of published literature found that less than 7% of published developmental psychology studies sampled children from Africa, Central and South America, Asia, Israel and the Middle East, while less than 1% sampled children from South or Central America (Nielsen, Haun, Kärtner, & Legare, 2017). This general lack of diversity makes it difficult to generate precise theoretical predictions about how research findings will generalize, and when and where we might find cultural differences. However, this gap can only be addressed by actually conducting studies in a wider range of cultures and socio-economic settings and using these findings to generate theoretical predictions; this is our strategy in this research. Given the lack of previous research with Peruvian children, as well as the lack of developmental and cross-cultural research on wishful thinking, cross-cultural comparisons should be viewed as exploratory.

Even so, results may be informative. If the development of wishful thinking differs culturally, we might expect the U.S. children, from both low and high SES backgrounds, to respond differently than the Peruvian children. Alternatively, wishful thinking could vary by SES. If so, there may be differences between the lower and middle SES children. Finally, all the children might initially show a similar degree of wishful thinking, with differences emerging later in development.

While wishful thinking has not been explicitly measured in young children from different cultural and SES backgrounds, Marks (1951) did compare high and low SES grade school children in her study. She found that SES did not impact wishful thinking. Other studies have explored optimism cross-culturally. Lockhart, Nakashima, Inagaki, and Keil (2008) measured Japanese and North American children's beliefs about negative physical and psychological traits as well as control attributes. They found that both Japanese and North American children predicted that negative attributes (e.g. being a poor learner or slow runner) will improve with time while control attributes (e.g. eye color) will remain stable. Younger children (ages 5–7) across both cultures were more likely to predict improvements than older children (ages 8–10), however the older Japanese children were more likely to predict improvements than the older North American children. Experimental research also suggests cultural variance in similar measures of optimism among adults (Heine & Lehman, 1995; Heine, Lehman, Markus & Kitayama, 1999; Heyman, Fu, & Lee 2013). For example, Heine and Lehman (1995) found that Japanese adults displayed less optimism than North American adults when asked to judge

possibilities such as, “You will get divorced after a few years of marriage” or “You will enjoy your [future] career.” While these studies do suggest that some types of optimism may vary by culture, they do not explicitly measure wishful thinking.

This paper reports findings from 3 experiments exploring the effects of desirability and probability on three- to seven-year-old Peruvian and U.S. children’s predictions, and one experiment doing so with lower income U.S. children. In Experiment 1, children viewed a card deck composed of two types of cards. In Experiments 2, 3, and 4 children viewed a bag of plastic eggs composed of two colors. Children were asked to guess what card type or egg color had been randomly selected. The distribution was heavily skewed so that 80% of objects were of one type, and only 20% were of the other. Baseline control conditions measured children’s probability judgments. In experimental conditions, the improbable outcome was also desirable. If young children can make accurate probability judgments, they should reliably predict the more likely outcome in the control conditions. If desirability alters expectancies, children should predict the unlikely (but desirable) outcome more often in the experimental conditions than in the control conditions. Furthermore, results could be qualified by SES, cultural or developmental differences.

## **4.2 Experiment 1 Methods**

### **4.2.1 Participants**

In the U.S., participants were recruited and tested at children’s science museums in the San Francisco Bay Area. The sample was predominantly middle- and upper-middle class, primarily composed of Asian (35%), Caucasian (33%), and Hispanic or Latino (17%) children. In Peru, children were recruited and tested in Innova schools located in and around Lima, Peru. This is a chain of private schools designed to serve largely lower-middle class children in Peru. Children were primarily second or third generation internal immigrants from the Peruvian highlands. Children were from an emerging middle-class background: families who have traditionally been in the lower class but recently have accumulated some expendable income. All schools were located in low-income, and largely high-crime neighborhoods. See Table 1 for subject numbers, mean age, and age ranges. In addition, one child was dropped because of parental interference, and two because of experimenter error.

### **4.2.2 Stimuli and Protocol**

Experimenters used white index cards with shapes pictured on one side. The cards featured black squares and circles (U.S.) or triangles and circles (Peru). This study was developed in the U.S. then extended to children in Peru. During the initial piloting in Peru, several of the younger children called the square a triangle, so experimenters replaced the square shape with a triangle shape. The experimenter also used small bins filled with colored plastic containers. The containers held prizes. U.S. participants were tested in English, and Peruvian

participants in Spanish. Study protocols were translated and back-translated by bilingual research personnel.

### 4.2.3 Procedure

In the U.S., children were tested in a quiet corner of the museum. In Peru, children were tested in private office spaces in their schools. First, the experimenter asked children if they liked prizes. Upon affirmation, the experimenter told children they could win prizes. Children were instructed to select one container from a bin and were told that it had a prize inside. Before the child could open the container, the experimenter placed it to the side of the table, explaining that the child might be able to win the prize later.

The experimenter next introduced the participants to a deck of 20 cards and told them that the cards had circles and squares (U.S.A.) or circles and triangles (Peru) on them. The experimenter explained that they were going to mix the cards up, then randomly select one card from the deck.

Next, the experimenter explained the prize contingencies, which differed across conditions. In the *control* condition, participants were told that they would win an additional prize, regardless of the experimenter's card selection from the deck. In the *experimental* condition, participants were told that they would only win an additional prize if one of the types of cards (i.e., the unlikely card) was selected, and would lose their initial prize if the other type was selected. Thus, in the control condition, the children believed they would receive two prizes regardless of the experimenter's selection, while in the experimental condition they believed they would receive two prizes if the experimenter selected the unlikely card, and no prizes if the experimenter selected the likely card.

In the experimental condition, children were asked to state which of the card types they wanted. If they said that they wanted the card that resulted in no prizes, the experimenter explained the prize contingencies again, and asked the question again. All but one child agreed they wanted the experimenter to select the desirable card.

Next, the experimenter sorted all cards face up by shape type. Then, the experimenter and participants counted the number of cards of each shape. Card decks contained 16 cards of the majority shape, and 4 cards of the minority shape. In the experimental condition, the majority card was associated with loss, while the minority card was associated with gain.

Following this, the experimenter turned the cards over, mixed them up, selected one card randomly from the deck, and placed it face down on the table. Children were asked to guess which card the experimenter had selected (e.g., "What card do you think this is?"). A memory check was introduced part way through data collection. After making a prediction, 219 children were also asked to state the majority card (e.g., "Do you remember which card there was more of?"). Majority card type was counterbalanced. All study procedures presented in this paper were approved by the institutional review board at the University of California, Berkeley. Parental consent was given for all participants.

### 4.3 Experiment 1 Results

Children were scored on whether they stated that the majority card type had been selected. A binary logistic regression explored if children predicted the majority card type using condition, country, and age group (4 and 6) as predictor variables. The resulting model was statistically significant,  $\chi^2(3) = 33.129, p < .0001$ , Nagelkerke  $R^2 = .163$ ; there was a main effect of condition,  $\chi^2 = 23.127, df = 1, p < .0001$ , and age,  $\chi^2 = 8.266, df = 1, p = .004$ , but not of country,  $p = .355, ns$ . Overall, children were more likely to choose the majority card type in the control condition than they were in the experimental condition, and older children chose the majority card type more often than younger children (see Figure 1).

In the control condition, children reliably predicted the majority card type; 99 of 130 children (or 76.2%;  $SD = .43$ ; 95%  $CI = .69-.84$ ) predicted the majority card type, which is significantly greater than chance would predict,  $p < .0001$ , two-tailed binomial test. This was also true when both the 4- and 6-year-old age groups were considered separately (4-year-olds: 42 of 64, or 65.6%;  $SD = .48$ , 95%  $CI = .54-.78$ ;  $p = .017$ , two-tailed; 6-year-olds: 57 of 66, or 86.4%;  $SD = .35$ , 95%  $CI = .78-.95$ ;  $p < .0001$ , two-tailed). In the experimental condition, 61 of 130 children (or 46.9%;  $SD = .5$ ; 95%  $CI = .38-.56$ ) chose the majority card, which is not significantly different from chance,  $p = .539, ns$ . A power analysis was conducted using the program G\*power, and the means presented above. Results suggest a total sample size of 90 to find the main effect of condition (with power  $1 - \beta$  set to .80;  $\alpha = .05$ ; two-tailed test), indicating that the sample size in the current study was more than adequate.

