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*Georgia State University*

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A Comparative Perspective on the Paradox of Choice

by

Maisy D. Bowden

Under the Direction of Michael J. Beran, PhD

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

in the College of Arts and Sciences

Georgia State University

2021

## ABSTRACT

The paradox of choice leads one to desire more options over fewer options even when there are negative consequences when choosing from larger arrays (choice overload). The paradox of choice may be shared among mammals or it could result from cultural influences relevant to humans. Research with monkeys and young children sheds light on the developmental precursors of the paradox and may highlight the human-uniqueness of this effect. I tested young children (41.5–66.0 months) and monkeys (tufted capuchins, rhesus macaques) to examine choice overload effects. Limited evidence was found that children exhibited choice overload when choosing among six and twelve toys but not when choosing among three toys. No evidence of choice overload was found for monkeys, although this may be due to methodological limitations. Consistent with previous literature on choice and control, monkeys also demonstrated a preference for more options over fewer.

**INDEX WORDS:** Paradox of choice, Choice overload, Comparative cognition, Nonhuman primates, Developmental psychology

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2021

A Comparative Perspective on the Paradox of Choice

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May 2021

**DEDICATION**

This thesis is dedicated to my mother, for getting me started; to Grace, for keeping me going; and to Andrew, for seeing me through – in this endeavor, and all the others.

## ACKNOWLEDGEMENTS

I would like to express my sincere appreciation and gratitude to my advisor and committee chair, Dr. Mike Beran, who not only encouraged my ideas and challenged my thinking, but has also helped me to navigate the confusing and arduous world of graduate school. Without your support and guidance, this thesis would not have been possible. Thank you.

Besides my advisor, I would also like to thank my other committee members: Dr. David Washburn, Dr. Sarah Brosnan, and Dr. Bonnie Perdue, for your insightful questions and feedback, and for your kindness and flexibility in light of the abrupt changes made due to the pandemic. A special thank you to Dr. Washburn for helping me grow the seed of this idea into a full-fledged project plan.

I wish to extend a special thanks to Will Whitham, who acted as a stand-in advisor and mentor to me in my first couple years of graduate school, and who helped me develop my data analysis plan for this project. I look forward to a future of collaboration and friendship.

Additionally, I have the unique experience of getting to express my gratitude to my sister- and father-in-law for their professional assistance in coding in R and helping me interpret data using generalized linear mixed models. Thank you, Doug and Alina, for wearing two hats during this process, I love you.

I'd also like to thank the members of my lab for helping me with data collection: Brielle, Kristin, Joel, Myah, Liz, Emma, Molly, and Will.

My research was made possible by funding from the Georgia State University 2CI Primate Social Cognition and Evolutionary Behavior Fellowship program.

## TABLE OF CONTENTS

<b>ACKNOWLEDGEMENTS</b> .....		<b>V</b>
<b>LIST OF TABLES</b> .....		<b>IX</b>
<b>LIST OF FIGURES</b> .....		<b>X</b>
<b>1 INTRODUCTION</b> .....		<b>1</b>
<b>1.1 Evidence that the need for control is widespread across species</b> .....		<b>1</b>
<b>1.2 Evidence for limits to the benefits of control</b> .....		<b>5</b>
<b>1.3 The paradox of choice</b> .....		<b>7</b>
<b>1.4 Consequences of choice overload: Dependent measures</b> .....		<b>8</b>
<i>1.4.1 Choice satisfaction</i> .....		<i>9</i>
<i>1.4.2 Choice switching</i> .....		<i>10</i>
<i>1.4.3 Performance</i> .....		<i>10</i>
<b>1.5 Mechanisms of choice overload: Factors that moderate the effects of large arrays</b> .....		<b>11</b>
<i>1.5.1 Choice set complexity: Presence of a dominant option</i> .....		<i>13</i>
<i>1.5.2 Preference uncertainty: Articulated ideal point</i> .....		<i>14</i>
<i>1.5.3 Summary</i> .....		<i>15</i>
<b>1.6 The gap in the literature</b> .....		<b>15</b>
<b>1.7 The present study</b> .....		<b>17</b>
<b>2 EXPERIMENT 1</b> .....		<b>21</b>



2.1	Participants.....	22
2.2	General procedure .....	22
2.3	Experiment 1a: Investigating choice overload in children.....	23
	2.3.1 Controlling for prior preferences or dominant alternatives .....	23
	2.3.2 Procedure.....	24
3	EXPERIMENT 1 RESULTS .....	26
4	EXPERIMENT 2 .....	30
4.1	Subjects .....	30
4.2	Apparatus .....	31
4.3	Tasks.....	31
4.4	Controlling for prior preferences or dominant alternative.....	34
4.5	Experiment 2a: Investigating choice overload in monkeys.....	37
	4.5.1 Design .....	37
	4.5.2 Dependent measures: Task switching .....	39
	4.5.3 Dependent measures: Latency to make a task choice.....	39
	4.5.4 Dependent measures: Latency to complete a task (task performance) .....	39
	4.5.5 Dependent measures: Dropouts.....	40
4.6	Experiment 2b: Determining condition preference in monkeys.....	40
	4.6.1 Design .....	40
5	EXPERIMENT 2 RESULTS .....	42

5.1	Experiment 2a: Investigating choice overload in monkeys .....	42
5.2	Experiment 2b: Investigating choice condition preference in monkeys .....	46
6	DISCUSSION .....	48
	REFERENCES.....	56
	APPENDICES .....	65
	Appendix A: Instructions and Script for Experiment 1a.....	65
	Appendix B: Favorites Questionnaire.....	66
	Appendix C: Smiley Face Likert Scale.....	67

## LIST OF TABLES

Table 1. Relative difference in latency to choose a toy as a function of choice condition. ....	26
Table 2. Children’s raw switching rates in each choice condition. ....	28
Table 3. Adjusted odds ratio of children’s toy switching based on choice condition. ....	28
Table 4. Correlation matrix demonstrating relationship between number of options and children’s satisfaction score, latency to choose, and switching likelihood.....	29
Table 5. Relative difference in children’s satisfaction rating as a function of choice condition. .	30
Table 6. Results of Chi square tests. Monkeys who completed all 600 trials had an expected raw count of 200 in each cell should the null hypothesis not be rejected. Expected raw counts for monkeys who did not complete all 600 trials (Gretel and Lychee) were calculated by dividing their total trial count by three. Cell values that fell outside of the expected distribution range are signified with an asterisk. Monkey species is indicated by cap (capuchin) or mac (rhesus macaque). ....	47

## LIST OF FIGURES

Figure 1. Conceptual model of moderators and consequences of choice overload. Adapted from Chernev et al., (2015).....	12
Figure 2. Latency to make a choice as a function of choice set size. Error bars represent 95% confidence intervals. ....	27
Figure 3. SELECT screen(s). (a) represents the SELECT screen in the LC condition. (b) represents the SELECT screen in the IC condition. (c) represents the SELECT screen in the EC condition. ....	33
Figure 4. Forced trials. (a) Forced CHASE selection screen. (b) CHASE task: cursor must chase moving target until contact is made. (c) Forced DEFLECT selection screen. (d) DEFLECT task: cursor must come into contact with (stationary) ovals. Ovals will appear in any of the four cardinal directions around the cursor. (e) Forced MAZE selection screen. (f) MAZE task: cursor must be navigated around blockades to reach the target. ....	38
Figure 5. Condition Selection and Task Selection screens. Monkeys must manipulate their joystick in order to select their preferred choice condition (LC, IC, or EC). This selection will lead the monkey to the corresponding task selection screen with either three (LC), six (IC), or nine (EC) task options. They must then navigate the cursor to the task of their choosing, and complete the task to receive their pellet reward. ....	41
Figure 6. The average time it took monkeys to select a task in each choice condition. Error bars represent 95% confidence intervals. ....	43
Figure 7. Monkeys' overall proportion of task switching as a function of choice condition. Error bars represent 95% confidence intervals.....	44

Figure 8. The average time it took monkeys to complete tasks in each condition (“task performance”). Error bars represent 95% confidence intervals..... 45

## 1 INTRODUCTION

Humans make countless choices each day. In the first hour after waking up, we may decide what to wear, what to eat, whether to go into work, the route we want to take, what we want to listen to on the way, and so on. Nonhuman animals (hereafter, animals) also make many choices every day, some that are critical to their survival (e.g., who to attack, who to defend, where to feed, where to sleep) and some that are not (e.g., who to play with, what to investigate, etc.). Having choices provides us with a perception of control over our environment (Perlmutter & Monty, 1977), and it enhances our feelings of autonomy and self-determination (Deci & Ryan, 1985). It is widely accepted that possessing a sense of control over one's environment, that is, by having choices, is a psychological necessity for the wellbeing of humans and other animals (e.g., Leotti et al., 2010; Deci & Ryan, 1985; Washburn, 2015), such that we—humans and other animals—have evolved to desire and seek out choice and control.

### 1.1 Evidence that the need for control is widespread across species

In their review of the psychological literature on control, Leotti and colleagues (2010) argued that perceiving control over one's environment is evolutionarily adaptive, because increased control over the environment will improve an animal's chance of survival. For instance, when faced with choices, animals are likely to choose the option that provides them with the most favorable outcome and avoid the option that may cause harm (Leotti et al., 2010). Leotti and colleagues (2010) point to evidence that indicates control is needed for typical, healthy development: for instance, healthy individuals tend to overestimate their personal control in a situation as compared to depressed people, and healthy individuals will attempt to rationalize outcomes where they did not have control rather than concede any loss of their perceived control (Alloy & Abramson, 1979; Cannon, 1999; Lewinsohn et al., 1980; Peterson & Seligman, 1987,

as cited by Leotti et al., 2010). Further, the authors point to evidence that overcompensation for a diminished sense of control can lead to maladaptive, destructive behaviors and mood disorders (Fenton-O’Creivy et al., 2003; Goodie, 2005; Shapiro et al., 1996, as cited by Leotti et al., 2010).

To argue that control over choices is adaptive, humans and other species must experience positive side effects when they have increased control and, correspondingly, experience negative consequences when their perception of control is diminished. The psychological literature has demonstrated evidence to support this claim: a diverse range of animals – including flies (Batsching et al., 2016), pigeons (Catania, 1980; Catania & Sagvolden, 1980), rats (Voss & Homzie, 1970), and monkeys (Beran et al., 2007; Suzuki, 1999; Washburn, 2015; Washburn et al., 1991) – are sensitive to the perception of control and prefer having more choices.

The removal of the perception of control is similarly aversive and harmful to many species. In their classic study on learned helplessness, Seligman and Maier (1967) demonstrated that dogs who were repeatedly exposed to inescapable shock later did not attempt to escape electric shock even when it was avoidable. This study led to an abundance of research on the psychological impacts of choice and lack thereof. The research that followed illustrated that diminished autonomy or personal control leads to decreased performance, motivation, and cognitive functioning, and greater likelihood of developing mood disorders and maladaptive behaviors (Greenberger et al., 1989; Langer & Rodin, 1976; Leotti et al., 2010; Seligman & Maier, 1967; Washburn et al., 1991; Winocur et al., 1987). For instance, institutionalized individuals, such as those in nursing homes, prisons, and hospitals, who inevitably are less able to exercise control over their day-to-day lives, experience reduced physical and psychological wellbeing and increased learned helplessness (nursing homes: Langer & Rodin, 1976; prisons:

Schill & Marcus, 1998; hospitals: Raps et al., 1982). Similarly, animals in captivity display stereotypical behaviors (repetitive, purposeless behaviors induced by stress) likely due, at least in part, to decreased control over their environment compared to their feral counterparts (Kurtysz, 2015).

Whereas diminished control has harmful effects on psychological well-being, the opposite is also true: increasing the perception of control greatly benefits satisfaction, motivation, and performance in humans and other animals (e.g., Beran et al., 2007; Greenberger et al., 1989; Langer & Rodin, 1976; Leotti et al., 2010; Perlmutter & Monty, 1977; Washburn et al., 1991; Zuckerman et al., 1978). For instance, pleasure is enhanced when rats can control their positive reinforcement rather than receive it passively (Faircloth, 1974), and self-controlled locomotion in rats caused faster healing following surgery than passive movement through an identical environment (Dru et al., 1975). Additionally, Washburn and colleagues (1991) found that rhesus monkeys' performance on computerized tasks improved when they choose their own tasks compared to their performance when the same task was assigned to them, eliminating the opportunity for choice. Monkeys demonstrated this improved performance because they maintained greater motivation when they were provided with choices compared to when no choice was available (Washburn et al., 1991). Beran and colleagues (2007) replicated this result in a similar study with capuchin monkeys who were able to choose the order in which they were able to complete their tasks.