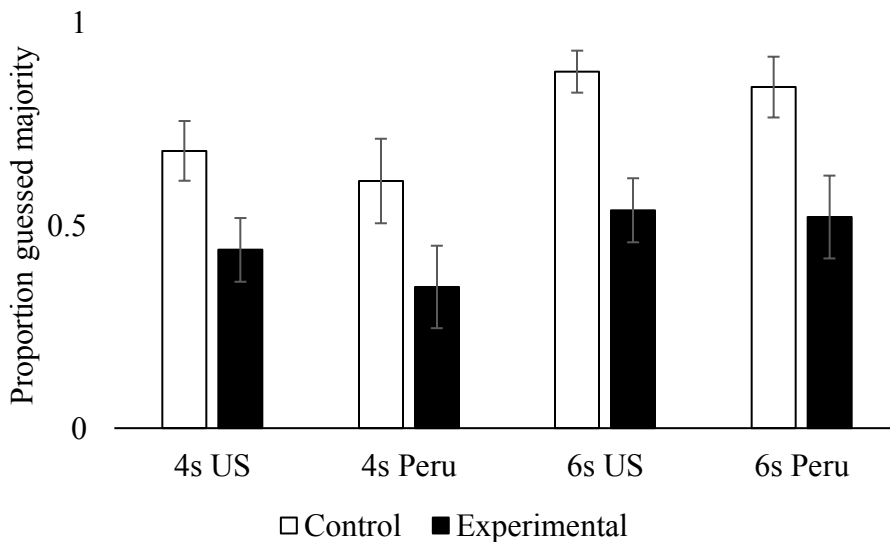


Figure 4.1. Proportion of children who stated the majority shape in Experiment 1. Error bars represent one standard error of the mean.

Two-hundred-and nineteen children were asked if they remembered which card there was more of, as well as which card there was less of. In the *control* condition, 82.57% of children answered both questions correctly. In the *experimental* condition, 89.09% of children correctly answered both questions (chance is 25%). Looking only at children who responded correctly to the memory checks, in the control condition 62 of 90 children guessed the majority, and in the experimental condition 43 of 98 did so. Fisher's exact test confirms that the difference between conditions remained significant,  $p=.0007$ . Children's optimism in the experimental condition cannot be explained by a failure to remember the distribution.

## 4.4 Experiment 1 Discussion

Study 1 suggests that four- and six-year-old children's verbal predictions were influenced by both desirability and probability. Children scored significantly above chance in the control condition, and there was a significant difference between control and experimental conditions, indicating an effect of wishful thinking on children's judgments. We did not find a cultural difference.

Older children overall were more likely to state the majority card than younger children, but they did so in both the control and the experimental conditions. While 4-year-olds did score above chance in the control condition, their performance was still not great (65.6% of 4-year-olds guessed the majority vs. 86.4% of 6-year-olds). This pattern of results may suggest that older children are less likely to engage in wishful thinking than younger ones, but the similar pattern in the control condition may also suggest that 6-year-olds are just better at making accurate probability judgments than 4-year-olds. It is also possible that older children are more likely to override an *a priori* tendency to engage in wishful thinking because they have developed a more robust ability to reason about probability.

However, it is also possible that the developmental trend was driven by some other aspect of the experimental design. For example, gathering and shuffling the cards took a while, and there was a substantial gap in time between when children viewed the distribution, and when the card was selected. Additionally, the memory checks at the beginning of the experiment were lengthy, and many children seemed to lose interest during these. Given this, it is possible that the developmental trends were impacted, at least in part, by developmental differences in working memory, or attentional regulation. Another possibility is that the younger children were less motivated to track the evidence and provide accurate responses in the control condition than the older children were, as the prize was not contingent on outcome.

Additionally, children scored at chance in the experimental condition. It is possible that desirability biased children's answers, resulting in a pattern of responses that was meaningfully different from the control condition, but coincidentally at chance. Alternatively, it is possible that tracking the two levels of prize contingencies (0 vs. 2 prizes), as well as both the gain and loss contingencies was difficult for children, and as a result, children resorted to guessing in the experimental condition.

In Experiment 2, we attempt to control for these possibilities and explore whether we could replicate the previous experiment using different materials and procedure. First, we used a shorter, more visually simple version of this task. In particular, we demonstrated a random

process by showing children that the experimenter chose a random sample from a collection of objects which visibly included more of one type than another (an “urn” type of probability task). The card task we and Marks used may require some additional assumptions about how cards work. In contrast, both infants, implicitly, and older preschool children, explicitly, have demonstrated that they understand probability in “urn” tasks and assume random sampling (Xu & Garcia, 2008; Denison et al, 2014; Denison et al. 2013). We also included an additional control condition, where children were incentivized for providing a correct answer, to explore the possibility that greater motivation might improve the younger children’s performance on the control task. Additionally, this new control condition required children to track 3 colors of eggs, that contained two different amounts of prizes (0 or 2), thus increasing the cognitive demands required to successfully answer the control questions, and more closely matching the cognitive demands to the experimental condition.

## **4.5 Experiment 2 Methods**

### **4.5.1 Participants**

One-hundred-and twenty-one North American and 128 Peruvian three- to six-year-olds participated. Children were further divided across 3 conditions: the experimental condition, the motivated control condition, and the unmotivated control condition. See Table 1 for further information on subject numbers and age. Additionally, three participants were tested and not included: one child voluntarily withdrew, one child failed to provide a response, and one was dropped due to experimenter error.

### **4.5.2 Stimuli**

In Peru, the experimenter used a special blue plastic egg (motivated control condition only), a white cloth, a brown paper bag, and a clear plastic bag containing a total of 10 yellow and purple plastic eggs. Some eggs contained stickers. In the U.S., stimuli were similar, but egg colors differed slightly. The experimenter used a silver plastic egg (motivated control condition only), and a clear plastic bag containing 10 yellow and blue eggs. Experiment 2 was initially developed and tested in Lima, Peru, where experimenters had limited access to study stimuli. U.S. experimenters changed the egg color from purple to blue because it was thought that some children (mostly females) might have a strong preference for purple eggs, and this might impact the results. The special blue egg (motivated control condition) was painted silver in the U.S. to differentiate it from the other eggs.

### **4.5.3 Procedure**



**4.5.3.1 Experimental Condition.** Children were first introduced to a clear bag containing purple and yellow (Peru) or blue and yellow (U.S.) plastic eggs. The color distribution was 8:2, and the majority color was counterbalanced. To ensure that children took note of the different colors and could differentiate them when asked, children were asked to point to one of each color of egg. Then, the experimenter told participants that the minority egg color contained two stickers and the majority color did not have any stickers. Following this, the experimenter took one of each type of egg out of the bag, opened them up, and showed the children what was inside. The example eggs were then reassembled and placed back inside of the plastic bag. Next, the experimenter asked participants to point to an egg containing two stickers, and an egg containing no stickers. The experimenter and child counted out loud the number of each type. Then the experimenter again asked the child if they remembered which egg had two stickers, and which egg had no stickers. Next the experimenter held the clear plastic bag of eggs over a brown paper bag and explained that they were going to place the clear bag into the paper bag and select one egg without looking, and the child would have to guess the color. The experimenter also told participants that if the egg had prizes inside, the child could keep them.

Then, the experimenter lowered the clear bag into the opaque bag, reached in and placed a white cloth over a randomly selected egg. The selected egg was immediately placed on the table, still under the cloth and covered by the experimenter's hands. The experimenter said, "Hmm, I wonder what color it is. What color do you think it is? Purple or yellow?" The order in which the two colors were listed was counterbalanced.

**4.5.3.2 Unmotivated Control Condition.** This condition was identical to the experimental condition, except that all the eggs contained two stickers.

**4.5.3.3 Motivated control condition.** First the experimenter showed participants a special blue egg (Peru) or silver egg (U.S.), explaining that it contained two stickers, which could be won. They then opened the special egg to show that it actually contained two stickers.

The rest of the procedure was similar to the other conditions, except for two differences. First, there were no stickers inside any of the other eggs (i.e., the eggs in the clear plastic bag that formed the distribution from which the experimenter was sampling). Second, children were told that they would win the stickers inside of the special blue (or silver) egg if they correctly guessed what color the experimenter selected from the bag. This is different from the experimental and unmotivated control conditions, in which children were told that they would win whatever was inside of the egg *selected* from the bag. This condition was included to test whether children who were motivated to be accurate in their predictions would perform better than children who were not. It also better matched the cognitive demands of the experimental condition, in that children had to track 2 amounts of prizes (0 vs. 2 stickers) across 3 colors of eggs, rather than just 1 type of prize contingency (2 stickers) across 2 colors of eggs.

In all three conditions, after children guessed what color of egg was under the cloth, they were asked to recall the egg color there was "more of." In the experimental condition, they were also asked to recall which egg color they wanted. We included this question *after* the child's guess in Experiment 2—as opposed to *before* the child's guess in Experiment 1—to control for the possibility that stating a preference might have primed participants' guesses. At the end of the procedure, the experimenter revealed the egg color. All children were immediately given

prizes, regardless of the outcome- either the prizes inside of the egg, or a reward for playing the game.

## 4.6 Experiment 2 Results

Children were scored on whether they guessed that the majority egg color had been drawn from the bag. First a binary logistic regression was used to compare the experimental to the unmotivated control condition, using country, exact age (as a continuous variable, given that the children were not divided into two age groups), and condition as predictor variables. The resulting model was statistically significant,  $\chi^2(3) = 46.133, p < .001$ , Nagelkerke  $R^2 = .329$ . Analyses revealed a main effect of condition,  $\chi^2 = 32.971, df = 1, p < .001$ , and age,  $\chi^2 = 7.43, df = 1, p = .006$ , but not country,  $p = .419, ns$ . As in experiment 1 children chose the majority egg more often in the unmotivated control condition than in the experimental condition, and older children chose the majority egg color more often than younger children.