Humans' performance also appears to improve when an element of control is introduced. Institutionalized older people who possessed greater control over their day-to-day lives had greater physical and psychological well-being than those who had less control (Langer & Rodin, 1976). In the same vein, institutionalized older people's personal locus of control



(operationalized by the individuals' ratings of their desire for control multiplied by their ratings of their perceived control in several areas of life; see Reid et al., 1977) predicted performance on cognitive tasks better than stress and psychosocial measures, where a higher perceived locus of control led to higher performance on a cognitive battery (Winocur et al., 1987). Other studies have found a similar positive correlation between perception of control and performance (Greenberger et al., 1989; Perlmutter & Monty, 1977), intrinsic motivation (Greenberger et al., 1989; Perlmutter & Monty, 1977; Zuckerman et al., 1978), and satisfaction (Greenberger et al., 1989).

Perhaps the most compelling evidence pointing to the adaptive nature of the perception of control is that animals and humans *choose to choose*. Rats and children sometimes will choose to work for food rather than accepting free reward (Singh, 1970), and Perdue and colleagues (2014) empirically tested rhesus and capuchin monkeys' preference for choice by providing them the ability to choose the order in which they completed a task or choose to receive the tasks in a previously established preferred order. The monkeys maintained a preference for choice, even when the alternative already provided a preferred task order, providing supporting evidence that the perception of control is inherently rewarding (Perdue et al., 2014). Finally, humans and capuchin monkeys will choose an option simply for the sake of not losing that option from a choice array (Perdue & Brown, 2018; Shin & Ariely, 2004). That is, when given a computerized choice array in which one icon that leads to a specific task becomes progressively smaller following each trial where it is not chosen (until the option disappears entirely or is restored to full size by selecting the option), humans and capuchin monkeys will eventually choose the diminishing option, even when it is not preferred, rather than losing it entirely. This indicates that

humans and capuchins would prefer to ‘keep their options open,’ even when some of those options are less preferred or provide no additional benefit (Perdue & Brown, 2018).

It is important to note that choosing to choose requires a greater expenditure of energy than being assigned a task; therefore, it must be an important aspect of a choice environment (Leotti et al., 2010). Together with the evidence that removing an animal’s control over their environment leads to extensive and long-lasting psychological harm and introducing control prompts immediate benefits in cognitive performance, mental health, and overall well-being in a wide range of animal species, it is reasonable to conclude that the perception of control is not just a desire; rather, possessing some perception of control is a *need* and is a key component of the psychology of rats, dogs, pigeons, flies, and primates, and likely extends even more broadly phylogenetically. Providing choices is one way by which to give an animal control over its environment, which, for most species, would beget more beneficial outcomes. Therefore, it would follow that most animals may have evolved to always prefer having more choices – even when, in some cases, more choices may do more harm than good.

## **1.2 Evidence for limits to the benefits of control**

Psychological research informs us that humans and other animals are prone to making common, systematic decision-making errors (Furlong & Santos, 2014). Though we may think that our choices and our preferences are our own, both humans’ and nonhuman primates’ (hereafter, primates) decision making can easily be manipulated through priming effects and social pressure (see Furlong & Santos, 2014, for a review). Evidence points to environmental factors that often predispose humans and primates to make certain decisions (and mistakes), at least when it comes to economic, numeric, or social decisions (e.g., the Prisoner’s dilemma and numeric discrimination, Furlong & Opfer, 2009, 2012; Furlong & Santos, 2014; inequity

aversion and cooperation, see Brosnan & de Waal, 2012, for a review). However, intuition may lead us to believe that when it comes to *well-being*, we would always be able to choose correctly—would we not always be able to choose what makes us feel best? The common perception is that more control, more choices, and more freedom equals more happiness. Mounting evidence indicates that this is a flawed assumption.

Although in general having control is better than not having control, there are some notable constraints to the benefits of control. For instance, control itself is not as important as the *perception* of control. Individuals perform better when they perceive a greater amount of control (e.g., when they are making a decision between two equally meaningful alternatives) compared to less perceived but functionally equivalent control (e.g., when there is an ‘obvious choice,’ where one alternative is clearly better than the other; Perlmutter & Monty, 1977). Further, the *timing* of perceived control matters: individuals who chose the first three stimulus-response pairs in a set of 12 (and were assigned the rest of the stimulus-response pairs) memorized the pairs equally as well as individuals who were able to choose all 12 pairs (Perlmutter & Monty, 1977). In contrast, individuals who chose the final three stimulus-response pairs performed as poorly as those who were provided no choice (Perlmutter & Monty, 1977). Individuals who were able to choose pairs that were randomly distributed throughout the set of twelve learned the pairs at an intermediate level (Perlmutter & Monty, 1977). Collectively, this evidence indicates that having control over a situation (via provided choices) does not necessarily or automatically lead to greater performance or satisfaction. Finally, mounting evidence indicates that there may be such a thing as *too much* control, where too many choices leads to negative outcomes (*choice overload*; e.g., Iyengar & Lepper, 2000; Schwartz, 2000, 2004).

### 1.3 The paradox of choice

Basic economic theory and common intuition lead us to believe that more choice is always better, and therefore an attraction to larger arrays should not be problematic. In line with this conception, research demonstrates that people desire more control than they have (Greenberger et al., 1987), and people are drawn to opportunities to choose from a higher number of alternatives (Bown et al., 2003; Iyengar & Lepper, 2000). For instance, shoppers are more likely to approach a jam tasting booth that includes 24 jams than a tasting booth that includes six (Iyengar & Lepper, 2000), and consumers report greater enjoyment from the decision-making process when they chose an item out of a larger array compared to participants who chose from a smaller array (e.g., Haynes, 2009; Iyengar & Lepper, 2000). Surprisingly, although we tend to be initially drawn toward a higher number of alternatives, people who choose from a larger array of choices are often more likely to experience negative consequences associated with their choice (e.g., decreased satisfaction or performance) than individuals who chose from a smaller array (Iyengar & Lepper, 2000). This phenomenon is known as the paradox (or tyranny) of choice (Schwartz, 2004).

The paradox of choice has not been fully investigated in nonhuman animals or young children, and it is unclear whether this phenomenon is a product of sociocultural pressures and is unique to humans or is a byproduct of broader decision-making mechanisms and therefore likely to be present early in human development and in other animals. Humans' initial attraction to larger arrays could be a result of cultural influences, for instance, via the Western emphasis on individual freedom, reliance on the internet (which has no physical limits to the number of options it provides), and marketing strategies that push endless product alternatives. On the other hand, the tendency to be attracted to a greater number of options (no matter the psychological

cost) may be a product of general choice mechanisms, because larger arrays are statistically more likely to include a preferred choice. Further, more choice grants an organism more control over their environment, and therefore the ability to potentially select more desirable outcomes (Hutchinson, 2005; Leotti et al, 2010). Broadly, the present study aims to investigate the role of experience and culture on the paradox of choice by exploring whether monkeys (rhesus macaques and tufted capuchins) and young children (ages three to five) demonstrate the behavioral pattern that is typical of the paradox of choice effect in adult humans: an attraction to choosing from larger arrays that subsequently begets greater negative affect regarding those choices. I predict that the paradox of choice effect is a byproduct of conserved and evolutionarily widespread adaptation to prefer choice and control; accordingly, I hypothesize that humans and monkeys will exhibit a preference for larger arrays and experience more negative outcomes as a result of making a choice from a larger (compared to a smaller) array.

#### **1.4 Consequences of choice overload: Dependent measures**

The trademark of the paradox of choice, and what makes the phenomenon paradoxical, is the negative experience that come along with too many choices. The negative experience associated with choosing from too many options is known as *choice overload* (or *overchoice*). Choice overload is ubiquitous in the psychological literature; evidence for choice overload was documented well before the development of the paradox of choice (e.g., Payne & Bettman, 1992; Payne et al., 1993). However, until recently (e.g., Chernev et al., 2015) there has not been a formal operational definition for the choice overload effect. Rather, over the history of the research on the topic, studies have described a wide range of consequences that occur when we are faced with too many choices. For instance, Perlmutter and Monty (1977) noted that with increased choice comes increased potential for frustration, and Schwartz (2000) described the

general sensation of being overwhelmed, even paralyzed, by too many options. In experiments that attempted to systematically measure choice overload effects, researchers have used subjective and objective measures. For instance, *choice satisfaction*, (e.g., Diehl & Poynor, 2010; Haynes, 2009; Iyengar & Lepper, 2000), *anticipatory and post-decision regret* (e.g., Haynes, 2009; Inbar et al., 2011; Sagi & Friedland, 2007) and *decision confidence* (e.g., Dhar & Nowlis, 1999; Haynes, 2009) have been used as subjective measures of choice overload. On the other hand, *choice deferral* (e.g., Iyengar & Lepper, 2000; Chernev, 2005), *switching* (e.g., Chernev, 2003; Lin & Wu, 2006), *option selection* (e.g., Gourville & Sourman, 2005), and *assortment choice* (e.g., Chernev & Hamilton, 2009) have been used as objective measures of choice overload.

A recent meta-analysis on choice overload effects attempted to more formally operationalize the choice overload construct. Chernev and colleagues (2015) demonstrated that the majority of these measures (satisfaction, confidence, regret, deferral, and switching) reliably reflect choice overload effects, and can be used interchangeably (Chernev et al., 2015). Chernev and colleagues (2015) conceded that the dependent variables included in their meta-analysis do not represent an exhaustive list. For example, Chernev et al. (2015) failed to mention performance measures and consequences on overall well-being that have been documented in the literature. Although many consequences of choice overload have been reported, below I will only describe the dependent variables that will be directly relevant to my study.

#### ***1.4.1 Choice satisfaction***

Several studies have demonstrated that consumers were less satisfied with their selection when they chose from a larger array compared to a smaller array. For instance, in Iyengar and Lepper's (2000) seminal study, participants chose either from a limited array (six options) or

extensive array (30 options) of chocolates. Participants in the limited-array condition expressed greater satisfaction with their chocolate selection than did participants in the extensive-array condition. These findings have been replicated in other experiments and with differently sized arrays. For instance, Haynes (2009) found that people reported greater satisfaction with their prize selection when they chose a prize from three options than people who chose from 10 options, and Diehl and Poynor (2010) found that their participants were less satisfied with their selection of a computer wallpaper when they choose it from 50 alternatives compared to those who made a selection from 10 alternatives.

#### ***1.4.2 Choice switching***

Choice switching describes situations in which a participant makes a selection from an array and then changes their mind, returns their original selection, and chooses a different option from the same array. Research has demonstrated that, without access to an articulated ideal point (a combination of features that represents their ideal option), participants were more likely to exchange their originally selected box of chocolates to the most popular option than were participants who did have an articulated ideal point (Chernev, 2003). Similarly, individuals with a lower 'need for cognition' (NFC; which, according to the authors, indicates lower cognitive resources and higher propensity to rely on heuristics when making decisions in larger arrays) were more likely to make a switch in larger varieties than in smaller varieties (Lin & Wu, 2006). This tells us that an increased likelihood to exchange an original selection is indicative of choice overload.

#### ***1.4.3 Performance***

Increased choice overload tends to lower the quality of performance subsequent to the choice. Iyengar and Lepper (2000) demonstrated this in their study in which undergraduate

students were randomly assigned into one of two groups. All students were informed that they could write an essay in order to receive extra credit points, but one group was provided with 30 essay topics, and the second group was provided with six essay topics. The results showed that students in the limited-choice (six option) condition received higher scores on their essays than did students who were in the extensive-choice (30 option) condition. Similarly, individuals who had to choose from more laundry detergent options with more differing attributes (i.e., bleach content, fabric softener content, price, etc.; Jacoby et al., 1974) or who were under time constraints (Payne et al., 1993) made poorer choices than those who chose from fewer options/attributes or who were not under time constraints. One reason this may occur is because as decisions become more difficult (that is, choice overload increases) people rely more heavily on heuristics, which leads lower quality decisions (Payne et al., 1993).

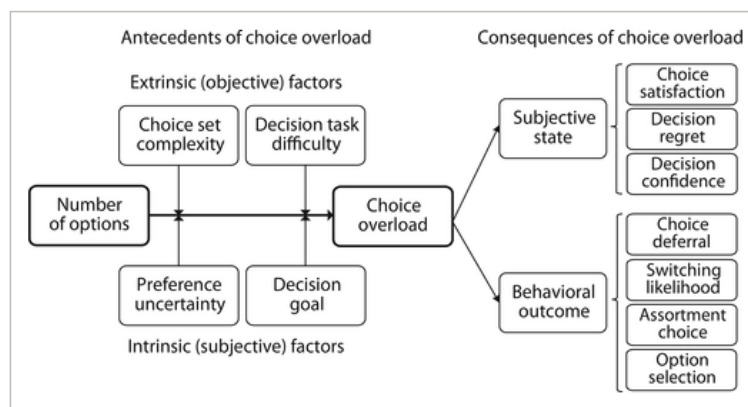
### **1.5 Mechanisms of choice overload: Factors that moderate the effects of large arrays**

It is important to note that choice overload is highly context dependent. In many cases, more choice does lead to better outcomes (the more-is-better effect). For instance, if I am specifically in the mood to eat a beet salad, I will have better luck finding a beet salad – or a close alternative – at a restaurant that offers 100 meal options than I am at a restaurant that offers six. Because some studies demonstrate the more-is-better effect and others demonstrate the choice overload effect, some researchers speculated that choice overload is not a reliable effect (e.g., Scheibehenne et al., 2010). However, Chernev and colleagues (2015) argued that *context matters*; that is, assortment size, alone, is not a reliable predictor of choice overload, but other factors do reliably moderate the effect of assortment size on subsequent subjective states and behavioral outcomes (Chernev et al., 2015). Chernev and colleagues (2015) argue that the seemingly non-significant effect of choice overload found in Scheibehenne and colleagues'



(2010) meta-analysis is a consequence of the authors' failure to take into account theoretically-driven and relevant moderators of choice overload.

In response to Scheibehenne and colleagues' (2010) meta-analysis, Chernev and colleagues (2015) proposed and found statistical support for their own theoretical model, which includes decision task difficulty, choice set complexity, preference uncertainty, and decision goal as moderators that influence whether a large array will lead to choice overload or the more-is-better effect (Figure 1).



*Figure 1.* Conceptual model of moderators and consequences of choice overload. Adapted from Chernev et al., (2015).

Chernev and colleagues (2015) remarked that there are likely even more moderators than the ones they included in their model. For example, evidence has been found that individual differences, such as cognitive ability (Lin & Wu, 2006) or certain personality traits (i.e., “maximizers” who exhaust every option before making a choice compared to “satisficers” who settle for ‘good enough’ options; Dar-Nimrod et al., 2009; Iyengar et al., 2006; Schwartz, 2000; Schwartz et al., 2002) can influence a person’s propensity to experience choice overload. Below, I will only discuss in detail the specific moderators that are immediately relevant to the present experiment; however, it is important for the reader to remember that there are many possible

ways by which to induce the effects of choice overload when choosing options from larger arrays, and larger arrays, in and of themselves, do not necessarily induce choice overload.

### *1.5.1 Choice set complexity: Presence of a dominant option*

The more complex a choice set is, the more likely a person is to experience choice overload when choosing from larger arrays. Presumably, this is because choosing from a more complex set requires more cognitive effort than when a simple choice can be made. One way to manipulate choice set complexity is through the presence of a dominant option.

In cases where one of the alternatives is obviously superior to the others, it becomes much easier to make a decision, therefore decreasing the likelihood of choice overload (Chernev, 2006; Payne et al., 1992). For example, choosing between 20 different rings, each with a precious gem in its center, would be a harder decision and therefore more likely to result in choice overload than choosing among an array with 19 plastic rings and one diamond ring.

Although not investigating the paradox of choice phenomenon, Perlmutter and Monty (1977) used a somewhat similar paradigm when investigating the importance of the perception of control, and they found that choosing between similarly desirable options (i.e., choosing among gold- and silver-plated pencils) led to a greater perception of control than choosing between options where there is a clear dominant option (e.g., a gold-plated pencil versus a wooden pencil). This provides support for the paradox of choice phenomenon: people perceive more control and enjoy the decision-making process more when making a more difficult decision (Perlmutter & Monty, 1977), but they are more likely to experience choice overload in these instances (Chernev, 2006; Dhar, 1997).

### ***1.5.2 Preference uncertainty: Articulated ideal point***

Preference uncertainty refers to an individual's predetermined product or attribute preferences (or lack thereof). When an individual is uncertain of their preferences, they are more likely to experience choice overload when making a selection from a larger array than are individuals who have clear, definite preferences (Chernev, 2003; Mogilner et al., 2008). The opposite is true of individuals who do possess clear predetermined preferences, who are more likely to defer choice and exhibit weaker preferences when choosing from a smaller array compared to a larger array (Chernev, 2003; Mogilner et al., 2008). These preferences can arise out of an individual's prior expertise or their *articulated ideal point*.

Possessing an articulated ideal point means that you have specific set of features or a specific item in mind that represents your ideal option. In the example I described earlier in the paper I indicated that, if I were in the mood to order a beet salad, I would have better luck (and more likely be satisfied) by going to a restaurant with a large menu over a restaurant with a small menu. My yearning for a beet salad is an example of an articulated ideal point: it is the combination of attributes that I know would most satisfy me. Even if my exact preference (i.e., my ideal combination of attributes) is not met, I am still more likely to find a close second that matches at least some of my ideal attributes – perhaps a pear salad – when I am choosing from a larger array. Therefore, it should follow that, if an individual has an articulated ideal preference, a larger array should lead to a more-is-better effect. Research supports this claim: participants who had an articulated ideal point (i.e., a preferred type of chocolate, or preferred attributes of chocolate) were less likely to switch their choice when they chose from a large array and more likely to switch their choice when they chose from a smaller array (Chernev, 2003). On the other hand, an individual who does not have an articulated ideal point should fare better from a smaller

selection; for instance, if I was not yearning a particular food, I should ultimately be more satisfied with my selection at the restaurant that provides menu choices. Research supports this claim as well: participants without a strong preference for chocolate type or chocolate attributes were more likely to switch their selection after choosing from larger arrays (Chernev, 2003).

### ***1.5.3 Summary***

A person's propensity to choice overload can be influenced by a number of factors, including the presence of a dominant option or a person's articulated ideal point. Having to choose from large arrays that do not have a clear "winner" (a dominant option or a preferred choice) is more likely to cause choice overload because more cognitive effort is required to weigh the relative benefits and disadvantages of the alternatives, which increases as the array increases in size.

## **1.6 The gap in the literature**

While extensive evidence supports the paradox of choice theory in human adults, very little research on this topic has been conducted with children and animals. Indeed, to my knowledge, no one has directly investigated the paradox of choice or choice overload in animals. However, Addessi and colleagues (2010) indirectly tested this question by investigating capuchin monkeys' preference for variety versus monotony. In this study, capuchins chose between two tokens. If the variety token was chosen, monkeys could choose a food item from ten different options, where one option was a highly-preferred choice and the other nine were less-preferred choices. Alternatively, if the monotony token was chosen, monkeys could choose a food item from ten identical, highly-preferred options. Consistent with the human data, capuchins preferred to make a choice from the array that included a single preferred option (the variety option).

However, unlike human tendencies, the monkeys tended to choose a less-preferred food from the array (Addessi et al., 2010).

Similarly, to my knowledge only one study has explored this topic with children, in which the researchers identified a curvilinear relationship between choice overload and age (Misuraca et al., 2016). Specifically, the researchers found that children (mean age of 9.8) and older adults (mean age of 76.6) experienced greater difficulty and less satisfaction when choosing from larger arrays than smaller arrays (consistent with the choice overload effect). However, when compared to adolescents (mean age of 16) and younger adults (mean age of 32.2), children and older adults experienced greater satisfaction and less regret when choosing from larger arrays (Misuraca et al., 2016). In other words, children and older adults were less susceptible to choice overload effects than were teens and younger adults (Misuraca et al., 2016) even though they did still experience such choice overload.

This study included a few important limitations; for instance, the dependent measure of satisfaction was based on children's rankings on a Likert scale, which, the authors noted, other research has demonstrated is not a reliable measure of children's feelings and opinions (Markopoulos et al., 2008, as cited by Misuraca et al., 2016; see also Mellor & Moore, 2013). Further, the authors remarked that children's and seniors' reports of greater satisfaction on their choice of cookie might have been a consequence of the documented differences between age and preference for sugar: older adults and children have been shown to have a stronger sweet tooth than adolescents and younger adults (e.g., Coldwell et al., 2009; Desor & Beauchamp, 1987; Walter & Soliah, 1995, as cited by Misuraca et al., 2016).

The current state of the literature leaves much to be desired regarding our knowledge of the paradox of choice effect in animals and young children. An investigation of these populations

can shed light on the evolutionary foundations and developmental nature of the paradox of choice effect. Specifically, it will help answer the question of whether the paradox of choice is a byproduct of cultural influences or a more widespread phenomenon likely grounded in mechanisms of choice behavior shared across species. That is, is it a result of cultural practices or is it a basic feature of decision making that has led us to always desire more choices, even when more choices ultimately leave us feeling less happy or more overwhelmed? Importantly, the answer to this question will better our understanding of choice behavior and cognitive processes more generally. That is, this research may help us understand whether the human tendency to seek out and expend effort to access more choices, *even when it diminishes our well-being*, is a result of cultural norms and the mindset that more choice is always better, or if we are biologically driven to always seek out more choice regardless of the psychological cost.

Further, this research could have important practical implications, especially for humans and other animals whose choice arrays are provided by others. For instance, institutionalized individuals and captive animals are provided only a subset of options for food and activities each day compared to their non-institutionalized counterparts. Data collected from this study may point to what number of alternatives may optimize psychological well-being when individuals are faced with a difficult decision, or, at least, at what point providing more options may do more harm than good.

### **1.7 The present study**

As previously mentioned, the tendency to be attracted to a greater number of options may be a product of cultural influence. Iyengar and Lepper (2000) named examples such as enterprises that market endless varieties of ice creams and fast food restaurants that encourage us to “have it your way.” Fasolo and colleagues (2007) noted that, with the advancement of the

internet, people today have virtually limitless choices. These factors, especially coupled with the Western value of ever greater personal freedom, may lead us to be attracted to a greater number of options, even when a greater number of options may ultimately reduce our well-being. Indeed, Schwartz (2000) pointed out that, because of these advances, people today have more choice than ever before. That being said, if more choice inherently evokes more happiness, it would follow that we should see greatly reduced rates of depression compared to past decades (Schwartz, 2000). On the contrary, depression rates, like our number of choices, are higher than ever, occurring at as much as 10 times the rate than in the previous 100 years (e.g., Klerman et al., 1985; Robins et al., 1984, as cited by Schwartz, 2000).

An alternative explanation for our attraction to a greater number of choices is the adaptive benefit that comes along with more control over the environment. That is, we may be instinctually driven to seek out more choices (no matter the psychological cost), because more options means a better chance of finding a preferred choice (e.g., a ripe fruit or a healthy mate) and more control over our environment (e.g., the ability to avoid a threatening situation). Decades of research has demonstrated that humans and animals are similarly sensitive to the perception of control (e.g., Perlmutter & Monty, 1977; Seligman & Maier, 1967; Washburn et al., 1991) and rely on similar cognitive processes and heuristics when it comes to making decisions (Brosnan & de Waal, 2012; Furlong & Santos, 2014). Consequently, I hypothesize that the paradox of choice is a shared phenomenon across species due to shared mechanisms underlying choice behavior, and therefore will be present early in human development and in other animals.

The present study also addressed limitations found in other studies. For instance, our measures were primarily behavioral (i.e., latency to make a choice, switching likelihood, dropout rates, performance) and therefore were not subject to the disadvantages associated with self-

report data that are often used in other studies. Switching likelihood and performance have been used as dependent measures of choice overload in previous literature, and so those are valuable measures here. I proposed that longer latency to make a choice (above and beyond proportional scanning time) would be indicative of increased cognitive effort; in other words, taking longer to choose would indicate greater decision difficulty. I also used a modified Likert scale to collect children's satisfaction ratings with the toys they choose, with smiley faces that increased in size (Appendix C). However, past research has demonstrated that children's responses on Likert scales are not reliable measurements of their feelings and moods (Mellor & Moore, 2013); therefore, the satisfaction data acted as a potential secondary, supporting analysis to our other collected measurements.