A second binary logistic regression compared the motivated control condition to the experimental condition. Country, exact age (as a continuous variable), and condition were entered into the model as predictor variables. The resulting model was also statistically significant,  $\chi^2(3) = 39.927, p < .001$ , Nagelkerke  $R^2 = .283$ . Analyses again revealed a main effect of condition,  $\chi^2 = 32.71, df = 1, p < .001$ . Age trended towards being a significant predictor,  $\chi^2 = 3.15, df = 1, p = .076$ . Country was not significant,  $p = .444, ns$ . Children chose the majority egg more often in the motivated control condition than in the experimental condition, and older children trended towards choosing the majority egg color more often than younger children. Thus, overall, as in the first experiment, the desire bias appeared to decrease rather than increase with age, however this decrease corresponded to comparable changes in the control conditions.

Two-tailed binomial tests confirmed that overall children chose the majority option significantly above chance in the unmotivated control condition (57 of 81, or 70.4%;  $SD = .46$ ; 95% CI = .60-.81),  $p = .0003$ , as well as in the motivated control condition (59 of 86, or 68.8%;  $SD = .47$ ; 95% CI = .59-.79),  $p = .0007$ , there were no differences between the two control conditions,  $p = .867, ns$ , two-tailed Fisher's exact test. By contrast, children scored significantly *below* chance in the experimental condition. Only 19 of 82, or 23.2% ( $SD = .42$ ; 95% CI = .14-.33) stated the experimenter had selected the majority egg,  $p < .0001$ . Most children believed that the experimenter had selected the desirable, yet highly improbable, egg. A power analysis was conducted using the software G\*power, and the means presented above. Results suggest a total sample size of 37 to find the difference between the experimental and unmotivated control conditions, and a total sample size of 39 to find the difference between the experimental and motivated control conditions (with power  $1 - \beta$  set to .80;  $\alpha = .05$ ; two-tailed test). Again, this suggests that the sample size used in the current study was more than adequate and validates the sample sizes used in the following experiments, which use a similar paradigm.

In the experimental condition 83.33% of participants stated they wanted the egg with the prizes, and 75.61% correctly stated which egg there was more of. In the motivated control condition, 84.71% correctly stated the majority egg color, and 91.34% did so in the unmotivated control condition. Looking only at children who passed the memory check questions, and also stated they wanted the egg with the prizes, in the unmotivated control 50 of 74 (67.6%) children

predicted the majority egg, in the motivated control condition 48 of 72 (66.7%) guessed the majority egg, and in the experimental condition 11 of 52 (21.2%) predicted the majority egg. Fisher's exact tests confirm that the difference between the unmotivated control and experimental conditions remained significant,  $p < .0001$ , as did the difference between the motivated control and experimental conditions,  $p < .0001$ .

## 4.7 Experiment 2 Discussion

Like Experiment 1, Experiment 2 yielded a difference between the experimental and control conditions, supporting the hypothesis that young children engage in wishful thinking, using different materials and procedures. In the experimental condition, very few children, only 23.2%, predicted the likely outcome, which was significantly different from chance. In control conditions, children again made accurate probability judgments, scoring above chance on both the motivated and unmotivated control conditions, with no significant differences between the two. Children's performance in control conditions was generally similar to their performance in Experiment 1, suggesting that both motivation and changing the design did not enhance children's performance.

In the experimental condition in Experiment 2, most children (76.8%) stated the unlikely (and desirable) outcome, whereas in Experiment 1, only 53.1% did so. This may be because the design in Experiment 2 was simpler and more straightforward for children, decreasing the noise in children's responses. A few changes in particular may have made the experimental condition easier for young children to follow. First, prizes were inside of the eggs, rather than contingently given to children from an external source. Second, in Experiment 2, the eggs simply had 2 prizes or no prizes. In Experiment 1 children were given an initial prize, then, based on the experimenter's selection they were either given 1 more prize, or the initial prize was taken away—thus they had to track both gain and loss contingencies. This may have been confusing. Additionally, Experiment 2 was faster, and more visually appealing, possibly making it easier for children to track the information.

In Experiments 1 and 2, older children chose the majority egg color more often than younger children. In both experiments, this was a main effect across conditions. This did not change when the task was simplified, or when children were motivated to provide a correct response. These results could indicate that wishful thinking declines with age and/or that older children are better at making accurate probability judgments than younger children. These two possibilities could also be related. Wishful thinking could decline with age because children develop stronger probabilistic reasoning abilities. However, the current findings do not specifically support any 1 of these 3 possibilities.

In Experiment 3, we further explore this by testing older children, 5- to 7-year-olds. Observation of the previous data set suggested that 5-year-olds from both Peru and the U.S. score quite accurately in the control conditions, yet still score optimistically in the experimental conditions. Contrasting results from Marks (1951) and Irwin (1953) seems to suggest that wishful thinking decreases over development, however the youngest children tested in previous studies were 9-year-olds, and this conclusion is drawn from comparing results from different research studies which used slightly differing methodology. If wishful thinking does decrease,

older children might score less optimistically than younger children in the experimental condition of Experiment 3. If developmental declines in wishful thinking are related to developmental changes in probabilistic reasoning abilities, developmental differences should be consistent across conditions – children should become increasingly more likely to choose the majority option in the experimental condition, as they also become more likely to predict that option in the control. If wishful thinking declines independently of probabilistic reasoning abilities, then a developmental difference should be seen in the experimental condition only. There also might be cultural differences for the older children, even if those differences did not emerge for the younger children. This type of developmental trend has been seen in other cross-cultural studies (e.g. Astuti, Solomon, & Cary, 2004; Miller, 1984).

## 4.8 Experiment 3 Methods

### 4.8.1 Participants

Eighty U.S. and 80 Peruvian five- to seven-year-olds participated in this study. Participant demographic information and testing setup were similar to that of Experiments 1 and 2. See Table 1 for more information on subject ages. Additionally, 1 six-year-old was tested and not included in the final sample due to experimenter error.

### 4.8.2 Methods

Procedures were identical to the experimental and unmotivated control conditions of Experiment 2 with two exceptions. First, children were not told there were stickers inside of the eggs or shown the prizes. Rather, they were told that the eggs contained “prizes.” This was to control for any developmental differences in the desirability of specific types of prizes. Second, light blue and yellow eggs were used for children from both Peru and the U.S.

## 4.9 Experiment 3 Results

A binary logistic regression explored if children’s responses were predicted by age (continuous) country (Peru vs. U.S.A.) and condition (experimental vs. control). Inspection of the data suggested an interaction between age, country, and condition (see Figure 2). The regression also explored if this interaction was significant. The model was significant,  $\chi^2(4) = 46.114, p < .001$ , Nagelkerke  $R^2 = .34$ . Analyses revealed a main effect of condition,  $\chi^2 = 17.641, df = 1, p < .001$ , as well as a significant interaction between age, country and condition,  $\chi^2 = 7.337, df = 1, p = .007$ . There was no main effect of age,  $p = .718, ns$ , or country,  $p = .228, ns$ .

To explore this interaction, two-tailed Fisher's exact tests were used to compare the control condition to the experimental condition for each of the 4 groups we tested. The difference between conditions was significant for the U.S. 5-year-olds (16 of 20 control vs. 2 of 20 experimental guessed the majority color),  $p < .0001$ ; the Peruvian 5-year-olds (18 of 20 control vs. 5 of 20 experimental guessed the majority color),  $p < .0001$ ; and the Peruvian 6- and 7-year-olds (14 of 20 control vs. 5 of 20 experimental guessed the majority color),  $p = .01$ . However, performance in the two conditions was identical for the U.S. 6- and 7-year-olds (15 of 20 control vs. 15 of 20 experimental guessed the majority color),  $p = 1$ , *ns*. Further comparisons reveal that the U.S. 6- and 7-year-olds scored significantly differently than the U.S. 5-year-olds in the experimental condition,  $p < .0001$ , as well as the Peruvian 6- and 7-year-olds in the experimental condition,  $p = .004$ . In short, the 5-year-olds from both countries demonstrated a wishful thinking bias, as in Experiment 1 and 2. However, the bias had attenuated with age in U.S. children but not in Peruvian children. No comparable difference was seen in the control condition.

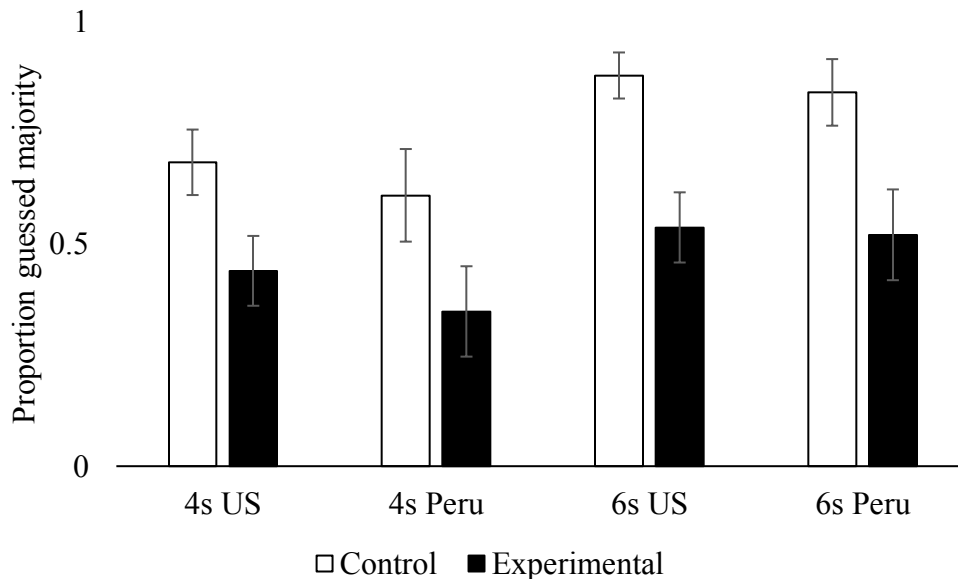


Figure 4.2: Proportion of children who stated the majority color in Experiment 3. Error bars represent one standard error of the mean.

Two-tailed Binomial tests were again used to compare children's responses to chance. Overall, in the control condition, 63 of 80 (or 78.75%;  $SD = .41$ , 95%  $CI = .7 - .88$ ) children predicted the majority response, which is significantly above chance  $p < .0001$ . This can be contrasted with the experimental condition, where 27 of 80 (or 33.75%;  $SD = .48$ , 95%  $CI = .23 - .44$ ) children stated the majority response, which is significantly below chance,  $p = .005$ . Splitting the data from the experimental condition by age group and culture suggests that U.S. 5-year-olds scored significantly *below* chance,  $p < .001$ , Peruvian 5-year-olds scored significantly

below chance,  $p=.04$ ; and Peruvian 6-and 7-year-olds scored significantly below chance,  $p=.04$ ., by contrast, U.S. 6- and 7-year-olds scored significantly above chance,  $p=.04$ .

Condition	Age Group	N	Mean Age	Age Range	Gussed Majority	95% CI of the Mean	Comparisons to Chance
<b>Experiment 1</b>							
<b>U.S.</b>							
Experimental	4	41	4.47	3.86–5	18 (43.9%)	.28-.6	$p=.533$
	6	41	6.44	5.94–7	22 (53.7%)	.38-.7	$p=.755$
Control	4	41	4.47	3.9–5.09	28 (68.3%)	.53-.83	$p=.028$
	6	41	6.47	5.95–7	36 (87.8%)	.77-.98	$p<.0001$
<b>Peru</b>							
Experimental	4	23	4.54	3.97–4.85	8 (34.8%)	.14-.56	$p=.21$
	6	25	6.55	6.06–7.0	12 (52%)	.31-.73	$p=1$
Control	4	23	4.3	3.87–4.98	14 (60.9%)	.39-.82	$p=.405$
	6	25	6.55	5.94–6.98	21 (84%)	.69-.99	$p<.001$
<b>Experiment 2</b>							
<b>U.S.</b>							
Experimental	N/A	41	5.08	3.53-6.96	8 (20%)	.07- .32	$p<.001$
Unmotivated	N/A	40	4.98	3.51-6.99	31 (78%)	.64-.91	$p<.001$
Motivated	N/A	40	5.09	3.55-6.95	27 (68%)	.52-.83	$p=.039$
<b>Peru</b>							
Experimental	N/A	41	5.13	3.64-7	11 (27%)	.13- .41	$p=.004$
Unmotivated	N/A	41	5.41	3.7-7.1	26 (63%)	.48-.79	$p=.117$
Motivated	N/A	46	4.82	3.65-6.83	32 (70%)	.56-.83	$p=.011$
<b>Experiment 3</b>							
<b>U.S.</b>							
Experimental	5	20	5.48	4.94–5.96	2 (10%)	-.04-.24	$p<.001$
	6- 7	20	6.99	6.08–7.86	15 (75%)	.54-.96	$p=.041$
Control	5	20	5.5	4.89–5.99	16 (80%)	.61-.99	$p=.012$
	6- 7	20	6.96	6.22–7.84	15 (75%)	.54-.96	$p=.041$
<b>Peru</b>							
Experimental	5	20	5.43	5.01–5.95	5 (25%)	.04-.46	$p=.041$
	6- 7	20	7.02	6.02–7.94	5 (25%)	.04-.46	$p=.041$
Control	5	20	5.64	5.0–5.96	18 (90%)	.76-1.04	$p<.001$
	6- 7	20	7.08	6.07–7.95	14 (70%)	.48-.92	$p=.115$

**Table 4.1.** Summary of participants included in Experiments 1-3 and responses given. Table 1 includes subject numbers, mean ages, age ranges, the number (and percent) of participants who guessed the majority card or egg, 95% confidence intervals for the mean number participants who guessed the majority card or egg, and results from two-tailed binomial tests comparing the pattern of responses to chance.

At the end of the experiment, 93.75% of children in the control condition and 81.25% of children in the experimental condition correctly recalled the majority color. In the experimental condition, all but six children stated they wanted the egg with the prize. After removing the children who answered these questions unexpectedly, 58 of 75 (or 77.3%) children in the control condition and 16 of 61 (or 26.2%) children in the experimental condition guessed the majority egg. A Fisher's exact test confirmed that the difference between conditions remained significant,  $p < .0001$ . In the experimental condition, 10 of 15 (66.7%) U.S. 6- and 7-year-olds guessed the majority egg, whereas in Peru only 3 of 17 (17.6%) 6- and 7-year-olds did so. The cultural difference for the 6- and 7-year-olds remained significant,  $p = .01$  (Fisher's exact test two-tailed). Only 1 of 15 (6.7%) U.S. 5-year-olds stated the majority egg in the experimental condition. The developmental difference for U.S. children also remained significant,  $p = .002$  (two-tailed Fisher's exact test).

## 4.10 Experiment 3 Discussion

Experiment 3 again found a strong effect of wishful thinking, however it also found cultural differences in developmental trends. In Experiment 3, wishful thinking decreased with age for the U.S. children, but not for the Peruvian children. Results did not yield comparable trends in the control condition: overall 85% of 5-year-olds predicted the majority egg color, and 72.5% of 6- and 7-year-olds did so. Furthermore, children from the U.S. and Peru performed comparably in the control conditions. This suggests that wishful thinking, itself, is changing independently from probabilistic reasoning, and does so differently across cultures. It also suggests that, across the cultures tested, children develop fairly robust probabilistic reasoning abilities by the age of 5.

These results raise questions about patterns of developmental change cross-culturally. It is possible that children from Peru will show a similar reduction in wishful thinking, but at a later point in development. It is also possible that the Peruvian population we sampled from retains a higher level of wishful thinking into adulthood. At this point, it is unclear what cognitive and sociocultural factors might contribute to children's tendency to engage in wishful thinking, although we discuss this further in the general discussion.

In Experiment 4, we explore the relationship between socioeconomic status and wishful thinking by testing 3- to 5-year-old children enrolled in Head Start programs in Berkeley, California. To be eligible for enrollment in Head Start, families' income must fall below the federal poverty level, which, at the time of testing, was below \$24,600 for a family of four ("2017 Poverty Guidelines," 2017). Economists of happiness have reported that levels of optimism, happiness and life satisfaction vary by income, with people from lower SES backgrounds consistently scoring lower on these measures than those from middle- and upper-middle class backgrounds ("Gallup World Poll," 2014-2016, Graham, 2009; 2017; Kahneman & Deaton, 2010). This could indicate that lower-SES children may be less prone to a wishful thinking bias (as it is a type of optimism). However, Marks (1951) found that SES did not impact

wishful thinking in grade school children, suggesting that the lower-SES U.S. children might score similarly to the samples previously tested.

## 4.11 Experiment 4 Methods

### 4.11.1 Participants

Experiment 4 included 45 children. Twenty children participated in the experimental condition ( $M$  age= 4.47,  $range$ = 3.5 to 5.46), and 25 in the control condition ( $M$  age= 4.46,  $range$ = 3.43 to 5.59). Children were recruited and tested at Head Start programs located in Berkeley, CA.

### 4.11.2 Methods

Methods were identical to the experimental and unmotivated control conditions of Experiment 2; all children viewed a clear bag of blue and yellow eggs. Children were tested in a quiet room or hallway at their preschool.