In line with Chernev and colleagues' (2015) meta-analysis on the moderators of choice overload, I attempted to induce potential choice overload effects by eliminating options that would be considered objectively or subjectively dominant (i.e., options that include higher quality attributes or that closely matched the participants' previously established preferences). This was important because previous research has demonstrated that individuals are more likely to experience choice overload at larger arrays when those arrays do not include a clearly superior alternative or an alternative that matches the participant's ideal point (Chernev, 2003, 2006).

Finally, I used three, six, and nine options (for monkeys) or three, six, and 12 options (for children) in the limited-choice, intermediate-choice, and extensive-choice conditions, respectively. In human (adult) studies, the most commonly utilized number of alternatives is 16-24 for the extensive-choice condition (Chernev et al., 2015), and this range falls outside of what is considered the typical range of items that adult humans can maintain in their working memory (Miller, 1956). However, it is important to note that paradox of choice effects have been found at



relatively smaller arrays (e.g., three versus ten; Haynes, 2009). In this study, I used relatively smaller arrays (three, six, and nine or 12) for the practicality of designing the computer program on which the monkeys will be tested. Additionally, nine (for the monkeys) and 12 (for the children) falls outside the range of what is easily and immediately countable.

Six is the most commonly used number of alternatives for the limited-choice condition (Chernev et al., 2015), and it falls into range which is considered manageable for adult working memory (i.e., the “seven plus or minus two” rule; Miller, 1956). Additionally, Reed and colleagues (2011) found that six was the number most often associated with individuals’ “break-point” – that is, the number at which participants switched to preferring fewer options rather than more. Because six is a widely used and theoretically important number of alternatives, I included it as an option in the present study. However, because young children (Alloway et al., 2006; Gathercole et al., 2004) and primates have more limited working memory capacity and cognitive control than that of adult humans, I also included a smaller range of options (three) as the limited-choice condition.

I hypothesized that monkeys (tufted capuchins and rhesus macaques) and young children (ages three to five) would exhibit the paradox of choice effect, such that (a) they would prefer to choose from a larger array over a smaller or intermediate array and (b) they would experience choice overload when choosing from the larger array but not the small or intermediate array. In order to induce choice overload at larger arrays, all of the alternatives in the arrays were made to be roughly equally preferable, thereby eliminating any objectively dominant options as well as any alternatives that may have matched any individual’s ideal point. Choice overload was measured by evaluating children and monkeys’ propensity to switch and latency to choose, children’s satisfaction ratings, and monkeys’ task performance. Because this was the first time

the paradox of choice was explored in very young children and nonhuman primates, I did not make any a priori predictions about species or age differences – rather, I expected there to be a wide range of individual differences within each species and age.

## 2 EXPERIMENT 1

The goal of Experiment 1a and Experiment 1b was to determine whether children (three to five years old) exhibited a paradox of choice effect. I hypothesized that children would experience the paradox of choice, such that (a) they would prefer to choose from a larger array over a small or intermediate array and (b) they would experience choice overload when choosing from the larger array and not from the small and intermediate array. In order to diminish prior preference effects, before Experiments 1a and 1b were conducted, I first gathered information on each child's favorite color and animal, and I used that information to remove prize options from the experimental arrays that may have closely matched the child's ideal point. In Experiment 1a, children were assigned to each of three choice conditions (limited choice (LC): three options; intermediate choice (IC): six options; extensive choice (EC): 12 options) in random order. The children were asked to choose a toy from the array of options presented to them, and researchers measured whether each child chose to exchange their first choice after a 60 second delay (Appendix A). In Experiment 1b, children were to first choose among three differently sized buckets (small, representing a limited-choice option; medium, representing an intermediate-choice option; and large, representing an extensive-choice option). The child would have to choose a bucket without seeing the toys inside; however, the experimenter would explain the child how many toys were in each bucket, and that they would only get to choose one toy from whatever bucket they chose. After choosing a bucket, they would then be allowed to select one toy from the bucket of their choice. I hoped to utilize the data from Experiment 1b in order to

determine whether children would exhibit the typical preference-for-more effect by demonstrating a strong tendency to choose the extensive-choice bucket. However, due to school closures amidst the COVID-19 pandemic, data collection was interrupted: Experiment 1a concluded prematurely and Experiment 1b was not carried out.

## **2.1 Participants**

Participants were 41 preschool children (ages 41.5 – 66.0 months), recruited from three daycares in the Atlanta area. All procedures were approved by Georgia State University's Institutional Review Board. Parents provided written consent for their child to be in the study, and verbal assent was attained from each child on the day of testing.

## **2.2 General procedure**

All testing was carried out in the children's daycare centers, during their daily hour of free play. A researcher asked the child if they would like to come do their research work for the day, and, with their assent, the child was taken out of the classroom and brought to a private room with the researcher(s). The child first completed an unrelated task, either on the computer or manually, that took anywhere from one minute to thirty minutes. Upon completing that task, the child was then able to pick out a "prize" (toy) for doing research for the day. The children were familiar with this procedure; any time children were asked to come back and do research, they received a prize at the end of the session. The current experiments took place during this prize selection phase. The children were able to choose a prize out of some array (consisting of 3, 6, or 12 items) of toys that differed on only a few dimensions (i.e., an array of toy vehicles, plastic animals, or balls).

### **2.3 Experiment 1a: Investigating choice overload in children**

The goal for this experiment was to determine whether children, like adults, exhibited increased choice overload when choosing from larger assortments when no dominant option/predetermined preference was available. The independent variable for this experiment was the assigned choice condition: limited choice (three options; LC), intermediate-choice (six options, IC) and extensive-choice (12 options; EC) and the dependent variables were the child's decision to exchange or keep their first choice, their reported satisfaction with their decision, and their latency to make an initial choice. Children were assigned to the conditions in pseudo-random order. It was planned that every child would experience each condition twice, for a total of six sessions. Because testing was cut short, I was not able to test 20 of the 41 children all six times; however, every child experienced each condition at least once. Data from all children were analyzed, including the children who completed fewer than six trials. I hypothesized that children would exhibit greater choice overload (i.e., increased switching, decreased satisfaction, and longer latency to choose) when exposed to the EC condition compared to the IC or LC conditions.

#### ***2.3.1 Controlling for prior preferences or dominant alternatives***

Before testing began, the experimenters asked each child to indicate their two favorite colors and animals as well as their favorite toy (Appendix B). We then removed from each child's experimental array any prizes that we felt fell in their "favorites" categories based on these responses. Because this experiment was conducted over the course of a few months and children's preferences may have changed during that time, this survey was repeated after the third trial, and their future prize arrays were adjusted according to their newly recorded

preferences. We also removed the specific toys that a child chose in any given trial from arrays in future trials.

Each array included only one toy type (i.e., toy vehicles, plastic animals, or balls) in order to diminish the number of dimensions on which the toys differed. This avoided a situation in which one item possessed a quality that made it more appealing than all others to a given child. This is also why we discussed with each child their preferences before Trial 1 and after Trial 3, and this is the means by which we hoped to eliminate options that were clearly dominant or corresponded to a child's ideal point.

### ***2.3.2 Procedure***

Each child was pseudo-randomly assigned to the choice conditions (LC, IC, and EC), and underwent between three and six testing sessions, based on the data we were able to collect before testing was discontinued. After completing a different, unrelated task, researchers told the child they could pick out a toy from a (predetermined) array. The child was presented with three, six, or 12 similar toy options (i.e., toy vehicles, plastic animals, or balls), according to what condition they are assigned for that testing session. Each child only chose from one toy type throughout the duration of the experiment, and that toy type was randomly assigned to each child based on available toys. Again, these were all highly salient and preferred toys for these children but not the most preferred. Researchers informed the child that they could choose one prize from the array to keep and take home. The researchers instructed the child that they could look at the array for as long as they wanted before selecting the prize they would ultimately take home, but, as soon as they touched a toy, that would be their selection for the day (Appendix A). Researchers timed how long the child visually investigated the toy options before making a selection.

As soon as a toy was touched, researchers coded the touched toy as the child's first choice selection. Next, the researchers told the child that the researchers had to "do some paperwork" before they could take the child back to class, and the researchers encouraged the child to play with their new toy while waiting (Appendix A). During this time, the other toys were all removed from view. The child was then given 60 seconds to play with and manipulate the toy of their choice while researchers appeared to be otherwise preoccupied.

When 60 seconds expired, researchers then gave the child the opportunity to exchange their toy (Appendix A). If the child chose to exchange their toy, the researchers placed the first-picked-toy back into the array, which was then presented a second time, and provided the child with the same instructions as before: the child could look at the array for as long as they liked, but as soon as they touched a toy, that toy would be the one they took home.

As soon as the final selection was made, either after the child refused the opportunity to exchange or selected a second toy, the researcher then asked the child to rate their satisfaction with their selected toy (Appendix A). Researchers presented the child with five progressively larger smiley faces (Appendix C) and explained to the child that they should think of the size of the smiley face as representing how happy they were with their selection (Appendix A). They then asked the child to rate their satisfaction by pointing to the smiley face that represented their happiness, and their response was recorded (1 = smallest smiley, 5 = largest smiley; Appendix C). After the satisfaction-rating phase, the trial was complete, and the child was taken back to the classroom with their selected toy. In three trials, researchers failed to collect satisfaction ratings from a child; those trials were excluded from satisfaction rating analyses.

### 3 EXPERIMENT 1 RESULTS

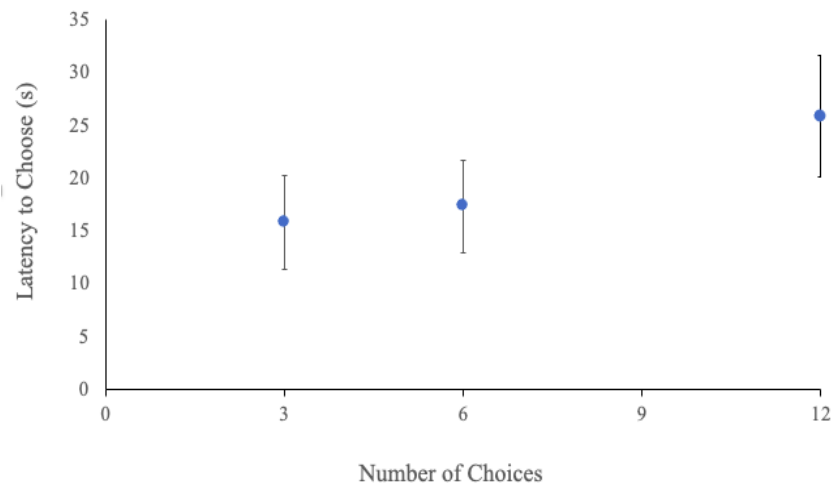
To measure possible effects of choice overload in children, I measured children's latency to choose a toy, their propensity to switch their original selection, and their ultimate satisfaction rating in each choice condition (LC = three toys, IC = six toys, EC = 12 toys). Data were analyzed in R studio. Testing was cut short due to the COVID-19 pandemic and half of all participants ( $n = 20$ ) did not complete all six testing sessions. Since non-parametric tests such as the Friedman's test cannot accommodate blank cells, general linear mixed effects models were used to analyze the data so that all trials could be included in analyses.

Overall, the mean latencies to choose a toy in the LC, IC, and EC conditions were 16.60 seconds, 17.75 seconds and 25.19 seconds, respectively. I conducted a general linear mixed effects model of the effect of condition on latency to choose a toy. In this model, observations were nested within each child, and the main goal was to determine whether there was a significant difference in latency to choose a toy as a function of choice condition. To help control for age and trial-order effects, age and trial number were included as covariates. The model indicated that children took significantly longer to make a selection in the EC condition compared to the LC condition, but there was not a significant difference in the time it took children to make a toy selection between the LC and IC conditions (Table 1).

*Table 1.* Relative difference in latency to choose a toy as a function of choice condition.

Condition	Estimate	t-value	p-value
LC	Ref		
IC	1.56	0.54	0.593
EC	9.08	3.15	0.002 **
Age	0.16	0.64	0.530
Trial	-0.06	-0.08	0.933

This result aligned with my hypothesis that children would take longer to choose a toy when there were more options; however, because this latency was not disproportionately longer than that of the other conditions (that is, although the EC condition had two or four times as many choices as the LC and IC conditions, respectively, it did not take more than two or four times the amount of time to make a decision), this result is likely attributable to the scanning time necessary to visually inspect larger arrays. However, it is interesting to note that when these latencies are plotted as a function of set size, it appears that the relationship is not linear, as one would expect if scanning time were the only cause increased latency (Figure 2). In this study, I cannot rule out that this is simply a result of increased scanning time, but future studies could investigate further the relationship between latency to choose and choice set size.



*Figure 2.* Latency to make a choice as a function of choice set size. Error bars represent 95% confidence intervals.

I also analyzed children's propensity to switch their toy in each of the three conditions. Overall, children chose to switch their toy 49% of the time when they were in the LC condition, 82% of the time when they were in the IC condition, and 85% of the time when they were in the



EC condition. A Chi-square test assessing differences in switching by choice condition showed no significant differences in switching in each condition ( $X^2(2) = 3.05, p = .218$ ); however, the summary tables showed that children switched more in the IC and EC conditions compared with the LC condition (Table 2).

*Table 2.* Children’s raw switching rates in each choice condition.

Choice Condition	Switch	
	No Raw count (residuals)	Yes Raw count (residuals)
LC	45 (0.93)	22 (-1.10)
IC	39 (-0.40)	32 (0.47)
EC	40 (-0.50)	34 (0.60)

I then analyzed these switching data further using a generalized linear mixed model, including age and trial as covariates. The results indicated that children demonstrated nearly twice the odds of switching in the IC condition than the LC condition after adjusting for age and trial (Table 3). Similarly, there were twice the odds that children would switch in the EC condition than the LC condition children (Table 3). These results did not reach significance at an alpha level of  $p < .05$ . However, given that we had to cut short the number of trials collected and considering the large effect size found here, these results provide promising evidence for our hypothesis.

*Table 3.* Adjusted odds ratio of children’s toy switching based on choice condition.

Condition	aOR	95% CI	p-value
LC	Ref		
IC	1.92	0.90 - 4.12	.093
EC	2.00	0.94 - 4.26	.073
Age	0.97	0.91 - 1.03	.255
Trial	0.91	0.75 – 1.10	.331

Table 4 provides an overview of the correlational relationships between the variables described thus far, as well as children's satisfaction rating which I have yet to discuss. There is a small, positive relationship ( $p = .004$ ) between the number of options provided and children's latency to make a choice. There is no correlation between any other variables. This table previews the lack of relationship between satisfaction rating and all other variables of interest in this study, suggesting that it was not a reliable measure of choice overload.

*Table 4.* Correlation matrix demonstrating relationship between number of options and children's satisfaction score, latency to choose, and switching likelihood.

	No. of options	Satisfaction Score	Latency to Choose	Switching Likelihood
No. of options	1.00			
Satisfaction Score	-0.04	1.00		
Latency to Choose	0.20	-0.02	1.00	
Switching Likelihood	0.09	0.03	-0.01	1.00

To explore the effects of choice condition on satisfaction rating, I conducted a general linear mixed effects model of the effect of condition on rating, controlling for age and trial. The goal was to determine whether there was a significant difference in satisfaction rating as a function of choice condition. At the end of each trial, children could rate their satisfaction with their chosen toy on a scale of 1-5 based on progressively larger smiley faces. The model indicated that children tended to have lower satisfaction scores in the EC condition ( $M = 4.58$ ) compared to the LC condition ( $M = 4.77$ ), but the effect was not significant (Table 5). Children in the IC condition also reported lower satisfaction ratings ( $M = 4.35$ ) than the LC condition, and this difference was found to be significant (Table 5). These results somewhat align with my hypotheses, as children did report lower satisfaction scores when choosing from larger arrays; however, I predicted that children would have the greatest dissatisfaction when choosing from

the EC, which was not the result found here. Furthermore, given the previous research indicating the unreliable nature of measuring children's happiness with Likert scales (which we saw evidence of in our own study; Mellor & Moore, 2013), I would hesitate to draw any conclusions about the implications of these data.

*Table 5.* Relative difference in children's satisfaction rating as a function of choice condition.

Condition	Estimate	t-value	p-value
LC	Ref		
IC	-0.44	-2.31	.022 *
EC	-0.20	-1.05	.294
Age	0.01	0.70	.488
Trial	0.04	0.77	.441

## 4 EXPERIMENT 2

The goal for these experiments was to determine whether and to what degree nonhuman primates experienced the paradox of choice. In Experiment 2a, monkeys were pseudo-randomly assigned to each of the three conditions (LC = three task options, IC = six task options, or EC = nine task options). Data were collected on proportion of task switching, latency to choose a task, latency to complete a task ("task performance"), and dropout behaviors for each testing session. In Experiment 2b, I measured the number of times monkeys choose each condition (LC, IC, or EC) to assess whether monkeys prefer to choose from larger arrays over smaller arrays.

### 4.1 Subjects

Included in the study were 14 socially-housed capuchin monkeys (*Cebus apella*; 10 females; aged 8 to 24 years) and five male macaques (*Macaca mulatta*; aged 17 to 27 years) that were singly housed but had regular social contact with compatible conspecifics. Five of these capuchins (3 females; aged 10 to 22) and one macaque (age 21) either did not participate

regularly or completed very few trials on any given day and therefore were excluded from the study. All subjects were housed at Georgia State University's Language Research Center (LRC) and had extensive experience working on the computer testing systems (LRC-CTS) and with the SELECT task paradigm. The monkeys were not food or water deprived and engagement with the LRC-CTS was voluntary for each individual. All procedures conformed to LRC Standard Operating Procedures and were approved by the GSU Animal Care and Use Committee.

## **4.2 Apparatus**

Monkeys were tested on the Language Research Center's Computer Testing Systems (LRC-CTS; Rumbaugh et al., 1989). Monkeys observed a 17-inch computer monitor through clear face-plates, and monkeys manipulated a joystick that was mounted on the face-plate using their hand. A pellet-dispenser was also attached to the face-plate, and pellets were automatically dispensed through a tube to an opening in the face-plate when the monkeys correctly completed a trial.

## **4.3 Tasks**

In the present experiments, monkeys engaged in variations of computerized psychomotor tasks. Two of these -- CHASE and MAZE -- have been used extensively in past experiments (Rumbaugh et al., 1989; Washburn et al., 1989, 1990; Washburn, 1992) and all monkeys in the present study had previous experience with these tasks or closely related variations. A third task used in this experiment was named DEFLECT. Although the monkeys were not familiar with DEFLECT, the task was very similar to others to which the monkeys had been exposed (including CHASE and MAZE), as it was a psychomotor task that required directing the cursor (by manipulating the joystick) toward a target on a screen. Monkeys first selected a task to perform, and then completed one trial of that task. Each trial of a task ended as soon as the goal

was completed and a pellet was awarded (i.e., there is no way to “fail” any of the tasks). The screen then reset to the choice screen and monkeys were able to select their next task. This continued until the end of the trial block. In cases where monkeys were unmotivated to engage in the study, we increased their pellet reward for each completed task trial until they demonstrated willingness to complete the tasks or we excluded them from further study.

Each of these tasks could be carefully manipulated by the program to control how difficult they would be to complete. Each task was selected from an initial screen that gave the monkey an option of which task to complete. I describe that SELECT phase to each trial next, and then I describe the individual tasks and how the relative difficulties were set for each task for each monkey.

*SELECT Screen:* Like the original SELECT experiment (Washburn et al., 1991), the SELECT screen in this experiment was comprised of a set of arbitrary icons, each of which led, when selected, to a specific task. The monkeys could select these icons by manipulating their joystick to control an onscreen cursor. Navigating the cursor to a specific icon initiated the task that corresponded to that specific icon. In this experiment, the SELECT screen changed according to the choice condition the monkey was in: in the LC condition, the SELECT screen only included three task icons; in the IC condition, the SELECT screen included six task icons in the EC condition, the SELECT screen included nine task icons from which the monkeys could choose (Figure 3).

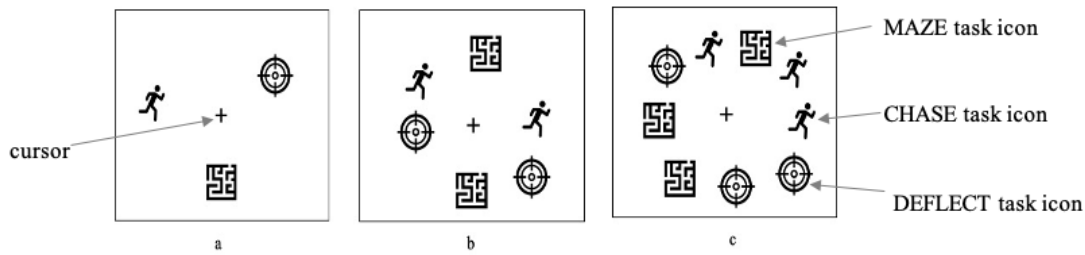


Figure 3. *SELECT* screen(s). (a) represents the *SELECT* screen in the LC condition. (b) represents the *SELECT* screen in the IC condition. (c) represents the *SELECT* screen in the EC condition.

*CHASE*: In this task, the monkeys controlled a cursor onscreen and moved in continuously until it made contact with a moving target onscreen. As long as the cursor was moving, the target was also moving across the screen (the target moved in a saw-tooth pattern and deflected off of the screen borders so that it gave the impression of bouncing off the walls). The speed at which the target and the cursor moved vary with the difficulty level of the task and with each monkey's preset levels suited to their equivalence criteria (see Section 4.4). When the cursor was stationary (that is, the monkeys were not manipulating the joystick), the target was also stationary. As soon as the cursor contacted the target, the monkey received a reward.

*MAZE*: In this task, the monkeys navigated a simple barrier maze by moving the cursor around graphic "blockades" in order to reach a target. The target was visible on the screen at all times (it appeared as a blue square somewhere within the maze), and it remained stationary while the monkey completed the maze. A pellet was awarded as soon as the monkey's cursor made contact with the target. The mazes consisted of either one, two, or three blockades, and the target and cursor could appear in one of nine different positions on the screen. The number of

blockades and the positions in which the target and cursor could appear were adjusted according to the difficulty level of the task.

*DEFLECT*: In this task, the cursor began in the middle of the screen, and a colored oval appeared in one of the four cardinal directions around the cursor. The monkey then had to direct their joystick in the direction of the oval. If moved in the correct direction, the cursor would jump immediately to the oval, the oval would disappear, and the cursor would return to the center of the screen. Another oval would then appear in another direction, and so on, until the monkeys hit a certain, predetermined number of ovals. The number of required ovals varied by the difficulty level of the task.

Prior to completing the formal tests of Experiment 2a and 2b, monkeys worked on these tasks to establish approximate equivalence of task preference (see Section 4.4). They then moved to the test phases. Even with this effort, there was still a concern that strong task biases might emerge over time. In an attempt to ensure that the choice condition and task decisions the monkeys made were meaningful (that is, that they did not fall into a rhythm of selecting the same icon, for example), monkeys only completed 30 testing trials in a given day before being put on a different task for the remainder of the day. Each monkey completed five testing sessions in each condition (LC, IC, and EC) for a total of 450 trials across 15 days of data collection. In Experiment 2b, monkeys completed four testing sessions (150 trials each) in which they were able to choose their condition (LC, IC, or EC), for a total of 600 trials per monkey in this experiment.

#### **4.4 Controlling for prior preferences or dominant alternative**

Each task (CHASE, DEFLECT, and MAZE) was represented equally across the choice conditions that were used for the SELECT phase of each trial. That is, the LC condition had one

CHASE icon in the choice set, one DEFLECT icon, and one MAZE icon. The IC condition had two identical icons for each those three tasks (totaling six options), and the EC condition had three identical icons for each task (totaling nine options; Figure 3). Because only three tasks were used in this experiment, but two of the choice conditions (IC and EC) required more than three alternatives, it was necessary to include variation within the tasks themselves. If there was not this intra-task variation, monkeys would only ever have three meaningful options, no matter the choice condition they were in: a particular version of MAZE, a particular version of CHASE, and a particular version of DEFLECT<sup>1</sup>.

At the same time that I wished to create this intra-task variation in order to provide the monkeys with more meaningful alternatives, I also wanted to prevent the monkeys from establishing a strong preference for one of the task icons over the others. Should the monkeys demonstrate a strong preference for a particular task (as they did in the original SELECT experiment, for example, Washburn et al., 1991), there would then be a clearly dominant option, which would erase any effects of choice overload at larger arrays. Therefore, I created approximately equivalently-preferred tasks by titrating the parameters of each difficulty level and the proportions at which each difficulty level would occur for each task. Additionally, I ensured that the icons for each task did not provide any indication of what level of difficulty the chosen task would ultimately be set. The difficulty level of the task was randomly generated based on a set of predetermined proportions (that is, the proportion that easy, medium, and difficult versions of the task would appear) after the icon was chosen. Therefore, anytime a

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<sup>1</sup> In the EC condition, where there would be three icons representing each task for a total of nine icons (see Figure 3), without variation *within* the tasks, this situation would be analogous to a child choosing among an array of nine toys in which three of the options were the exact same ball, three of the options were the exact same plastic animal, and three of the options were the exact same toy car. In that situation, the child is essentially choosing between the ball, the animal, and the car, and not among nine different options. For this reason, I introduced varying difficulty levels (easy, medium, and hard) within each task.



monkey chose the MAZE icon, for instance, they could not know whether they were about to play the easy, medium, or hard version of the MAZE task.