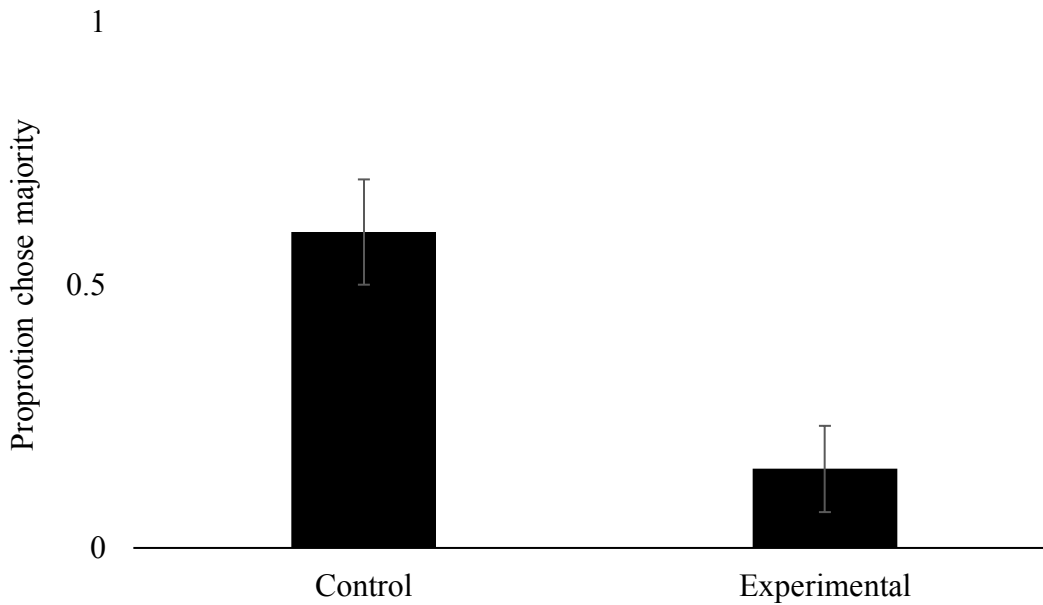
## 4.12 Results

Children were scored according to whether they guessed the majority egg color. A binary logistic regression measured if age (as a continuous variable) and condition predicted majority response. The model was statistically significant  $\chi^2(2) = 12.416, p=.002$ , Nagelkerke  $R^2 = .326$ . Analyses revealed a main effect of condition,  $\chi^2 = 8.339, df = 1, p = .004$ . There was no effect of age,  $p=.135, ns$ .

Two-tailed binomial tests compared responses to chance. In the experimental condition, only 3 of 20 (or 15%;  $SD = .37$ ; 95%  $CI = -.02 - .32$ ) children guessed the majority egg, which is significantly below chance,  $p=.003$ ; and in the control condition 15 of 25 (or 60%;  $SD = .5$ ; 95%  $CI = .39 - .81$ ) children guessed the majority egg, which is not significantly different from chance,  $p=.424, ns$ .

In the experimental condition, all but one child (95%) stated they wanted the desirable egg. In the control condition, 68% of children correctly stated the majority egg color, while 60% of children did so in the experimental condition. Looking only at the children who stated they wanted the minority color, as well as correctly stated the color there was more of, 9 of 17 (52.9%) children stated the majority color in the control condition, and only 1 of 11 (9.1%) did so in the experimental condition. A two-tailed Fisher's exact test confirms that the difference across conditions was significant,  $p=.041$ .





**Figure 4.3:** Proportion of lower income children who stated the majority response in Experiment 4. Error bars represent one standard error of the mean.

### 4.13 Experiment 4 Discussion

Experiment 4 extends findings from Experiments 1, 2 and 3 to lower income children in the U.S.A. Three-to 5-year-old children enrolled in Head Start programs displayed very high levels of wishful thinking, where 85% of children provided an optimistically biased response in the experimental condition. These responses are similar to the middle-income U.S. American, and Peruvian 3- to 5- year-olds. While previous research suggests that income is correlated with some measures of optimism in adults (Graham, 2009; 2017), young children from a low-income background displayed a strong desire bias in this experiment and answered quite optimistically. This is consistent with findings from Marks (1951), where SES did not impact wishful thinking. Future research should explore other measures of optimism in lower SES children and explore developmental trends within this population.

### 4.14 General Discussion

Across all four experiments, three- to five-year-old children reliably displayed a strikingly strong wishful thinking bias. This finding held across cultures and socioeconomic background. Unlike adults, children showed this bias even when there was a large difference in

the probability of the two outcomes: 80 versus 20 percent. In Experiment 3, this bias declined with age in the U.S., but not in Peru.

Across experiments, children also made accurate probabilistic judgments in control conditions, with the exception of the lower income children in Experiment 4. These results confirm the earlier findings on probabilistic reasoning, suggesting that children's success may be largely dependent on the task demands of the experimental design. With appropriately simplified materials, children under 7 can give explicit and accurate probabilistic judgments, however these results seem more robust for children ages 5 and above.

Other research suggests some degree of developmental continuity in wishful thinking, at least within the U.S. Marks (1951) did find a wishful thinking bias in older school age children (ages nine to twelve), and Irwin (1953) used a very similar paradigm, finding that adults also held this bias, but to a lesser degree. The present study used slightly different methodology making direct comparison to these previous studies difficult. However, results from the current experiments, as well as previous experiments, suggest that wishful thinking does decline over the course of development, and may do so differentially across cultures.

This raises the question of what, exactly, changes across development, and why there are differences across cultures. In our studies we pitted desirability directly against probability. Developmental differences could be due to differences in children's ability to make probabilistic judgments, or differences in the extent to which desires influence children's beliefs (i.e. wishful thinking). Experiment 3 weighs against this first possibility, and suggests that, when children have equivalent probabilistic reasoning abilities, younger children are still more likely to engage in wishful thinking, at least in the U.S. This may suggest children initially hold a wishful thinking bias, and developmental changes are independent of other aspects of cognitive development. Children may initially believe that their desires impact future events. Over time, children may encounter situations where their desires do not align with outcomes. In light of this, they may revise their understanding to include other casually relevant factors, such as probability in the present studies. This explanation would be consistent with a theory theory or rational constructivist framework of conceptual development (Carey 1985; Gopnik & Wellman 2012; Wellman and Gelman, 1992).

It is noteworthy that the Peruvian children came from a specific subculture within Lima, Peru: the emerging middle-class. Due to economic changes within Peru, many of the traditionally lower-income families have seen a recent growth in expendable income. The emerging middle class represents a group that is both culturally and economically distinct from the traditional Peruvian middle class and lower class. These families may generally be quite optimistic, and this could be why the Peruvian children demonstrated a bias at an older age. Further research should explore the extent that these results generalize across subcultures within Peru, and if wishful thinking is impacted by SES in other countries. Regardless, results do suggest that sociocultural, or socioeconomic background influences wishful thinking. This could further impact the development of optimism across cultures and SES. Future research should explore this as well.

Alternatively, wishful thinking could change as other aspects of cognition mature. It is possible that changes in probabilistic reasoning contribute to the developmental changes in the current studies, even if the effect is not solely due to changes in probabilistic reasoning. For example, performance in the control conditions of Experiment 1 and 2 suggested that older children have more robust probabilistic reasoning abilities than the younger children. As children

become more aware of explicit probabilities they may become more sensitive to the conflict between predictions that are based on those abilities and those that emerge from a desire bias. Overriding a wishful thinking bias may also require executive functioning. If so, the older U.S. children may have scored less optimistically because they have more advanced executive functioning. Future studies could explore if executive functioning predicts wishful thinking.

These results may suggest that young children are irrationally optimistic: they predicted the desirable response even when the evidence was clearly to the contrary. Some researchers have suggested that such an optimism bias, more generally, could confer an evolutionary advantage in spite of its apparent irrationality and so might develop very early and independently of evidence. (Johnson and Fowler, 2011; McKay and Dennett, 2009; Sharot, 2012; Sharot, Korn, and Dolan, 2011). Optimism may be particularly advantageous to children, from an evolutionary perspective, because it could guide them towards new learning experiences and encourage them to persevere after failed attempts. While our results are consistent with this possibility, they do not exclude other alternatives. First, the youngest children tested in this study were 3-years-old. It is possible that children develop this bias from experience before the age of 3. Studies with younger children, as well as comparative and more cross-cultural data would be useful.

There are also some limitations to the current study design. Earlier studies and the performance in the control conditions suggest that children do indeed infer a random sampling process. However, in the present studies, children may also have thought that the experimenter wanted to give them the prizes, as adults do frequently want to give children prizes. If so, children may have assumed intentionally in the experimental condition, rather than random sampling. This would itself involve an optimistic assumption, namely that the experimenter wanted them to win the prizes. This would suggest that children hold optimistic beliefs about outcomes that adults can control. However, this interpretation would not imply the classic “wishful thinking” assumption, that desirable outcomes are simply more likely. Given this, one good next step would be to explore if findings replicate in a non-agentive condition. For example, a machine could randomly distribute the prizes rather than the experimenter.

Another possibility is that children could have stated the desirable response simply because there was no cost associated with being incorrect. While the motivated control condition suggests that motivating children to be correct did not increase their accuracy in the control condition, no conditions explored if associating cost or benefit for accuracy would alter children’s predictions in experimental conditions. Future research could explore these possibilities.

In any case, these studies appear to suggest that young children from all the backgrounds tested hold a strong wishful thinking bias, and that wishful thinking declines with age and differentially across cultures. If desires do bias children’s beliefs, it is likely that this type of effect would be observed in a variety of domains. Furthermore, cross-domain comparisons could yield insight into the developmental mechanisms that underpin wishful thinking and could help determine the degree in which wishful thinking is stable across situations. For example, children may more readily override conflicting probability evidence than conflicting testimony evidence. Alternatively, wishful thinking may be stable across situations, but differ on an individual or cultural level. Or wishful thinking could vary across both of these dimensions. Future research should further explore these possibilities.

## **Chapter 5. General Discussion**

The present dissertation includes three cross-cultural studies exploring how young children reason about desirable possibilities, and how children's reasoning changes over the course of development. Chapters 2 and 3 presented research on young children's understanding of agent causation, and how young children in Peru, China, and the U.S., come to believe that people can 'choose to' practice self-control. Chapter 4, in contrast, explores the possibility that desires impact children's beliefs more broadly.

### **5.1 Discussion of Chapters 2 and 3**

In chapters two and three we explored children's beliefs about self-control and free will. Children from Peru, China, and the U.S. were asked if they believe that they themselves, or another person, can 'choose to' practice self-control. Cross-cultural comparisons revealed important trends in the development of children's beliefs about free will and self-control. First, children from different cultures provided different patterns of responses. In particular, Chinese and Peruvian children were less likely to attribute free choice to people than were U.S. children. Even so, the likelihood of attributing free will increased with age across cultures. This suggests that children, across the cultures tested, do gradually come to endorse the possibility to 'choose to' practice self-control, however the timing of these beliefs differs by culture. Additionally, other research suggests that the strength of adults' beliefs about free will does vary across cultures. Wentz et al. (forthcoming) contrasted Chinese and U.S. undergraduates, finding that Chinese undergraduate students were less likely to endorse choice than U.S. students, although the undergraduates from both cultures were much more likely to endorse choice than were children from their respective cultures.

These results are consistent with other empirical findings. Other studies have explored Nepalese and Singaporean children's beliefs about free will, and when children come to believe that they can act in opposition to social and moral constraints (e.g. wear pajamas to school or hit a friend). Results revealed that U.S. children were more likely to endorse this freedom than either Nepalese and Singaporean children (Chernyak, et al., 2013; Chernyak, Kang, & Kushnir, in press).

Recently, Zhao et al. (Zhao, et al., 2017) asked Chinese and Singaporean children the same ‘desire’ free will questions used in Chapter 2 of the present dissertation. Children were only asked questions about another person, rather than themselves. Zhao et al. (2017) found that Singaporean children were less likely to endorse choice than Chinese and U.S. children. This study did not reveal a difference between Chinese and U.S. children, indicating a non-replication of Chapter 2.

This non-replication warrants further discussion. There are a few reasons why findings may have failed to replicate. First, samples were collected approximately 7 years apart. During this time, there was considerable socio-cultural change in Beijing, China. Second, while children from both studies were tested in Beijing, China, children came from different types of familial backgrounds. The initial sample, presented in Chapter 2, was collected at a government military school, suggesting that many parents were active members of the Chinese Communist Party. The second sample was collected at a university affiliated preschool, and many parents were likely educated abroad.

Interestingly, as noted above, we have since sampled undergraduates in China and the U.S., finding differences in adults that mirror those we saw in Chapter 2 of this dissertation (Wente et al., forthcoming). In this study, Chinese undergraduates were less likely than U.S. undergraduates to endorse choice. As in Chapter 2, this difference was most apparent for the inhibition questions. There were also parallel cultural differences in qualitative responses, with U.S. undergraduates providing more of the ‘autonomous choice’ responses than Chinese undergraduates. Taken together, this supports two possible explanations for the inconsistent findings: either there are subcultural differences within Beijing, or there are cohort differences in free will beliefs. This would be an interesting topic to more thoroughly explore.

In addition to differences in children’s ‘choose to’ responses, Chapters 2 and 3 also suggest differences in children’s qualitative responses, or beliefs about why a person might practice, or not practice, self-control. In Chapter 2, U.S. children were more likely to provide autonomous choice responses than Chinese children. Chinese children were also more likely to provide ‘external’ responses than U.S. children after stating that someone could not choose to practice self-control. A similar finding was seen in Peru. In Peru, children were more likely to attribute self-control to external factors and less likely to attribute self-control to internal factors, when compared with U.S. children.

No cultural differences were seen in the autonomous choice responses when comparing Peruvian and U.S. children. One explanation for this is that the U.S. sample in Chapter 3 was, on average, younger than that in Chapter 2. Chapter 3 sampled 4- and 5-year-olds, while Chapter 2 sampled 4- and 6-year-olds. Older U.S. children (6-year-olds) tended to provide the majority of autonomous choice explanations in Kushnir et al. (2015). Additionally, different coders classified responses in Chapters 2 and 3, and it is possible that more stringent criteria were used when classifying responses in Chapter 3.

Cross-cultural trends in qualitative responses as well as ‘choose to’ responses are consistent with the self-construal framework proposed by Markus and Kitayama (1991) and previous cross-cultural findings. According to the self-construal framework, adults from interdependent cultures, such as China, are more likely to attribute the causes of people’s actions to external and contextual factors, whereas people from more independent cultures, such as the U.S., are more likely to attribute causation to internal factors, such as mental states. Several empirical studies have yielded findings in line with this framework (Kitayama, Snibbe, Markus,

& Suzuki, 2004; Kokkoris, Kuhnen & Yan, 2013; Miller, Das & Chakravarthy, 2011; Morris & Peng, 1994; Savani, Markus, Naidu, Kumar & Berlia, 2010). For example, Miller (1984), asked North American and Indian adults and children to explain every day social events. She found that appeals to internal factors increased with age in North American participants, whereas appeals to contextual factors increased with age in Indian participants. Findings from Chapter 3 of this dissertation may suggest that the Peruvian children we tested would score high on interdependence, however further exploration is necessary to make this claim.

While there were several cultural differences in free will beliefs, there were also important similarities across cultures. First, responses to experimental questions were contrasted with structurally similar control questions. Children were asked if they could 'choose to' perform impossible actions, such as float in the air, or simple and unconstrained actions, such as walk from the kitchen to the living room. Participants, across cultures, responded similarly to these control questions. Control questions used similar language and structure to the experimental questions. This suggests that cultural differences are due to children's conception of free will and self-control, rather than the language or structure of the questions, or children's general tendency to answer 'choose to' or 'have to.'

Another pattern that emerged across cultures was the difference between action and inhibition questions. Data presented in Chapters 2 and 3 suggest that, for some children, inhibition items were viewed as more constraining than action items. This seems to be especially true in the earlier stages of development- when children generally are less inclined to endorse choice.

Inhibition questions were also more variable across cultures. In Chapter 2, cultural differences were observed between Chinese and U.S. children for inhibition questions only. A similar pattern was found when comparing Peruvian 6- and 7-year-olds to U.S. 4- and 5-year-olds. However, when contrasting U.S. and Peruvian 4- and 5-year-olds, differences were observed for both action and inhibition questions.

The above two paragraphs, taken together, suggest that the development of beliefs about inhibition oriented self-control is distinct from the development of beliefs about action oriented self-control. Children seem to develop inhibition beliefs at a later age, and, as a result, cultural differences are more pronounced for inhibition questions. Future research could explore why this might be so, and what specific patterns of evidence underpin the development of beliefs about inhibition versus those about action.

In Chapters 2 and 3 we also explored the relationship between children's beliefs about free will and how these beliefs relate to their first-person experiences practicing self-control. Chapter 3, in particular, nicely illustrates the finding that beliefs about self-control may not directly correspond with children's overall capacity to practice self-control, at least when comparing trends across cultures. In Chapter 3, we found that Peruvian 7- and 8-year-old children held weaker beliefs about their own ability to practice self-control when contrasted with younger U.S. 4- and 5-year-olds. The older Peruvian 7- and 8-year-olds, however, demonstrated more developmentally advanced self-control abilities than the U.S. 4- and 5-year-olds. Furthermore, U.S. and Peruvian 4- and 5-year-olds scored comparably on self-control, even though the U.S. children were much more likely to endorse the freedom to practice self-control. Similarly, Zhao et al. (2017) found that Singaporean 4- to 8-year-olds held weaker beliefs about free will than U.S. and Chinese 4- to 8-year-olds, although they scored comparably on self-control tasks. Other studies suggest that Chinese and Singaporean preschool aged children often score better at

inhibitory control, which generally encompasses self-control, than North American children (Lan, Legare, Cameron Ponitz & Morrison, 2011; Sabbagh, Xu, Carlson, Moses & Lee, 2006), even though they hold weaker beliefs about free will and self-control (Chernyak, Kang, & Kushnir, in press; Wenthe et al., 2016; Zhao, et al., 2017).