The difficulty levels were adjusted for each monkey by increasing or decreasing cursor speed (CHASE, MAZE), increasing or decreasing target size (CHASE), increasing or decreasing the number of blockades and adjusting the positions of the target and cursor to require more or less maneuvering around the blockades (MAZE), and increasing the number of deflections required to earn a pellet (DEFLECT). After the icon was chosen, the difficulty level of the task was randomly generated based on a set of predetermined proportions (that is, the proportion that easy, medium, and difficult versions of the task would appear) which differed for each individual monkey based on which parameters led them to reach equivalence between tasks.

These customized parameters were created for each monkey after conducting several weeks of preliminary testing during which, at the end of each testing session, I analyzed the rate at which each monkey chose each task and manually adjusted the parameters of each task, making the more preferred task harder and the less preferred task easier. Also, during this time, I adjusted the relative rate at which the difficulty levels occurred, making harder versions of the more preferred task occur more often and easier versions of the less preferred task occur more often. These manual adjustments were made to ensure that monkeys would reach an equivalence point (i.e., no task chosen at >20% more or less than any other task). After six weeks of this preliminary testing and manual adjustments, I gained a better understanding of the difficulty-level parameters that were appropriate for each monkey, but monkeys were not consistently meeting the equivalence criterion more than one or two days in a row. Therefore, the program was modified to self-titrate the proportions that the difficulty level of each task would appear for Experiment 2a (described in more detail below). The program did not further titrate the

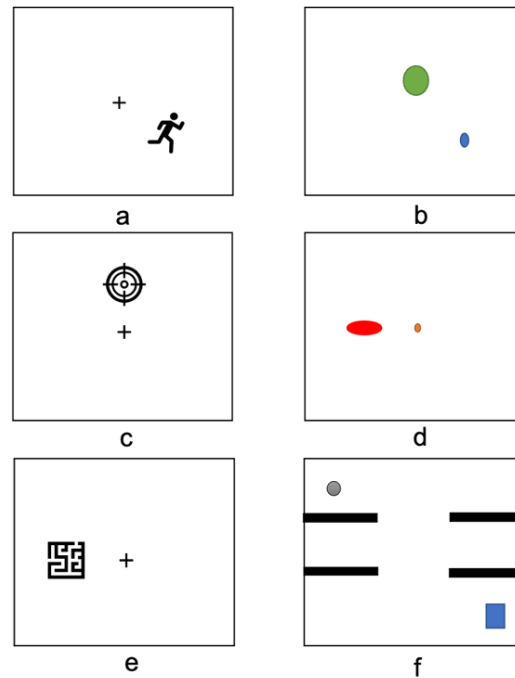
difficulty-level settings, such as cursor speed or number of deflections; these parameters were individually set for each monkey based on the data collected in the previous six weeks and remained constant for the remainder of the experiment, unless manually adjusted by the experimenter when deemed necessary. When the monkey progressed to Experiment 2b, the latest parameters set in Experiment 2a were utilized as the parameters throughout the course of Experiment 2b (i.e., the program did not continue to titrate proportion of difficulty level of task).

#### **4.5 Experiment 2a: Investigating choice overload in monkeys**

The goal for this experiment was to determine whether monkeys demonstrated choice overload when exposed to larger arrays compared to small and intermediate arrays. The independent variable was choice condition (LC, IC, EC). The dependent variables of this experiment included task switching, dropout rate, task performance (operationalized by latency to complete the task), and the latency to choose a task. Monkeys completed 30 test trials on each test day for 5 days in each condition, or a total of 450 trials across 15 testing days. I hypothesized that monkeys would demonstrate choice overload (greater rates of task switching and dropouts, lower task performance, and longer latency to choose) in the EC condition compared to the LC and IC conditions.

##### ***4.5.1 Design***

Each day, monkeys had to reestablish their equivalent preference point between tasks by progressing through at least one exposure session. The exposure session began with six forced trials, two forced trials of each task type (Figure 4) and was followed by 30 exposure trials. These exposure trials looked identical to an LC test condition: there were three task icons on the screen from which monkeys could choose (Figure 3). After choosing and completing the task (by earning a pellet reward), the program returned to the three-choice screen, and the monkey could



*Figure 4.* Forced trials. (a) Forced CHASE selection screen. (b) CHASE task: cursor must chase moving target until contact is made. (c) Forced DEFLECT selection screen. (d) DEFLECT task: cursor must come into contact with (stationary) ovals. Ovals will appear in any of the four cardinal directions around the cursor. (e) Forced MAZE selection screen. (f) MAZE task: cursor must be navigated around blockades to reach the target.

make another selection. If, at the end of the 30 trials, any task was chosen 20-100% less often than another task, the program automatically increased the likelihood the easy version of that task would appear by 20% and decreased the likelihood of the medium and hard versions by 10% each. Likewise, if any task was chosen 20-100% more often than another task at the end of the 30 trials, the program automatically increased the likelihood the hard version of that task would appear by 20% and decreased the likelihood the medium and easy versions by 10% each. In either of those cases, the program began a new training session, commencing with six new forced trials. If all tasks were chosen at approximate equivalence (no task was chosen more than 20% more frequently than another task), the program would progress into the testing phase.

The testing phase consisted of 30 trials (no forced trials) in one of the choice conditions (LC = three task icons; IC = six task icons; EC = nine task icons; Figure 3). The task icons could

appear in any of nine different positions around the perimeter of the screen. In the EC condition, each of the nine positions was filled with a task icon, and the location of each icon was randomly generated. In the LC and IC conditions, the program randomly generated three or six icons (respectively) into the nine positions.

Monkeys were pseudo-randomly assigned to the three conditions so that in each block, each condition was presented once. At the end of the 30 testing trials, the program ended and the monkey would begin a different, unrelated task until the end of the day. On any given day, monkeys only completed one of the choice conditions in the testing phase. Across the entirety of the experiment, monkeys performed each of the choice conditions five times.

#### ***4.5.2 Dependent measures: Task switching***

For every testing session, monkeys had 30 opportunities to select a task and 29 opportunities to switch. Task switching was measured as the proportion of times monkeys choose the same task or a different task across consecutive trials (e.g., Trial 1 to Trial 2, Trial 2 to Trial 3, etc.).

#### ***4.5.3 Dependent measures: Latency to make a task choice***

Latency to make a choice was measured as the amount of time (in ms) that passed after the task options appear on the screen and before the monkey selected a task from the SELECT array.

#### ***4.5.4 Dependent measures: Latency to complete a task (task performance)***

Because the tasks were designed so that they were impossible to fail, task performance was measured as the amount of time (in ms) that it took the monkey to complete the task. The timer started after the task appeared and ended when a pellet was awarded.

#### ***4.5.5 Dependent measures: Dropouts***

If, after initiating a trial by selecting a task icon, the monkey did not engage in the task (that is, they did not manipulate their joystick in any way) for 60 seconds, the trial was aborted (“dropout”) and the program returned to the choice selection screen. No pellets were awarded. This dropout counted as a trial toward the session total.

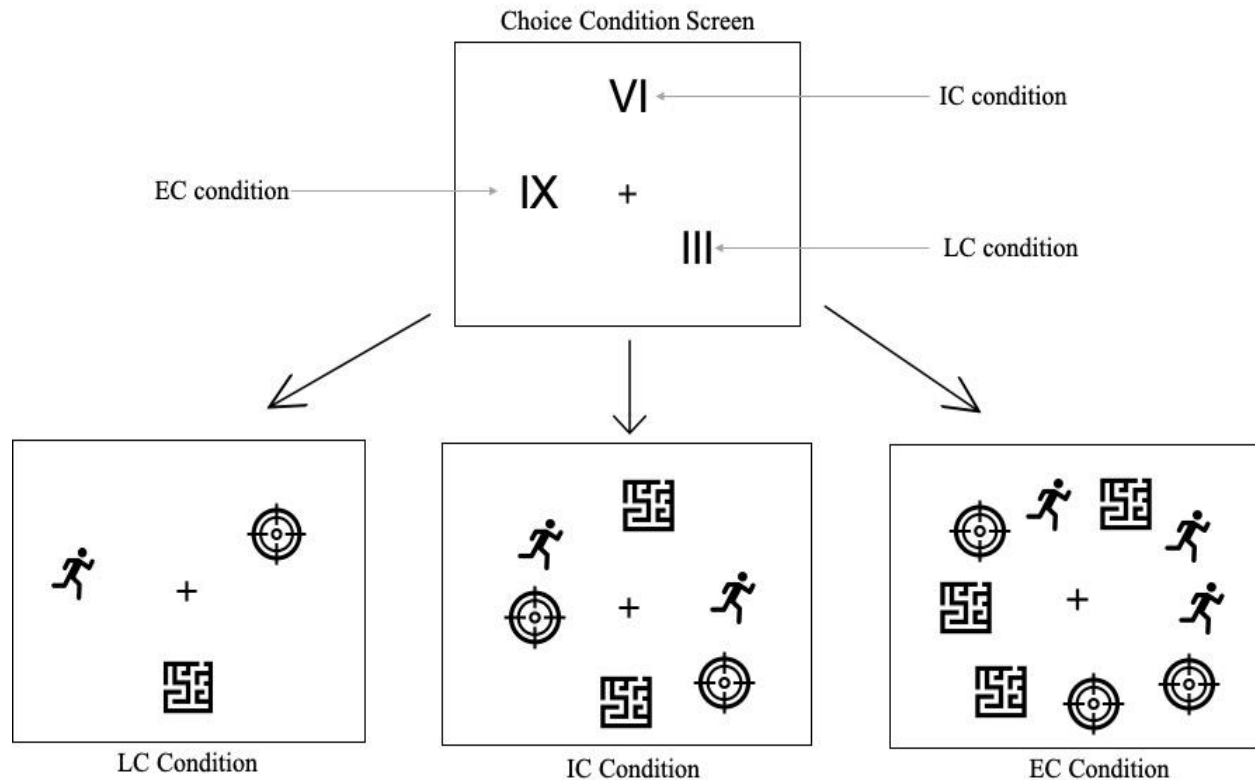
### **4.6 Experiment 2b: Determining condition preference in monkeys**

The goal for this experiment was to determine from what condition (LC, IC, EC) monkeys preferred to choose a task. The dependent variable was the proportion of trials in which each of the conditions was selected (out of 600 trials). I hypothesized that, like humans, rhesus macaques and capuchin monkeys would prefer the EC condition.

#### ***4.6.1 Design***

Rather than the start screen appearing as the SELECT array of potential task icons (i.e., CHASE, MAZE, DEFLECT), in Experiment 2a, monkeys began the experiment with an array of choice condition icons (Figure 5). Each icon represented one of the choice array sizes: LC, IC, or EC. As in Experiment 2a, these icons could appear in any of the nine positions of the screen, and the program randomly generated the position of each icon at the beginning of each new trial. Depending on the condition icon chosen, the monkey was then led to the corresponding task selection screen which was identical to the SELECT phase of trials in Experiment 2a. In this experiment, monkeys essentially encountered two SELECT screens in each trial. First, monkeys encountered a SELECT screen in which they chose their choice conditions, LC, IC, or EC. On this screen, monkeys chose between three arbitrary icons, each of which, if selected, would lead to a second corresponding SELECT screen (Figure 5). The subsequent SELECT screen(s) would appear exactly as seen in Experiment 2a, presenting either three, six, or nine task icons,

depending on which choice condition (LC, IC, or EC) was chosen on the first SELECT screen. Unlike Experiment 2a, in which monkeys were only exposed to a single choice condition on a given day, because monkeys were given the freedom to choose the choice condition in Experiment 2b, they might have seen one, two, or all three choice conditions (task selection screens) on any given day.



*Figure 5.* Condition Selection and Task Selection screens. Monkeys must manipulate their joystick in order to select their preferred choice condition (LC, IC, or EC). This selection will lead the monkey to the corresponding task selection screen with either three (LC), six (IC), or nine (EC) task options. They must then navigate the cursor to the task of their choosing, and complete the task to receive their pellet reward.

After selecting an array size from which subsequently to choose a specific task, the monkey was then able to choose the task itself (CHASE, DEFLECT, or MAZE) as they did in Experiment 2a. If they chose the LC array size, there was one icon for each task. If they chose the IC array size, there were two icons of each task, and choice of the EC array size led to 3

icons of each task being available to choose from. Monkeys then chose one task icon. After the monkey completed a single trial of the selected task, the program returned to the Condition SELECT screen and monkeys had a new opportunity to choose the choice condition (i.e., the number of task icons) and, subsequently, the task.

## 5 EXPERIMENT 2 RESULTS

### 5.1 Experiment 2a: Investigating choice overload in monkeys

In this experiment, I looked for evidence of choice overload effects in rhesus macaques and capuchin monkeys by measuring the monkeys' latency to select a task, the proportion of trials in which they switched tasks, their task performance (i.e., the time it took for the monkeys to complete the task), and their dropout rate (i.e., the proportion of trials in which they "gave up" on a game after selecting it), when presenting them with either three (LC), six (IC), or nine (EC) task options. After data collection was complete, I found that dropouts were very rare or nonexistent, occurring only between 0-2% of the time for any monkey in a given condition. For this reason, dropout rates were not included in subsequent analyses. Analyses described below were carried out in SPSS. Data initially were analyzed as a function of species, but no effects of that factor were found. In addition, species was not a variable of interest for this study, and so I collapsed across species for all subsequent analyses.

Latency-to-choose data were found to be non-normally distributed. Consequently, a non-parametric Friedman's test was utilized here. I found that the choice condition (LC, IC, EC) to which the monkey was assigned did not significantly affect the time it took them to choose a task ( $X^2(2) = 0.46, p = .794$ ; Figure 6). Unlike in Experiment 1 with children, where participants only partook in up to six trials, monkeys were able to engage in hundreds of trials in each condition. Therefore, I was able to analyze monkeys' global rate of switching in each condition rather than

on a trial-by-trial basis as I had for the children. Like monkeys' latency-to-choose data, the switching data were non-normally distributed, and a non-parametric Friedman's test was utilized for analysis. Consistent with the latency-to-choose result, choice condition did not have a significant effect on overall task switching ( $X^2(2) = 3.80, p = .149$ ; Figure 7).

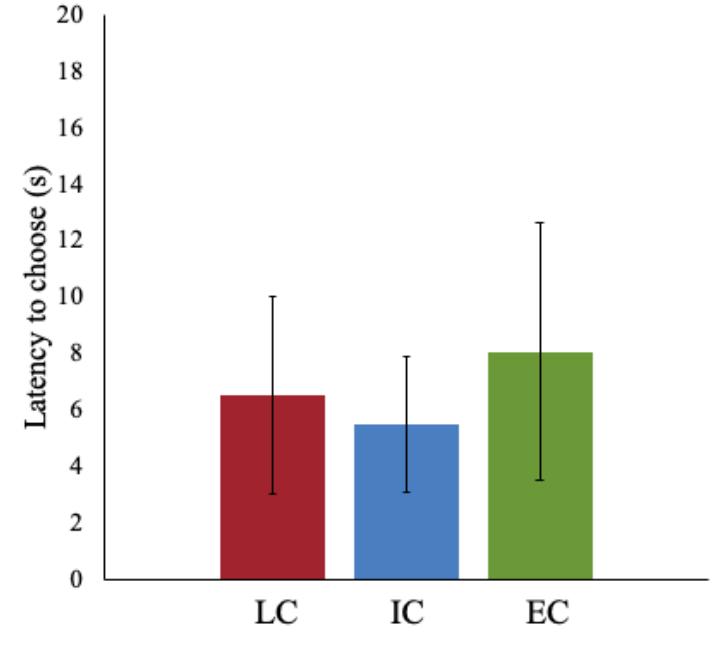


Figure 6. The average time it took monkeys to select a task in each choice condition. Error bars represent 95% confidence intervals.



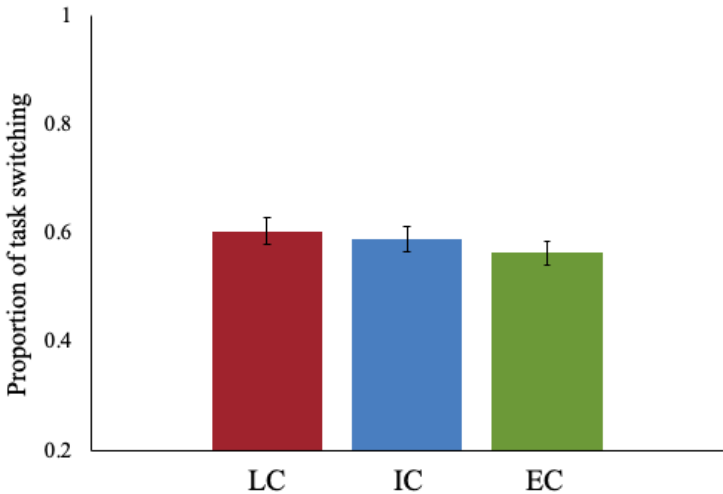
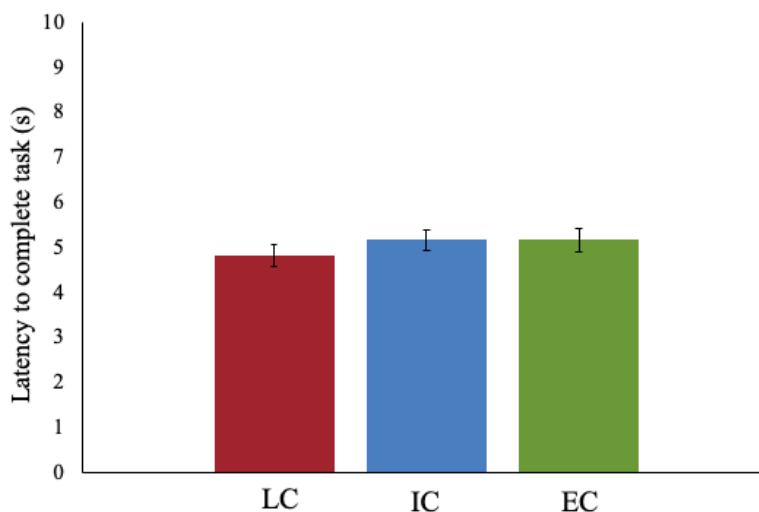


Figure 7. Monkeys' overall proportion of task switching as a function of choice condition. Error bars represent 95% confidence intervals.

The data on latency to complete tasks were found to be normally distributed and did not violate the assumption of sphericity. Therefore, a one-way repeated measures ANOVA was used to investigate the effect of choice condition on latency to complete the tasks. The choice conditions (LC, IC, EC) did not significantly affect the time it took monkeys to complete the tasks ( $F(2, 24) = 1.689, p = .210$ ; Figure 8).

In short, of the three measures analyzed here, I did not find any evidence to support the hypothesis that monkeys would experience choice overload at larger arrays: the monkeys did not demonstrate any significant differences in latency to choose a task, latency to complete a task, or propensity to switch from one task to another in back-to-back trials based on the choice condition (LC, IC, or EC) to which they were assigned in each test session. Although it is possible that these results indicate that monkeys, unlike humans, are not prone to the effects of choice overload, I speculate that monkeys likely do experience choice overload in some instances, but our design was not sensitive enough to find these effects.



*Figure 8.* The average time it took monkeys to complete tasks in each condition (“task performance”). Error bars represent 95% confidence intervals.

## 5.2 Experiment 2b: Investigating choice condition preference in monkeys

In this experiment, monkeys were able to choose their choice condition (LC, IC, or EC) instead of the choice condition being assigned to them, as they were in Experiment 2a. I hypothesized that monkeys, like adult humans, would exhibit a preference for larger arrays (the EC condition) over smaller arrays (the LC and IC conditions). I analyzed the relative proportions each condition was chosen out of 600 trials<sup>2</sup>. The proportion data were found to be non-normally distributed. I first conducted a non-parametric Friedman's ANOVA and found there was a significant difference in the proportions the choice icons were chosen ( $X^2 = 18.39, p < .001$ ). A post hoc analysis with Wilcoxon signed-rank was conducted with a Bonferroni correction applied, resulting in a significance level set at  $p < .016$ . The results indicated that the proportion of LC and IC choices were not significantly different ( $Z = -1.71, p = .087$ ). However, monkeys did choose the EC condition significantly more than the LC condition (39.4% compared to 28.0% of the time, respectively;  $Z = -3.18; p = .001$ ) and the IC condition (39.4% to 32.6%;  $Z = -2.98, p = .003$ ). These results corresponded with my hypothesis that monkeys would demonstrate a greater preference for the EC condition over the other two conditions.

Additionally, using three Sign tests, I explored whether the proportion each of the condition icons was chosen significantly differed from what the null hypothesis would predict (chance level of 33%). The Sign tests revealed that the LC and IC conditions were not chosen at proportions significantly different than chance (LC:  $p = .092$ ; IC:  $p = .581$ ). The proportion at which the monkeys chose the EC condition was determined to be significantly greater than chance ( $p < .001$ ).

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<sup>2</sup> Two female capuchin monkeys did not complete all 600 trials. However, they each completed at least 300 trials. Because the analyses were run on proportion data, I included these monkeys' data even though they had fewer than 600 trials.

I also conducted a Chi square test on each individual monkeys' proportion of choices using VassarStats.net. Five of the 13 monkeys exhibited a significant preference for the EC option. Five monkeys showed a significant bias against the LC or IC options (Table 6).

*Table 6.* Results of Chi square tests. Monkeys who completed all 600 trials had an expected raw count of 200 in each cell should the null hypothesis not be rejected. Expected raw counts for monkeys who did not complete all 600 trials (Gretel and Lychee) were calculated by dividing their total trial count by three. Cell values that fell outside of the expected distribution range are signified with an asterisk. Monkey species is indicated by cap (capuchin) or mac (rhesus macaque).

Monkey	Species	LC raw count (stand. resid.)	IC raw count (stand. resid.)	EC raw count (stand. resid.)	Expected raw count	Chi square	<i>p</i> -value
Gambit	Cap	78 (-8.63)*	261 (4.31)*	261 (4.31)*	200	111.63	<.001
Griffin	Cap	172 (-1.98)*	186 (-0.99)	242 (2.97)*	200	13.72	.0001
Gretel	Cap	87 (-1.58)	102 (-0.10)	120 (1.68)	103	5.30	.070
Ingrid	Cap	179 (-1.48)	205 (0.35)	216 (1.13)	200	3.61	.164
Irene	Cap	202 (.014)	178 (-1.56)	220 (1.41)	200	4.44	.108
Lily	Cap	150 (-3.54)*	202 (0.14)	248 (3.39)*	200	24.04	<.001
Logan	Cap	181 (-1.34)	188 (-0.85)	231 (2.19)*	200	7.33	.025
Lychee	Cap	160 (0.54)	146 (-0.59)	154 (0.05)	153.33	.64	.726
Wren	Cap	209 (0.64)	171 (-2.05)*	220 (1.41)	200	6.61	.036
Chewie	Mac	204 (0.28)	187 (-0.92)	209 (0.64)	200	1.33	.514
Han	Mac	177 (-1.63)	197 (-0.21)	226 (1.84)	200	6.07	.048
Murph	Mac	183 (-1.2)	202 (0.14)	215 (1.06)	200	2.59	.273
Obi	Mac	77 (-8.70)*	158 (-2.97)*	365 (11.67)*	200	220.59	<.001

## 6 DISCUSSION

The aim for this study was to determine whether and to what degree very young children and nonhuman primates exhibit the paradox of choice effect: an attraction to larger arrays over smaller arrays but experiencing negative consequences when choosing from larger arrays. I hypothesized that children and monkeys would fall prey to the paradox of choice, such that they would experience more negative consequences in the extensive choice (EC) condition relative to the intermediate choice (IC) condition and the limited choice (LC) condition but would also exhibit a strong preference for choosing from the EC condition.

To explore the presence of this phenomenon in these populations, I first investigated whether children and monkeys would experience choice overload, the negative consequences associated with too many options (Experiments 1a and 2a, respectively). Then I wished to establish whether children and monkeys would demonstrate a preference for the larger arrays, even after potentially exhibiting negative consequences from choosing among arrays of that size (Experiments 1b and 2b). However, the COVID-19 pandemic caused testing to be cut short with children, leading me to collect fewer trials than anticipated in Experiment 1a and unable to conduct Experiment 1b.