Chapters 2 and 3 center around the question of what causes the conceptual change in children's beliefs about free will, or what causes children to endorse a belief in free will. With the case of self-control, one obvious possibility is first person experiences in practicing self-control. Decades of research on self-control suggest that, with age, children become better at practicing self-control (e.g. Mischel, 2014). Given this, children may respond that they can 'choose to' practice self-control simply because they are actually better at practicing self-control. However, the cross-cultural misalignment between beliefs and abilities raises questions about the extent that beliefs about free will are actually grounded in first person experience. If they were, we would expect to see similar trends in free will beliefs when comparing Peruvian, Chinese, Singaporean and U.S. children. Singaporean and Chinese children might even be expected to show accelerated development of free will beliefs, since some studies have found accelerated development of inhibitory control in these children. However, this was not observed.

In Chapters 2 and 3 we suggested two alternative hypotheses. The first was that beliefs about free will and self-control are not grounded in actual abilities, rather they are taught to children. This hypothesis would explain the cultural variability observed, as children from different cultures may be taught different beliefs about self-control. The second hypothesis is that first person experience does impact children's beliefs, however culture also impacts how children experience and achieve self-control. In particular, children with a more interdependent mindset may view their self-control as caused by external sources, rather than stemming from their own free will or choice. In turn, these children may be less likely to incorporate first person experiences with self-control into their beliefs about free will. Children with more independent mindsets may view their actions as self-caused and autonomously motivated. As a result, these children may perceive free will as underpinning their self-control and incorporate their first-person experiences into their more general beliefs about free will. Culture may impact children's beliefs about free will in more than one way, and there may be merit in multiple hypotheses.

Chapter 3 directly tested and found some support for this second hypothesis. Results revealed a relationship between beliefs and first-person experience for U.S. children. However, no relationship was observed in the Peruvian sample. Zhao et al. (2017) obtained similar results when comparing Chinese, U.S, and Singaporean children. Researchers found correlations between inhibitory control and free will beliefs for U.S. children but not for Chinese and Singaporean children. Taken together, this suggests that there may be some cultural variance in how self-control is experienced, particularly in the extent that children view their self-control as internally guided, and this in turn could mediate the relationship between beliefs and first-person experience.

Chapter 3 also causally tested the impact of experience on beliefs. Children were split into two conditions, and either answered the free will questions first or completed the self-control tasks first. This allowed us to measure carry over effects between tasks. Results indicated that the immediate experience with self-control shaped children's subsequent beliefs, and, in particular, failure at self-control more strongly impacted children's subsequent beliefs about free will. On the other hand, asking children the free will questions first did not impact their subsequent self-control scores.

This study provides evidence that first person experience does impact U.S. children's beliefs about free will and self-control, and suggests that, to some extent, beliefs about free will are grounded in our actual capacity to exercise choice. However, at this point, additional corroborating evidence would be valuable. In particular, one good follow up would be to experimentally vary the degree of children's success on a self-control task, and measure if this manipulation altered children's subsequent beliefs. This would provide additional support for the notion that first person experience shapes children's beliefs.

While evidence from U.S. samples supports the link between beliefs and abilities, results also raise several questions about this relationship and the development of free will beliefs. First, results suggest that children adjusted their beliefs accordingly after failing self-control, however there is no evidence that success increased their tendency to endorse free will. This raises the question of where beliefs about free will come from to begin with. Currently we have no evidence that first person experience with self-control causes children to endorse free will or gives children a belief in free will. Furthermore, there is no evidence that Peruvian, Chinese and Singaporean children's beliefs are impacted by first person experiences whatsoever. These children, nevertheless, do come to endorse free will eventually. The specific type of experience that leads children to endorse free will, thus, remains unidentified. Given the current results, it seems likely that this process would be different across cultures.

Even so, it is still possible that children's beliefs are premised on first person experiences, and the present study design failed to find this. One limitation of Chapter 3, is that children were instructed to practice self-control by the experimenter. These more externally motivated self-control tasks can be contrasted with the classic marshmallow study design, where self-control may be more internally motivated. During the classic marshmallow task, the child is first asked if they would like one marshmallow now, or two later. Most children state that they would prefer the larger snack, even if it involves a wait. Thus, children first decide if they want to wait, and any subsequent self-control is the result of this decision. In the present study, it is possible that many children perceived their self-control as prompted by the experimenter, rather than internally chosen. As a result, in the present study, children may have not viewed their success as self-caused, but rather driven by the experimenter. Failure, on the other hand, could not have been driven by the experimenter's instructions, and may have been perceived as an internal breakdown of free will.

Another explanation for the asymmetry between success and failure is that failure may have been a more salient experience than success. Perhaps children began the task expecting to be successful, however many were not. If so, erroneous expectations may have surprised children, and as a result, strongly impacted their subsequent beliefs. These questions could be further explored in follow-up studies.

## **5.2 Discussion of Chapter 4**

Chapter 4 explored if desires themselves directly impact children's beliefs. In Chapter 4, children were asked to make predictions about random events; children had to guess which color of egg or which card type had been randomly selected. Desirability was pitted against probability, meaning that the desirable outcome was statistically unlikely. We found that, across



experiments, desires had a strong impact on children's predictions. A strong effect was reliably observed for U.S. middle and lower-income children, as well as for lower-income Peruvian children. In middle-class U.S. children, this effect diminished over the course of development. This developmental trend was not observed in Peru.

In Experiment 1 of Chapter 4, we showed Peruvian and U.S. 4- and 6-year-olds decks of cards, and children were asked to make predictions about a random card draw. In the experimental condition, children received prizes only if an unlikely card was selected. This was contrasted with a control condition, where children received prizes regardless of which card was selected. In the control condition, children tended to state that the more probable or likely card had been selected. In the experimental condition, however, children did not state that the probable card had been selected. Rather, many children believed that the desirable, and unlikely, card had been selected. This suggests that children's desire for the unlikely outcome biased their responses in the experimental condition. Results held across cultural and age groups, however across both experimental and control conditions, older children (6-year-olds) were more likely to state the probable outcome than younger children (4-year-olds). These results may reflect developmental changes in probabilistic reasoning, however they could also indicate that desires bias younger children's expectations more than older children's. In this paradigm, desires may have also bias younger children's expectations to a greater extent because they have less developed probabilistic reasoning skills.

Experiments 2, 3, and 4 were similar, however a slightly different methodology was used. In these experiments, children viewed a plastic bag with 10 plastic eggs, 8 of one color, and 2 of another color. Children had to guess which color of egg had been randomly selected. In the experimental condition, the less likely color contained two prizes, whereas the more likely color did not contain prizes. In the control condition, all eggs contained two prizes. Across all experimental conditions, younger children (4- and 5-year-olds) consistently believed that the desirable and unlikely egg had been selected, suggesting that the desirability outweighed probability. However, in the control conditions, children made accurate probability judgments, and in general, there was a large difference in children's responses when contrasting control and experimental conditions. In Experiment 3, we saw a culture by age interaction, indicating that older U.S. children (6- and 7-year-olds) were less biased than younger U.S. children (5-year-olds) as well as all Peruvian children (ages 5 to 7). In this study, wishful thinking attenuated during early childhood in the U.S. A comparable pattern of results was not observed in Peru.

Notably, in Experiment 3, 5-year-olds from the U.S. responded comparably to 6- and 7-year-olds on the control questions, yet differently on the experimental questions. This seems to suggest that, even when probabilistic reasoning skills are comparable, younger children from the U.S., and all children from Peru, were still more biased by the desirable outcome than were the older children from the U.S. This raises questions about what specifically changes with age, and why the developmental shift is different across cultures.

There are a few possible explanations for why we may have observed such a strong bias in young children, and why it may have weakened with age in the U.S. One possibility is that children's explicit ability to reason about probability is still developing. It may continue to develop past 5 years of age, and the development of this ability could be accelerated in U.S. children compared to Peruvian children. If so, the control tasks used in the present experiments may have just failed to capture the upper limit of this developmental change. Another possibility is that reasoning about probability together with desirability requires advancement in some other

aspect of cognition, such as inhibitory control. Perhaps stating the probable outcome in the experimental condition requires children to first inhibit themselves from stating the desirable outcome. Notably, there were no cultural differences in the inhibitory tasks used in Chapter 2, which might weigh against this possibility. However, other inhibitory control tasks, such as a stroop type task, may yield cultural differences. If changes in inhibitory control account for the developmental shift, older children and adults may display a stronger bias under certain conditions, for example when they are asked to make rapid judgments. Future work could explore this.