Despite this setback, the results of Experiment 1a provide some evidence that children experienced choice overload at the IC and EC conditions, such that children exhibited approximately twice the odds of switching (i.e., exchanging a selected toy for a different prize) in the IC and EC condition as they were to switch in the LC condition. These results were not found to be statistically significant at  $p < .05$ , but the results had a large effect size, were trending in the expected direction, and may have reached statistical significance had I completed the study as expected and had greater power. If I were to interpret these results as being true evidence of

choice overload, it would be interesting to note that children exhibit choice overload in the IC condition (when choosing among six toys) nearly to the same degree as they seem to exhibit choice overload in the EC condition, because six alternatives is often used at the limited choice condition in experiments with adult humans. If this is a real effect, it is possible that young children may experience choice overload at six alternatives when adults do not because of children's more limited working memory and cognitive control compared to adults (Alloway et al., 2006; Gathercole et al., 2004); but more research would need to be conducted to answer this question. Additionally, future research may want to manipulate the time children are given to play with the toy before they must make the decision to switch. The longer the child interacts with the toy, the more susceptible they may be to the endowment effect (a tendency to value an object more than it is really worth simply because you feel a sense of ownership for the object; Kahneman & Tversky, 1979; Thaler, 1980) and the less likely they may be to switch.

Children also took significantly longer to make a choice in the EC condition than in either of the other two conditions. It is possible that this was a sign of choice overload; that is, that this latency was a reflection of a more difficult decision-making process in the EC condition compared to the other conditions. However, it is also well within the realm of possibilities that this effect can be entirely explained by scanning time. The EC condition, by its nature, had more options for the children to visually investigate, and therefore took longer for the child to inspect each toy one by one. I had argued in the introduction that if the results revealed that children exhibited disproportionately longer latency to choose a toy in the EC condition than in other conditions, this may be interpreted as choice overload; however, that is not the case here, and accordingly, I am not interpreting the latency-to-choose data as evidence of choice overload in children. However, it is interesting to note that the relationship between latency to make a choice

and choice set size seems more exponential in nature than linear; at least, there was a qualitative jump in the time it took to make a choice between the IC and EC condition that seemed to reflect something more than a linear increase in looking time.

Finally, I analyzed children's satisfaction data in each choice condition. I hypothesized that children would exhibit decreased satisfaction in the EC condition compared to the other two conditions, a consequence typical of choice overload. The results trended in this direction: children reported lower satisfaction scores in the EC and IC condition compared to the LC condition, although this difference was only significant for the IC-LC comparison. However, previous research had indicated that Likert scales are an unreliable tool for measuring children's happiness (Mellor & Moore, 2013). We found this to be true in our own study as well: There was little variability in satisfaction rating between children or conditions, such that children almost always chose the largest smiley face. In fact, the largest smiley was chosen 176 times in total, whereas the four other smileys were chosen for a combined total of 35 times. Furthermore, anecdotally we observed that some children declared in the first or second trial that they were always going to choose the largest smiley in the subsequent trials, and some children chose the largest smiley even when they verbally expressed dissatisfaction during the trial. In cases that children did vary from the largest-smiley response, children often gave explanations for this decision that were unrelated to their satisfaction with their toy selection (i.e., because the smiley was cute, because the smiley represented them (the child) and the other smileys represented their family members, etc.). For these reasons, I considered these satisfaction rating analyses to be secondary to the latency-to-choose and switching analyses.

Because there was little variability in the rating data and because children often gave reasons unrelated to their satisfaction for making their rating-score decisions, I hesitate to draw

any conclusions from these results at this point in time. Replication of these results or a more reliable means of testing children's satisfaction scores would enable me to say with greater confidence how choice condition affects children's satisfaction.

The data did not reveal any evidence of choice overload for the monkeys. Despite collecting multiple measures to assess possible choice overload effects, it seemed that choice condition did not significantly impact the monkeys on any of these measures. It is possible that this evidence reflects that monkeys do not experience choice overload at all. Choice overload may be a human-unique phenomenon driven by cultural influences, especially in WEIRD (Western, educated, industrialized, rich, developed; Henrich et al., 2010) societies. The virtually limitless options granted by the internet and international trade, coupled with the Western value of personal freedom, may have influenced WEIRD humans to become "maximizers" at a population level, driven to always search for a better option. Alternatively, monkeys, who are not exposed to these cultural pressures, may be "satisficers" on the whole, content with 'good enough' alternatives and therefore less susceptible to choice overload.

Humans may also be uniquely susceptible to choice overload because of the personal accountability they place on their decisions. Scheibehenne and colleagues (2009) demonstrated the role that personal accountability plays on choice overload in their study, where participants were informed that they could choose to donate to a charity from a group, but that they would have to justify their choice of charity. Participants who were presented with the smaller (five option) assortment were more likely to donate than were participants who were presented with the larger (40 option) assortment (Scheibehenne et al., 2009). Without the justification manipulation, the opposite was found: individuals were more likely to donate to a charity if they chose from the larger array. If personal accountability is a driving factor of choice overload – a



sentiment we cannot attribute to nonhuman animals – this may explain why I did not find evidence of choice overload in monkeys in my study.

However, I speculate that monkeys likely *do* experience choice overload in some circumstances, although probably to a lesser degree than do adult humans because of the reasons described above. This experiment was the first to test this question, and though it was a valuable first attempt at evoking choice overload in monkeys, I believe the methodology was not sensitive enough to reveal any real effects even if monkeys are susceptible to choice overload.

It is important to remember that larger arrays, in and of themselves, do not lead to choice overload; rather, it is the presence of moderators that induce choice overload effects at larger arrays (Chernev et al., 2015). The primary moderator included in this study was increased choice set complexity through the elimination of a dominant option/ideal point. I attempted to control for the presence of a dominant option by creating three tasks that monkeys nearly equally preferred. Further variability was introduced by creating three difficulty levels within each task. So that monkeys would not seek out the EC condition only because it would have a higher likelihood of having an easy version of a preferred task, the program concealed the difficulty levels of the tasks by only ever displaying one icon for each task, and randomly generating the difficulty level after the icon was selected. However, by creating equivalently preferred tasks and hiding the difficulty level of the task, it is possible that I took away the experience of choosing among six or nine seemingly different alternatives in the IC and EC conditions, respectively, despite my best efforts to do otherwise. In other words, monkeys may not have perceived the six and nine sets as different from three. Because the icons gave no indication of the difficulty level of the task, monkeys likely perceived the set of nine icons as three icons that indicate MAZE of

unknown difficulty, three icons that indicate DEFLECT of unknown difficulty, and three icons that indicate CHASE of unknown difficulty, rather than nine separate tasks.

We may consider an analogy using the Iyengar and Lepper (2000) jam experiment. The monkeys' choices icons that provide no indication of the difficulty level of the task would be comparable to human subjects choosing among unmarked jams in just three colors, so that there are three basic flavors, but then varieties within each flavor that are unknown at the time of choice. In this hypothetical experiment, the humans would be able to choose among a few different unmarked jams (limited choice condition) or many different unmarked jams (extensive choice condition). The participants know some of the jams will be delicious (just as the monkeys know sometimes the tasks will be easy) and some jams will be less to their liking (like sometimes the tasks will be difficult) but participants will have no way of knowing which jam will be which until after they have made a selection. In this case, it is likely that people would not experience a strong preference between choosing from many jams or a few, because their ability to make a knowledgeable decision that would lead to a desirable outcome is equally limited in all scenarios.

There is another important methodological difference that must be acknowledged between most human studies – including the one I conducted with young children – and the study conducted with monkeys here: in human studies, the participants are choosing among options that are their ultimate prize (i.e., jams or toys), whereas the monkeys in this study are choosing among options that were a *proxy* for their ultimate prize (the pellet). Especially considering that these monkeys are experts at completing computer tasks for pellet rewards (and, it is worth noting, expertise reportedly decreases one's susceptibility to choice overload; Chernev, 2003; Chernev et al., 2015; Mogilner et al., 2008). Thus, it could have been a

consequence of equating task value that there was no reason for a monkey to concern themselves over whether they were choosing a MAZE icon from a set of three or a CHASE icon from a set of nine; to the monkey, they may all have just represented a mildly enjoyable task icon that took some number of seconds to a pellet reward. Monkeys also had many more chances to make selections, so if overload is tied to some level of “regret” over missed options, that may be washed out by their ability to choose many times. Of course, there is no way to assess whether monkey feel something akin to regret.

Although the monkeys did not demonstrate evidence of choice overload, some monkeys did exhibit the expected preference for larger arrays (EC) over smaller arrays (IC and LC). These data were analyzed using a Chi square tests and, although one assumption of Chi square tests is that each observation is independent, in this case I treated each monkey as its own population, and the observations recorded in this experiment as a sample of this “population.” This is consistent with the expanse of literature that informs us that animals prefer having choices. Because my experiment did not appear to evoke any negative consequences when faced with larger arrays, it is unsurprising that monkeys demonstrated a preference for more alternatives.

This study was the first to attempt to evoke choice overload in monkeys, and future studies may want to examine presenting approximately equivalent options that still allow for meaningfully distinct options as choices. One consideration is to present the same task but with each option within that task presenting slightly different aesthetic appearances, such as the shape of the cursor or the target, or to create nine (or more) completely distinct tasks or other such choice alternatives with visually distinct icons to create distinct and meaningful choices in each condition. Another future direction may include providing options that are not food-related, such as social scenarios or enrichment items, or testing monkeys and adult humans on an equitable

task and comparing results. In short, more research is necessary before any conclusions can be drawn about monkeys' susceptibility (or lack of susceptibility) to the paradox of choice phenomenon.

In summary, I found tentative evidence that young children, at least, may experience choice overload when a clearly preferred choice is not available to them. I did not find evidence that monkeys experienced choice overload, although I cannot say whether this is because monkeys are immune to choice overload or whether the design of this study failed to evoke the negative consequences of too many options. The goal for this study was to answer the question "Is the paradox of choice a phenomenon shared with other species?" Unfortunately, the results did not provide a definitive answer. However, I believe that this study sets the stage for future research on this topic by demonstrating the necessity of using choice alternatives that are, themselves, the reward (rather than proxies for reward), and which are not so similar to one another that the perception of choice is eliminated altogether when testing nonhuman primates.

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## APPENDICES

**Appendix A: Instructions and Script for Experiment 1a**

1. Before bringing the child into the room, or while they are not looking, use the child's sheet to determine which toys (balls, animals, or cars) they will be using, how many, and which colors/animals should **not** be included. Put the toys into an opaque bin so they do not see the toy options before testing begins
2. Bring the child outside the classroom to pick their toys.
3. Say the following:

*I am about to show you some toys. You will get to choose one of these toys to take home today as your prize for doing such a good job. However, today there is a special rule when you pick out your prize: you can't touch any of the toys until you are sure which one you would like to take home. You can look at the toys for as long as you want, but as soon as you touch one, that is the one you will have to take home. Do you understand this rule?*

4. Dump the toys out and immediately begin timing the child. You can arrange some of them if they are jumbled or on top of each other, but if the child touches a toy, that is their selection for the day.
5. As soon as the child touches a toy, stop the timer, and announce that they've made their selection. (record the time on the data sheet)
6. Put the rest of the toys back into the opaque bin.
7. Tell the child you need to do some paperwork really quickly, and encourage them to play with their toy while they wait. Pretend to busy yourself (or fill out the data sheet) while the child plays with the toy for 60 seconds.
8. Ask the child:

*Would you like to exchange your toy? If you want, you can put this toy back and choose again from the same options that you just saw. Would you like to do that today, or do you want to keep the toy you already chose?*

9. If they don't want to exchange, ask them how satisfied they are with the toy they chose (see number 11)
10. If they say they would like to exchange, put their first choice toy back into the bin and dump them out again. You do not need to time the child during this time, but the no-touching rule still applies.
11. Once a final selection has been made, ask them how happy they are with the toy they chose using the script below and showing them the satisfaction scale. Score it on data sheet as 1-5 (1 = smallest smiley, 5 = biggest smiley).

*How happy are you with the toy you chose today? Point to the face that shows how happy you are – the bigger the face means the happier you are. There are no wrong answers, and you'll get to keep your prize no matter what.*

**Appendix B: Favorites Questionnaire**

What is your favorite color?

What is your second favorite color?

What is your favorite animal?

What is your second favorite animal?

What is your favorite toy?

**Appendix C: Smiley Face Likert Scale**