A third possibility is that young children's beliefs about uncertain outcomes, particularly those that are desirable, undergo conceptual change over the course of development. Young children may initially believe their desires predict outcomes, or even that their desires have a causal impact on outcomes. Indeed, in some cases this may be a reasonable assumption, for example, in cases where people can actually exert control over outcomes. Additionally, adults often modify outcomes to be consistent with infants and young children's desires, providing further support for this belief. As children get older, they may encounter more situations where their desirable predictions do not hold. Over the course of time, children may begin to realize that desirable outcomes do not always manifest simply because they want them to, but rather other information must be factored into their predictions, such as the likelihood evidence in the present studies. Children may revise their predictions accordingly. This third possibility would be in line with a more rational constructivist approach to developmental change.

Review of the previous literature suggests that adults still hold a wishful thinking bias, as do school aged children, although it appears to weaken over the course of development. A rational constructivist account can explain these developmental trends. It predicts that inferences will result from the strength of the probability evidence that is observed (e.g. the ratio of desirable to undesirable outcomes) as well as prior beliefs about the extent to which likelihood influences outcomes. The present results also suggest that desires factor into this equation, and strongly impact decision making. Young children may only weakly believe that likelihood impacts outcomes. As a result, desires are weighed strongly. As children get older, they may develop a stronger belief that likelihood impacts outcomes, and, as a result, become less likely to endorse improbable and desirable outcomes. However, they may still hold a predisposition towards engaging in wishful thinking. This predisposition may be expressed when likelihood ratios are less extreme, when outcomes are less straight-forward or more convoluted, or when people are asked to make judgments within domains they have limited prior knowledge of. This hypothesis could easily be tested.

One question that arises is where this bias comes from to begin with? Do children learn to be wishful thinkers, or are humans just innately biased by their desires? It is possible that children do acquire a wishful thinking bias very early in development. As mentioned above, it is reasonable to associate desires with some types of outcomes, particularly those in which people can exert control. On the other hand, several researchers have suggested that an optimism bias, more generally, could confer an evolutionary advantage in spite of its apparent irrationality and so might develop very early and independently of evidence. (Johnson and Fowler, 2011; McKay and Dennett, 2009; Sharot, 2012; Sharot, Korn, and Dolan, 2011). Research with adults suggests that an optimism bias is associated with a range of adaptive benefits (e.g. Scheier, & Carver, 1992). Optimism may be especially advantageous to children because it could guide them towards new learning experiences and encourage them to persevere after failed attempts. Wishful

thinking, in particular, could have evolved to enhance adaptive optimism. At this point, both accounts are plausible.

In addition to providing an account for why wishful thinking changes over the course of development, the rational constructivist account makes several predictions. First, wishful thinking is a cause of optimism, so this account predicts that any resulting optimism, more generally, will calibrate in response to experience. In line with this, several developmental studies presented earlier (e.g. beliefs about traits and abilities, or general confidence) do suggest that optimism more broadly changes over the course of development.

Second, this account predicts that developmental declines in wishful thinking (and the resulting optimism) will covary with available evidence in support of alternative hypotheses. As a result, we can predict individual and cultural differences when evidence is variable. In line with this, previous studies have found variation in developmental shifts in optimism. In Experiment 3, we found that wishful thinking attenuated by 7 years of age in the U.S. sample, however this was not the case in the Peruvian. Relatedly, Lockhart, Nakashima, Inagaki, and Keil (2008) measured Japanese and North American children's beliefs about negative physical and psychological traits, finding that 8-to 10-year-old Japanese children were more likely to predict positive changes than were 8-to 10-year-old North American children. Younger children from both cultures, on the other hand, similarly displayed high levels of positivity. Future work should consider the type of evidence that underpins the observed cultural differences in developmental shifts. Due to the more exploratory nature of Chapter 4, this falls outside of the scope of the current paper.

Third, across domains (e.g. beliefs about stochastic events vs. traits and abilities), children encounter evidence at different rates. Given this, we can predict domain differences in developmental shifts in optimism. Again, surveying the available evidence provides support for this. In Chapter 4, we saw a developmental decrease in optimism by 6 to 7 years of age. However, studies exploring North American children's beliefs about traits and abilities suggests a developmental shift later in development, at 8 to 10 years of age (e.g. Lockhart, Goddu, and Keil, 2017). Given this, it seems likely that developmental shifts are premised on different patterns of evidence across domains.

While this account may explain developmental and cross-cultural findings in wishful thinking and optimism, it is not yet clear if wishful thinking is actually related to the earlier findings on optimism and positivity. In these studies, children may have judged negative traits to be more malleable because they wanted the story character to possess positive traits. Or children may have displayed over confidence in their own abilities because they wished it to be true. However, there are several alternative explanations for these findings.

Importantly, many of the studies demonstrating valence effects in children's reasoning about traits asked children to make judgments about a story character, rather than themselves. While children may have wanted the story character to display positive attributes, this was not explicitly measured; children were not asked what outcome they themselves preferred. Given this, it is not clear if children's own desires aligned with the positive trait valence. This could, however, be easily measured in follow-up studies.

Second, there are several alternative reasons why young children may have answered positively in these previous studies about traits and abilities. First, previous research suggests that younger children believe that positive traits are more widespread than older children (Lockhart, Chang, & Story 2002). Differences in beliefs about base rate prevalence could have biased children's responses and caused them to more readily endorse the positive attribute. If this

is so, developmental changes would be due to different beliefs about trait prevalence. Alternatively, beliefs about trait prevalence could be influenced by wishful thinking, or children could hold weak prior beliefs about trait prevalence. If so, an *a priori* wishful thinking bias may more strongly impact their inferences. Second, research suggests that younger children also believe people have more control over the development of traits, than do adults (Lockhart, Chang, & Story, 2002; Stipek & Mac Iver, 1989). This may cause younger children to believe that people can improve over time if they want to. If so, developmental changes may be due to developmental differences in beliefs about malleability, rather than wishful thinking. However, again, beliefs about trait malleability could also be directly impacted by wishful thinking. Similarly, if younger children hold weak beliefs about trait malleability, an *a priori* tendency to engage in wishful thinking may strongly bias their predictions.

Another factor to consider, particularly when considering studies on confidence, is that feedback from adults may change during development, and this may in turn shape children's beliefs about their own abilities. Importantly, empirical evidence suggests that young children's confidence is sensitive to adult feedback. For example, Stipek and Daniels (1988) found that while kindergarteners generally rate their academic attainment higher than 4th graders, kindergarteners who were given feedback similar to 4<sup>th</sup> graders rated themselves comparably. This could indicate that children's confidence is directly impacted by adult feedback; perhaps young children are overly confident because they receive more positive feedback from adults, and, as children get older, adults may begin to provide more realistic feedback. Alternatively, wishful thinking could cause young children to be overly confident about their own abilities. For example, they may think they can run really fast because they want to run really fast. With age, children may receive testimony, or other experiential evidence, suggesting otherwise, and adjust their beliefs accordingly. Of course, both explanations could hold some merit. Future work could explore this.

In sum, the findings from Chapter 4 do suggest that young children engage in wishful thinking, and that wishful thinking is a cause of young children's optimism. However, it is not yet clear why young children engage in wishful thinking and what causes the observed developmental and cultural differences. Furthermore, it is not yet clear how wishful thinking is related to previous developmental findings on optimism, positivity and confidence. Future research should more thoroughly explore these questions.

### **5.3 Conclusion**

This dissertation outlines a series of experiments exploring young children's judgments about desirable possibilities, how these judgments change over the course of development, and if they do so differentially across cultures. While predictions about stochastic events and those about agency have been considered separately throughout this dissertation, studies do share some underlying similarities. Importantly, all studies presented do suggest that desires initially bias children's beliefs, and that, over time, children's predictions change. Furthermore, the available evidence suggests variation in developmental shifts.

Across chapters, one question arises: how do we explain these changes in children's beliefs and what, more specifically, is changing during development? A rational constructivist

approach suggests children's understanding changes over the course of development as new evidence is accumulated. In the case of agent causation, children may initially believe that people act consistently with their desires. Over time, they may realize that this is not always true, and begin to consider other causally relevant factors, such as choice or free will. With regards to stochastic events, children may initially believe that their desires impact future events. Over time, children may encounter situations where their desires do not align with outcomes. In light of this, they may revise their understanding to include other causally relevant factors, such as probability in the present studies.

Importantly, this account predicts that developmental changes will covary with available evidence indicating that any environmental or cultural differences in relevant evidence should cause corresponding differences in conceptual change. In the present dissertation, children from different countries provided different patterns of responses, however, the more specific input that underpins these differences is less clear. In Chapters 2 and 3 we hypothesize that first-person experience practicing self-control, as well as culturally informed notions of agency, could impact children's beliefs about choice and free will. If and how culture impacts wishful thinking, however, is less clear. In general, children's reasoning about stochastic events may be influenced by different sources of evidence, including testimony, observation, or direct experimentation, all of which could be variable across individuals and cultures. Future studies could more systematically explore this.

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